

Draft for Public Comment

**Head office**

389 Chiswick High Road
London W4 4AL
Telephone: 020 8996 9000
Fax: 020 8996 7400
www.bsi.org.uk

DPC no.: 01/100804

Date: 15/01/01

Origin: N

Latest date for receipt of comments: end of April 2001

Project no.: 1991/07828

Responsible committee: B/517/8 – Protection and Repair of Concrete
Interested committees: B/2; B/11; CB/1; B/517

Draft: BS EN 12618-1

**Title: Products and systems for the protection and repair of concrete structures –
Test methods – Determination of adhesion of injection products, with or without thermal
cycling – Part 1: Adhesion and elongation capacity of ductile injection products**

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND ITS EXPIRY DATE FOR COMMENTS.**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. **See overleaf for information on commenting.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Customer Services, at the Head Office address above, telephone 020 8996 9001, fax 020 8996 7001, e-mail orders@bsi.org.uk.

NOTE British, international and foreign standards are also available from Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from the responsible committee secretary.

Cross-references

The British Standards which implement international or European publications referred to in this draft may be found by referring to the British Standards Online Service on the BSI website under the 'International Relationship' information. This information is also available within the BSI catalogue (paper version) and the BSI Standards Electronic Catalogue (CD).

The Online Service can also be used to find information on draft standards related to international or European publications.

Responsible BSI committee Secretary: Anita Attra

Direct tel: 020 8996 7603

E-mail address: anita.attra@bsi-global.com

No. 28, 18/01/01

j

Commenting on drafts

Introduction

Your comments on this draft are welcome and will assist in the preparation of the consequent British Standard. If no comments are received to the contrary, this draft may be implemented unchanged as a British Standard.

Format

The guidance given below is intended to ensure that all comments receive efficient and appropriate attention by the responsible BSI committee. **Annotated drafts are not acceptable and will be rejected.**

Each comment shall make one point only, be clearly separated from the others and be structured as follows in clause order:

- clause/sub-clause;
- paragraph/table/figure number;
- type of comment (general, technical or editorial);
- comment (with rationale);
- proposed change.

Submission

All comments should be submitted to the committee secretary at the Head Office address, preferably electronically via e-mail or on diskette (MS-DOS compatible, 1.44 megabytes). Comments should be compatible with Version 6.0 or Version 97 of Microsoft® Word for Windows™, if possible; otherwise comments in ASCII text format are acceptable. Any comments not submitted electronically should still adhere to the format requirements given above. No acknowledgement will normally be sent.

Microsoft and MS-DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation.

Table for submission of comments

Please use the attached table for submission of comments.
A blank electronic version of this table can be downloaded from the BSI web site at <http://www.bsi.org.uk/bsi/products/standards/development/public-comment.xhtml> or it is available from the committee secretary.

Draft no:	Project no.: 1991/07828	DPC no.: 01/100804
Short title:	Commentator:	Date:

Clause/ subclause	Paragraph/ Figure/ Table	Type of comment (General/ technical/editorial)	Comment (with rationale)	Proposed change
<u>Examples:</u>				
3.1	1st definition	Editorial	Definition is ambiguous and needs clarifying.	Amend to read '... so that the mains connector to which no connection ...'
6.4	2nd paragraph	Technical	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK, giving rise to misleadingly high results.	Delete reference to UV photometer.

3404589 0228483 607

EUROPEAN STANDARD
 NORME EUROPÉENNE
 EUROPÄISCHE NORM

DRAFT
prEN 12618-1

December 2000

ICS

English version

Products and systems for the protection and repair of concrete structures - Test methods - Determination of adhesion of injection products, with or without thermal cycling - Part 1: Adhesion and elongation capacity of ductile injection products

Produits et systèmes pour la protection et la réparation des structures en béton - Méthodes d'essais - Détermination de l'adhérence des produits d'injection, après cycles thermiques ou non - Partie 1: Capacité d'adhérence et d'allongement des produits d'injection ductiles

Produkte und Systeme für den Schutz und die Instandsetzung von Betontragwerken - Prüfverfahren - Bestimmung der Verbundwirkung von Einpreßstoffen mit oder ohne thermische Behandlung - Teil 1: Haftung und Dehnung flexibler Füllgüter für Risse

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 104.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION
 COMITÉ EUROPÉEN DE NORMALISATION
 EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

© 2000 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. prEN 12618-1:2000 E

1. SCOPE

This European Standard describes the method for determining the adhesive bond capacity and elongation capacity of injection products, intended for ductile filling of cracks and cavities.

This standard describes the reference procedure.

In the event of a dispute the reference procedure described in this standard shall be used.

The test can provide an opportunity for subjective assessment of injectability.

2. NORMATIVE REFERENCES.

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- | | |
|-------------------------|--|
| EN 1504-1 | Products and systems for the protection and repair of concrete structures - Part 1 : definitions. |
| EN 1504-5 ¹⁾ | Products and systems for the protection and repair of concrete structures - Part 5 : Concrete injection. |
| EN 1542 | Products and systems for the protection and repair of concrete structures - Test method - Pull off test. |
| EN 1766 | Products and systems for the protection and repair of concrete structures - Test methods - References concretes for testing. |

¹⁾ At stage of draft.

3. DEFINITIONS.

For the purpose of this European Standard, the definitions of EN 1504-1 and EN 1504-5 shall apply.

4. TEST METHOD.

4.1. Principles.

The extensibility and tensile bond strength of the product (and the effect of crack width upon these parameters) are determined after injection into cracks of two different widths and three conditions of crack surface : dry, wet and water-filled. The extension and bond strength testing are carried out at two test temperatures, 3 and 15 °C.

This test is normally used for two-component polyurethane or elastic products and systems.

4.2. Equipment.

4.2.1. Tensile test machine.

The laboratory in which these tests are carried out must be equipped with a test machine complying with the requirements of EN 196 Part 1. The test machine shall be fitted with self aligning chucks to ensure axial tensile loading of the specimen and have a controlled environment cabinet able to maintain constant temperatures of 3 ± 1 °C and 15 ± 1 °C.

The minimum tensile force has to be 50 kN with a precise adjustable speed of 0,1 mm/min.

4.2.2. Formwork.

See fig. 1a, 1b, 1c, 1d and 1e.
See table 2.

4.2.3. Electrical strain gauge.

The electrical strain gauge shall have a continuous recording with 1/1000 mm precision.

4.2.4. X - Y recorder.

4.2.5. Displacement gauge.

The displacement gauge shall have a measuring precision of 1/1000 mm.
The distance of two marked points shall be measured.

4.2.6. Injection equipment, including mixer, pressure pot or injection pump.

In the test cube are 2 injection packers with an inner diameter of 2-3 mm to concrete. The opening is closeable with a self closing valve. The manufacturer determines : mixing equipment, injection pump, kind of packer.

4.2.7. Pressure gauge.

The pressure gauge has to be usable for pressures up to 60 bars. The measurement has to have 0,5 bar \pm 20 % precision.

4.3. Procedure.

4.3.1. Manufacture of the specimen.

A separate specimen is required for each crack width in each of the moisture state of the cracks/crack flanks (surface) and at both of the test temperature. 3 specimens are to be tested for each test condition, 36 in all. The test parameters are summarized in Table 1. Other test temperatures in addition to those listed in Table 1 may be agreed. If the test program must be reduced, the test with a crack width of 0,5 mm should be preferred.

The specimen is a concrete cube with a crack with a defined width to be cast from a reference concrete selected from those defined in pr EN 1766. The concrete specimen are fabricated in steel formwork (Fig. 1) on the vibration table. The concrete is poured via an opening in the upper steel plate. Screwed bolts connect the concrete specimen with the upper and the lower steel plates. Four screwed bolts (M12) and the screw (M24) are fixed in the lower plate before the formwork has been filled. After the filling and the first compaction of the concrete, the four screwed bolts are inserted into the upper plate. Also the three tubes with a steel brad inside (protection against fresh concrete penetration) are pushed into the concrete, then the recompaction of the concrete follows.

The filled formworks are then maintained at room temperature with normal air moisture.

The steel side-sheets of the formwork and the steel brads are removed after two days, the specimens are fitted with measuring plates on all sides and a zero measurement is made in the intact state (crack width $w = 0$). The measuring sensibility is nearest 1/100 mm.

At an age of 3 days, a crack is induced in the specimen by splitting (Fig. 2), after the nuts of the screwed bolts have been slacked at one side. Then the crack width defined in Table 1 is set by tightening the bolt nuts and the nuts are secured with locking nuts.

Now each specimen get a jacketing with a rubber strip, fixed with an adhesive, and an reusable damming crown made of steel.

4.3.2. Injection procedure.

At an age of 7 d to 10 d the specimen shall be prepared for injection (Fig. 3). The specimen and the injection product shall be conditioned at 21 °C for 48 hours before injection. The moisture state of the crack/crack flanks is discribed in Table 1. A pressure gauge is fitted to one of the side tubes. The two components of resin system under test has been mixed according to manufacturer's instructions and then the injection takes place via the centre tube of the dammed specimen. The injection pressure is measured with an absolute pressure meter on a side tube. The other side tube is left clear for the venting of air or water and is closed as soon as material emerges. Injection is then continued, terminating when the polyurethane leaks out under the damming crown or when a maximum pressure of 60 bars is reached. The crack widths are controlled with displacement measurement before and after the injection.

The injected specimens are stored at room temperature for 6 days.

4.3.3. Measurement of adhesion and elongation capacity.

The damming crowns are removed and the injected specimens are prepared for the displacement sensors. All injected specimen shall then be conditioned at their test temperature, according to Table 1 for at least 48 hours before test.

Table 1 : Test conditions

crack width (mm)		0.3		0.5	
temperature (°C)	injection	21° ± 2			
	test	3 ± 1	15 ± 1	3 ± 1	15 ± 1
moisture state of the cracks/crack flanks		W	W	W	W
		M	M	M	M
		D	D	D	D

W (water-filled) The dammed crack is filled with water and injected immediately afterwards.

M (moist) The dammed crack is filled with water, blown out with compressed air after 10 min and injected immediately afterwards.

D (dry) Crack flank without water treatment.

The specimen shall be fitted into the tension test machine (Fig. 4) and only just sufficient load applied as is necessary to take up the slack in the fittings. The displacement sensors (strain gauges) are fixed across the crack. The screwed bolts are removed in this tensioned state with simultaneous loosening of the nuts. A manual displacement measurement takes place before the screwed bolts are removed, this is the zero - measurement for the displacement sensors. Now the specimen is subjected to tensile testing, the test is displacement - controlled at 0.1 mm/minute until failure occurs. The stresses and strains being recorded on a computer program or x-y plotter. The type of the failure (cohesive or adhesive rupture) and the degree of filling (percentage ratio of the injected area to the crack area) are observed and noted.

5. CALCULATION.

The ultimate tensile strength shall be calculated from the maximum stress recorded divided by the plan area of the specimen and expressed in N/mm².


The elongation at failure shall be calculated from the elongation at the moment of maximum stress and shall be expressed in relation to the original crack width before elongation in the tensile testing.

6. TEST REPORT.

- Complete identification of the injection product or system tested, including type, source, manufacturer's code numbers and history.
- Reference to this European Standard.
- Type of reference concrete used.
- Date and place of testing.
- The elongation at failure and stress/strain diagram for each crack width and moisture state.
- The type of failure, failure load and tensile bond strength of each specimen.
- Mean tensile bond strength, elongation at failure of each set of specimens prepared and tested under the same conditions.
- Percentage of crack filled.

Table 2 : Pieces for one cube formwork

				Quantity
1)	Upper plate	St 37	250 x 250 x 20	1
2)	Lower plate	St 37	250 x 250 x 20	1
3)	Fitting piece	St 37	60 x 60 x 15	2
4)	Fitting piece	St 37	60 x 80 x 20	1
5)	Sheet	St 52	250 x 156 x 5	2
6)	Sheet	St 52	156 x 150 x 5	2

with a triangular fillet  3 mm

5) + 6) The dimensional accuracy is very important.

7)	Galvanized screwed bolt (St 37, M 16 x 230)	4
7a)	Nuts M16	16
	alternative (see fig. 1d)	
7)	Galvanized screwed bolt M 16 x 1 x 85 (counterclockwise with a groove)	4
	Galvanized screwed bolt M 16 x 1 x 135 (clockwise)	4
	threaded sleeve 60	4
7a)	Nuts DIN 934 M 16 x 1 (counterclockwise)	8
	Nuts DIN 934 M 16 x 1 (clockwise)	12
8)	Cap screw VA M 10 x 20	12
9)	Screw M 24 (for the lower plate)	1
10)	Screwed tube and nut M 8	3
11)	Steel brad d ø 2 mm = l = 250 mm	3

after injection

12)	Rubber strip 604 mm x 48 mm x 4,65 mm	1
13)	damming crown made of steel x 4 screws and nuts	4

For 11, 12 and 13, see fig. 1e

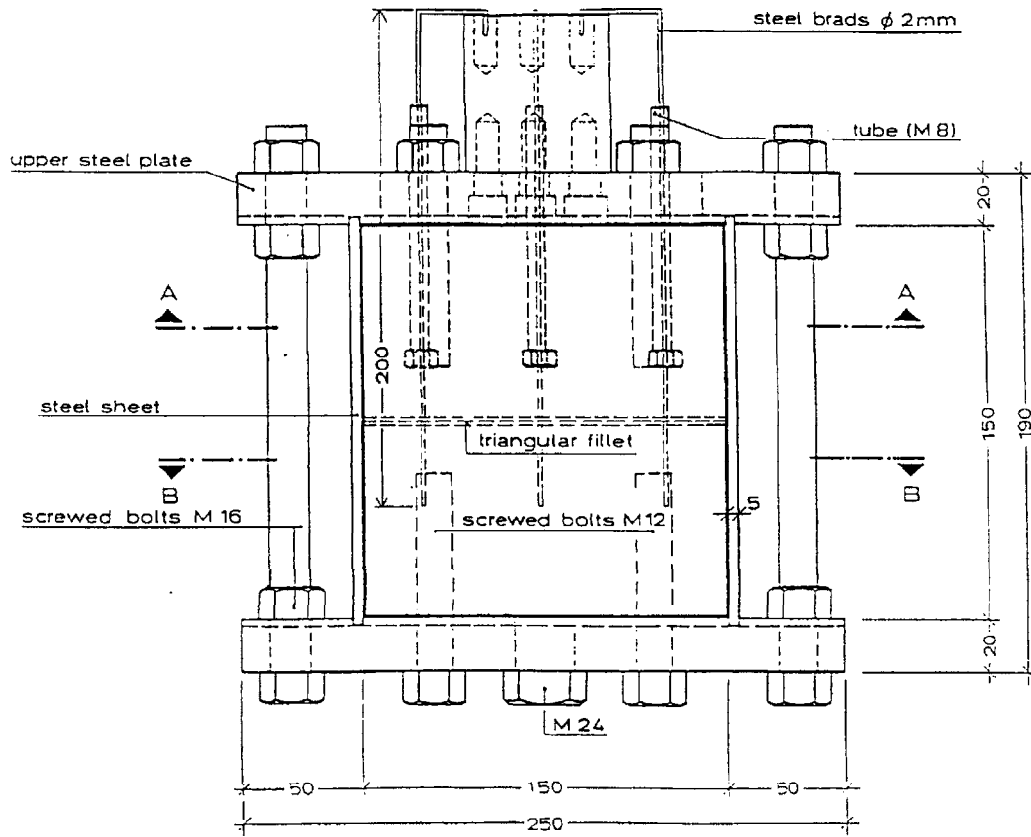


Fig. 1a Formwork (plan view, dimensions in mm).

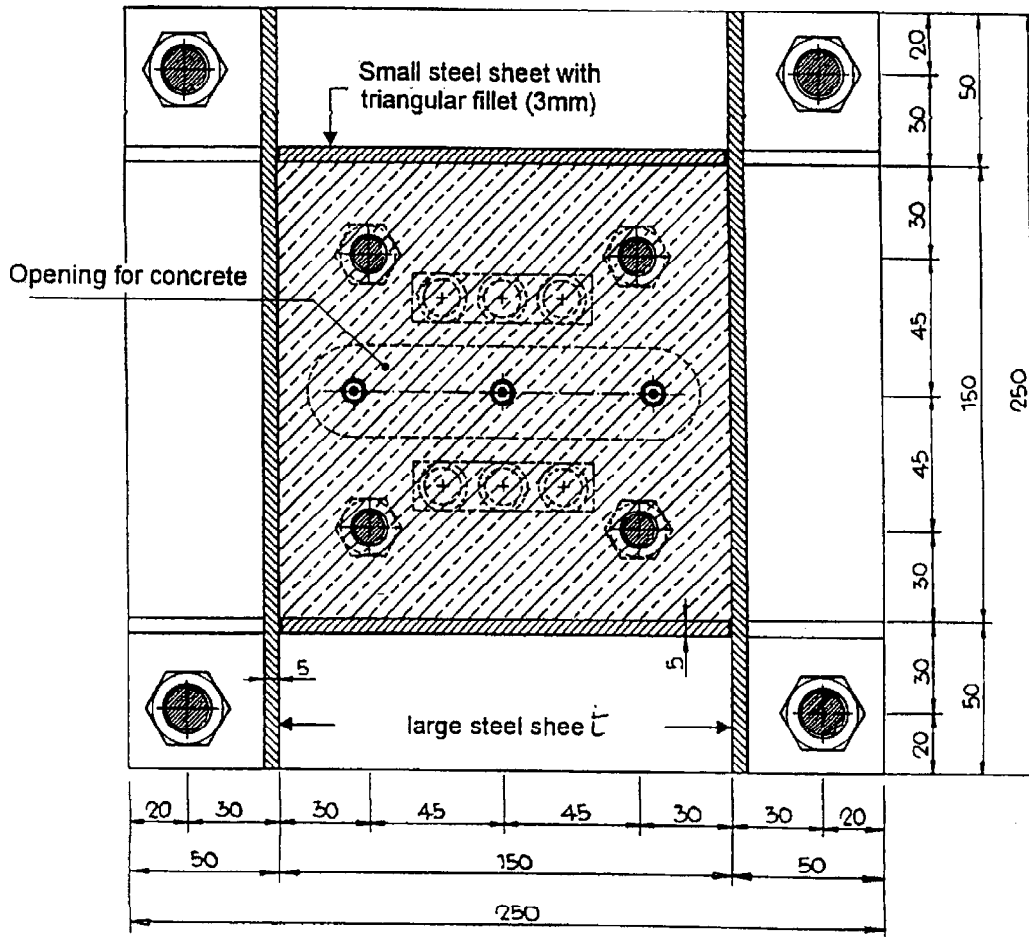


Fig. 1b Formwork (side view, cut A-A, dimensions in mm).

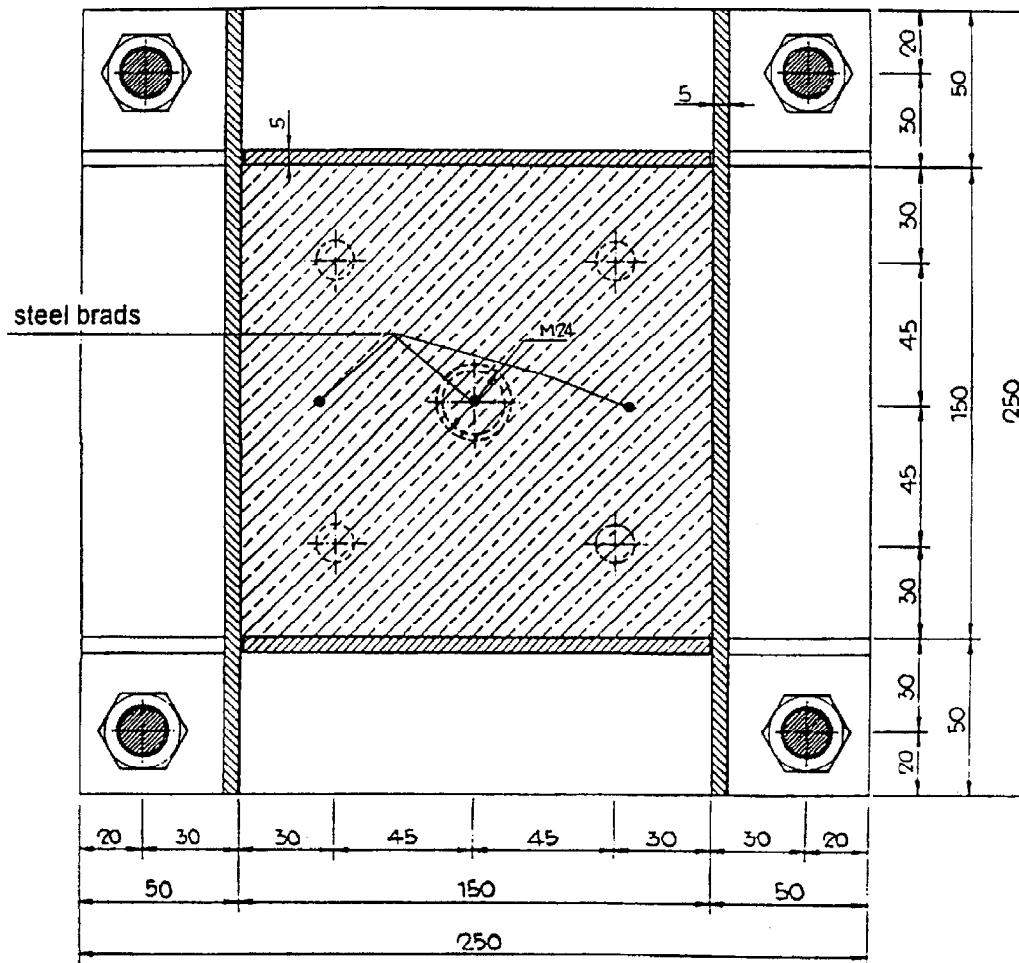
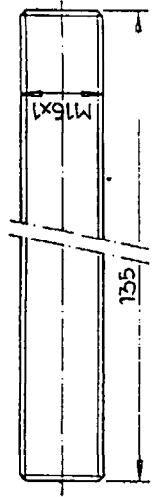


Fig 1c Formwork (side view, cut B-B, dimensions in mm).

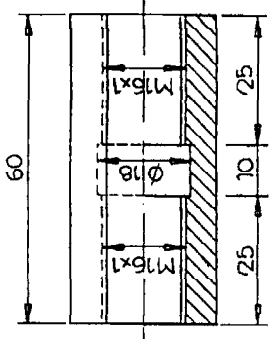
Nuts DIN934 M16X1 clockwise

screwed bolt, clockwise

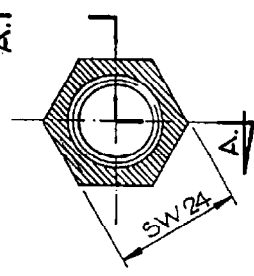


Threaded sleeve

1/2 View 1/2 Section A-A.



Section A-A



Nuts DIN934 M16X1 counterclockwise

screwed bolt, counterclockwise

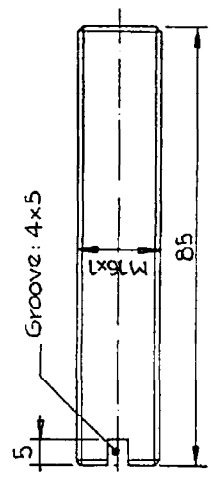
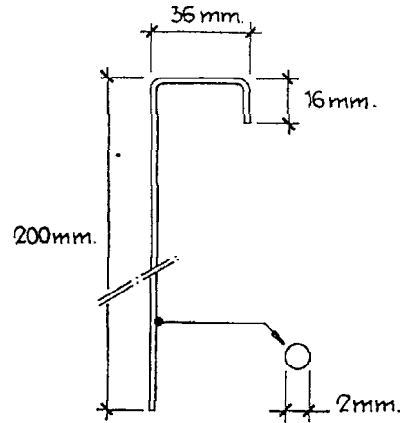
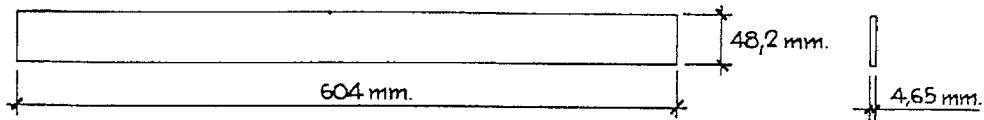


Fig 1d Alternative to fixing tools of upper and lower steel plates (dimensions in mm).

Steel brad



Rubber strip



Damming crown made of steel for one specimen, 4 screws M8

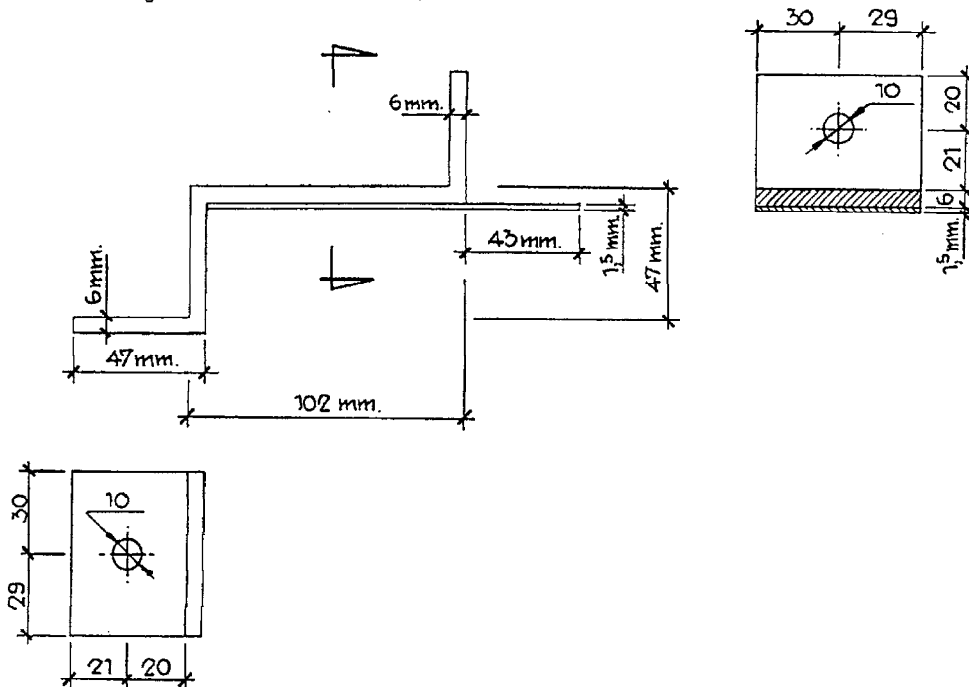


Fig 1e Jacketing tools and steel brad
(dimensions in mm).

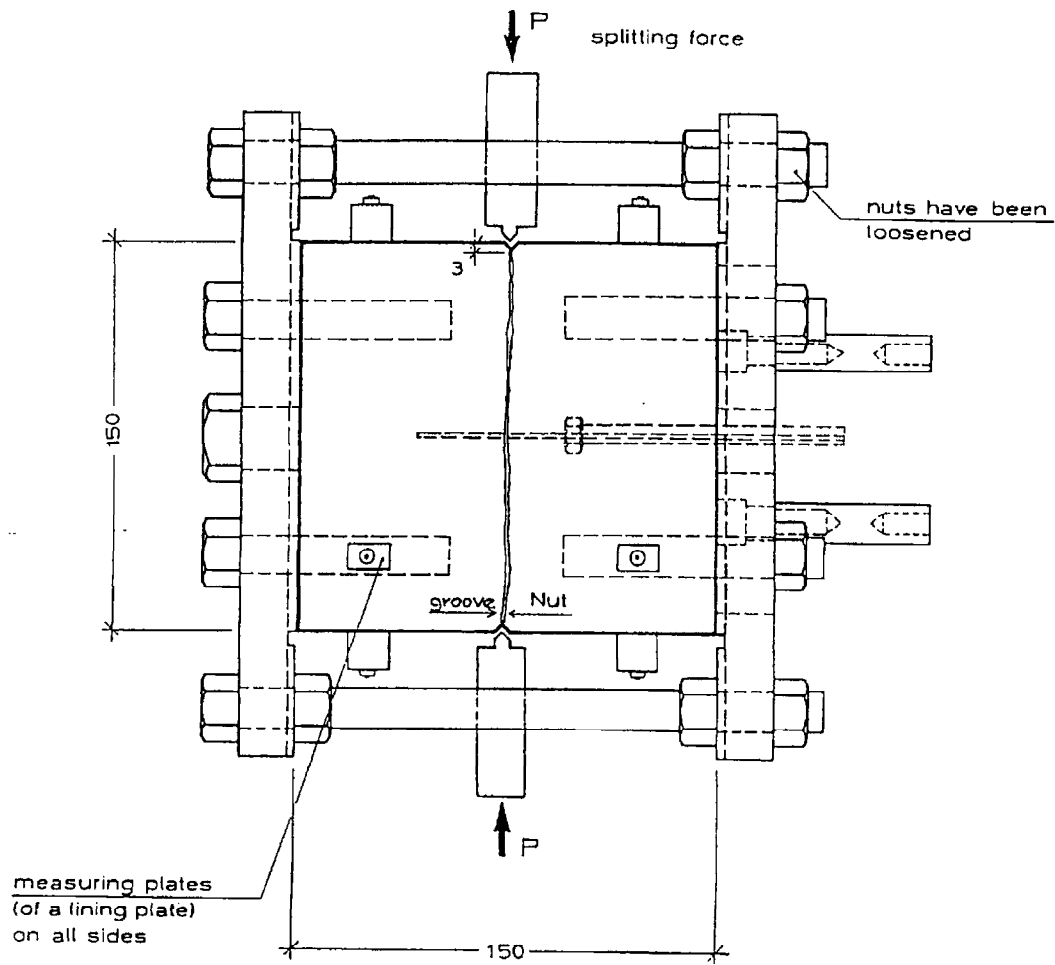


Fig 2 Crack inducing by splitting (dimesions in mm).

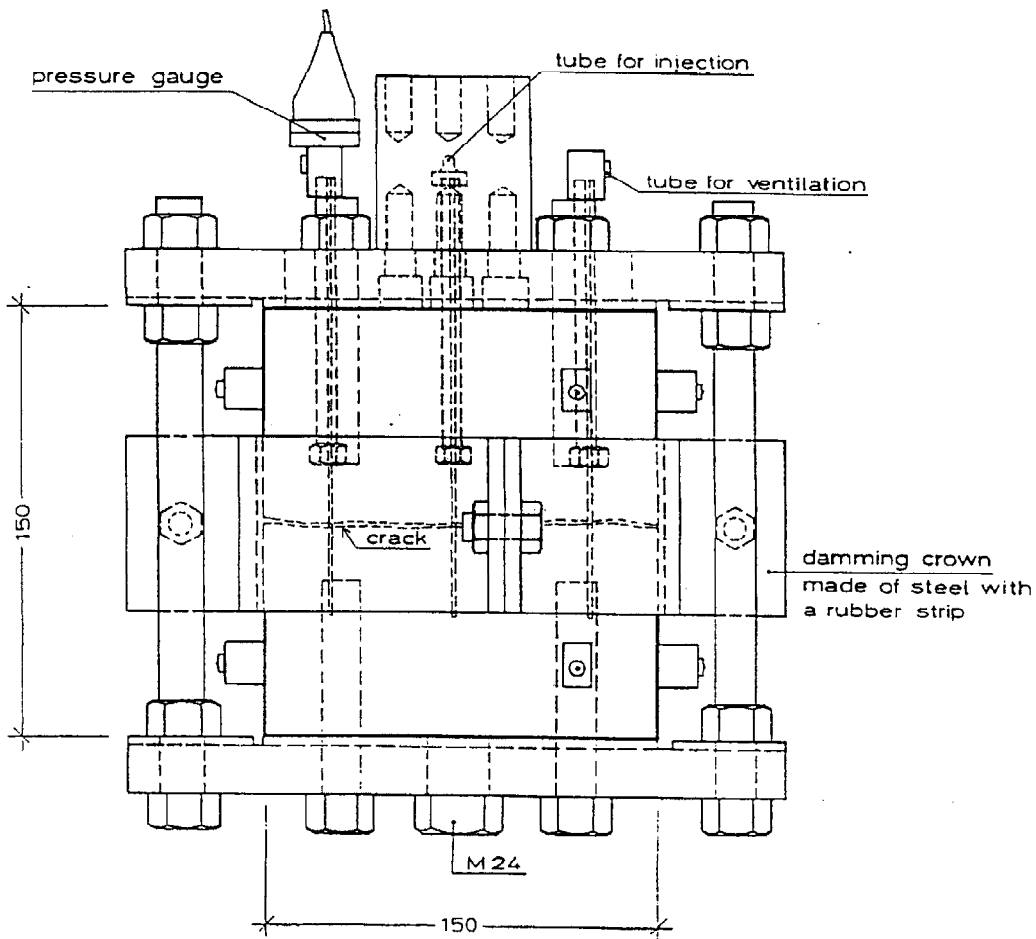


Fig 3 Crack injection (dimensions in mm).

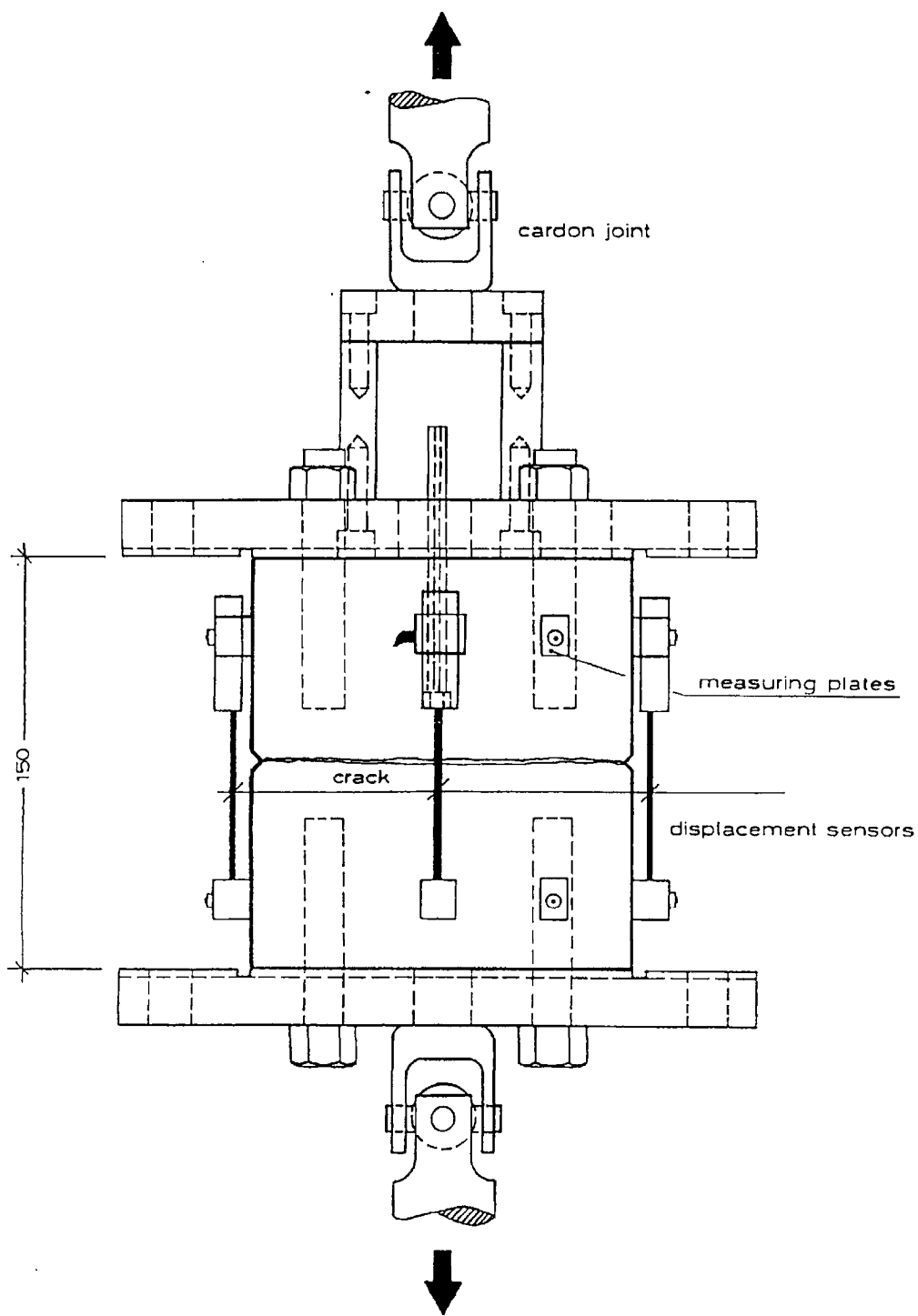


Fig 4 Measurement of adhesion and elongation capacity (dimensions in mm).