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PERSPEX
south africa

Cementing ‘Perspex’® and extruded Acrylic

CEMENTING 'PERPSEX'® AND EXTRUDED ACRYLIC

CONTENTS

1. SAFETY

Some solvents used as cements, and some components of 'Tensol'® cements, are highly flammable and having flash points below 32°C, come within the scope of "The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1973", made under the 1961 Factories Act, which came into force on 21.6.73. These regulations require that quantities of cement in excess of 0.5 litre and below fifty litres be stored in closed vessels kept in a suitable fire-resisting cupboard or bin, and that quantities above 50 litres be stored in a fire-resisting storeroom, or in the open air, protected from direct sunlight. The cupboard, bin or storeroom should be marked 'Highly Flammable'. Precautions should be taken to reduce the risk of leakage or spilling and to make spillage safe should it occur. Used containers should be removed to the storeroom. Forced ventilation should be provided through fire-resisting ducts. Smoking should be prohibited. The premises must be provided with fire extinguishers containing carbon dioxide or dry powder. Inhalation of vapours should be minimised. Excessive contact with the skin should be avoided.

2. INTRODUCTION

This note deals with the various aspects of fixing 'Perspex'® to itself and to other materials. 'Perspex'® may be joined to 'Perspex'® by using certain solvents and special cements, and the nature and preparation of these adhesives are described in Table 1. These cements may also be used to join 'Perspex'® to some other materials but usually other methods of fixing are necessary, such as mechanical jointing or the use of general-purpose adhesives; suggested techniques are discussed in this note. The strength, weathering properties, resistance to attack by moisture, gap-filling properties and resultant appearance of the joint vary with the type of cement used, and careful consideration should be given to deciding which cement is appropriate for a particular application.

2.1 TYPES OF CEMENT AND THEIR PROPERTIES

There are three types of cement for joining 'Perspex'® to 'Perspex'®:

(1) Solvents such as chloroform, ethylene dichloride or acetic acid, which act by dissolving the 'Perspex'® surface, allowing intimate fusion of the two faces to be joined, followed by evaporation of the solvent.

(2) Solutions of polymer in a solvent which act in the same manner as pure solvents, but deposit polymer in the joint as the solvent evaporates. ‘Tensol’® 12 is a cement of this type.

(3) Solutions of polymer dissolved in monomer. The monomer dissolves the surface of the 'Perspex'® in the same manner as other solvents but it is then polymerized in the joint instead of evaporating. Polymerisation of monomer to give polymer can be induced by one of two methods:

a. Chemical Activation (for example ‘Tensol’® 7)

b. Light exposure in the presence of a photocatalyst (for example ‘Tensol’® 2000)

Safety

Solvents used as cements, and components of 'Tensol'® cements, are highly flammable. They should be stored in a cool place, remote from naked flames. If they are involved in a fire despite precautions, extinguishers containing carbon dioxide or dry powder should be used. Adequate ventilation should be provided to minimise inhalation of the vapour. Excessive contact with the skin should be avoided.

Solvents
Organic solvents are capable of causing a toxic hazard; therefore it is important that the precautions advised by manufacturers should be followed.

3. 'TENSOL'® 7
3.1 PHYSICAL PROPERTIES

DESCRIPTION: A two component glue consisting of 7A adhesive and 7B catalyst.

PROPERTIES: Viscosity: 130 – 150 seconds @ 25 ºC by Darwin Cup.

STORAGE: Should be stored in closed containers in a cool, dark room.

HAZARDS: It is flammable and its vapours are toxic. Flash point is 11, 5 ºC

3.2 MIXING RATIO OF THE COMPONENTS

Component A 96%

Component B 4%

3.3 SPECIFICATION

APPLICATIONS: In the natural form (colourless) as 'Perspex'® bonding adhesive for indoor and outdoor use.

APPEARANCE: Component A is a clear syrup, which may also be pigmented, free from visible impurities. Component B is a colourless to straw coloured solution.

SETTING TIME: The cement will set and harden after one hour of its application. After setting, the cement may take on a pale straw colour appearance and may deepen if exposed to sunlight.

VISCOSITY: Between 130 - 150 @ 25°C by Darwin Cup.

PACKAGING: Component A - 500gm amber glass bottles. Component B – 30gm plastic bottles. 12 x 500gm Component A and 12 x 30gm. Component B make up a carton of 'Tensol'® 7.

LABELING: Labels give information on product, handling and hazards.

SHE: The solvents used in manufacturing 'Tensol'® 7 are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (C02) or dry powder fire extinguisher should be use

4. 'TENSOL'® 7A
4.1 PHYSICAL PROPERTIES

APPEARANCE: a clear colourless mobile syrup free from visible impurities and sediment or coloured for Bath Repair Kits.

DESCRIPTION: A solution of PMMA dissolved in monomer containing an initiator, stabiliser/antioxidant and UV absorber

STORAGE: Should be stored in closed containers in a cool, dark room.

HAZARDS: It is flammable and its vapours are toxic. Flash point is 11, 5 ºC.

4.2 SPECIFICATIONS
APPLICATIONS: 96% of component A is used in conjunction with the 4% of the catalyst (Component B) to form a 'Tensol'® cement.

APPEARANCE: The material is a homogeneous, colourless, viscous liquid free from visible impurities, foreign and suspended matter and sediment

VISCOSITY: At room temperature; 30s - 40s (falling ball test)

PACKAGING: 500g amber glass bottles

LABELING: Labels give information on product, handling and hazards.

SHE: The solvents used in manufacturing 'Tensol'® are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (C02) or dry powder fire extinguisher should be used

5. 'TENSOL'® 7B
5.1 PHYSICAL PROPERTIES
DESCRIPTION: A clear, colourless to a pale straw coloured liquid.

STORAGE: As it is unstabilised, it should be stored in closed containers in a cool, dark room.

HAZARDS: It is flammable and because of its organic peroxide content, dangerous.

5.2 SPECIFICATION

APPLICATIONS: 4% of this component B is used as a catalyst with Component A to make a 'Tensol'® glue cement.

APPEARANCE: The material is a clear, colourless, to a straw coloured liquid free from visible impurities, foreign and suspended matter.

PACKAGING: 30g plastic bottles.

LABELING: Labels give information on product, handling and hazards.

SHE: The solvents used in manufacturing 'Tensol'® are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (CO_2) or dry powder fire extinguisher should be used.

6. 'TENSOL'® 12
6.1 PHYSICAL PROPERTIES

APPEARANCE: Clear, colourless mobile syrup free of visible impurities/sediment, packed in 200gm, 500gm, or 5Kg tins

DESCRIPTION: A solution of polymer in solvents.

STORAGE: Should be stored in closed containers in a cool, dark room.

HAZARDS: Its vapours are toxic. Should be kept away from naked flames and direct heat

6.2 SPECIFICATION
APPLICATIONS: For bonding 'Perspex'® to 'Perspex'®, for indoor and outdoor use.

SETTING TIME: A joint may be handled after 3 hours of application of the glue.

VISCOSITY: +/- 40 seconds at 25°C (falling ball test).

LABELING: Labels give information on product, handling and hazards.

SHE: The solvents used in manufacturing 'Tensol'® are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (CO_2) or dry powder fire extinguisher should be used.

7. 'TENSOL'® 30 & 17
7.1 PHYSICAL PROPERTIES

APPEARANCE: Clear, colourless liquid free of suspended solids and foreign matter.

DESCRIPTION: A solution that is applicable for the glueing of extruded acrylic sheet only; for indoor and outdoor use.

STORAGE: As it is unstabilised, it should be stored in closed containers in a cool, dark room.

HAZARDS: Vapours of dichloromethane/nitromethane are toxic. Material should be kept away from naked flames and direct heat.

7.2 SPECIFICATION
APPLICATIONS: For bonding of extruded acrylic sheet only.

SETTING TIME: 1 hour after application of the glue.

PACKAGING: 200gm or 500g tins.

LABELING: Labels give information on product, handling
and hazards.

SHE: The solvents used in manufacturing Tensol are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (CO_2) or dry powder fire extinguisher should be used.

8. ‘TENSOL’® 2000
8.1 PHYSICAL PROPERTIES

APPEARANCE: A clear yellowish viscous liquid, (which becomes colourless on cure) free from visible impurities and sediment.

DESCRIPTION: A solution of PMMA in MMA monomer, containing a photo sensitive catalyst and U.V. stabilizer.

STORAGE: Store in a cool dark room.

HAZARDS: It is flammable and its vapours are toxic. Flash point is 11,5°C.

8.2 SPECIFICATION

APPLICATIONS: Single component adhesive for acrylic sheet, applied as is, and polymerised by specified light in the 400 nm band.

APPEARANCE: The material shall be homogeneous, yellowish, clear viscous liquid, free from visible impurities, foreign and suspended matter and sediment.

VISCOSITY: 150 sec +/-15 sec at 25°C using the "Darwin Cup".

REACTIVITY:

a) On exposure to the specified light, a 10 gm pool of ‘Tensol’® 2000, on a polythene lid carrier, will photo bleach within approximately 8 mins and be substantially polymerised to handleability within 15 to 20 mins, with no residual tackiness, at an ambient of 20 – 25°C.

b) A lap joint made with 3 or 4 mm thick clear cast acrylic sheet and ‘Tensol’® 2000 when exposed to the specified light shall photo bleach within 8 mins and cure to a strong tack free, handleable state, within 15 to 20 mins, at an ambient of 20-25°C. No boiling of the Tensol shall take place in either of the above tests.

PACKAGING: 500 gm tinplate screw top containers.

LABELING: Labels give information on product, handling and hazards.

SHE: The solvents used in manufacturing ‘Tensol’® are volatile and inflammable. It should be used in well ventilated areas and contact with skin or eyes should be avoided. In case of fire, smoke given off may be toxic - Carbon dioxide (CO2) or dry powder fire extinguisher should be used.

SPECIFIED LIGHT: This shall be a 125 watt miniflood fitting, using an OSRAM HQL (MBF-U) 125 watt lamp. The lamp shall be switched on not less than 5 mins prior to the test, in order to reach its full light intensity. The sample shall be placed immediately below the glass cover of the light fitting.

Cement should be used in a ventilated room and, as the vapour is heavier than air, fume extraction from the periphery of the work bench as well as from the floor level is important. Care should be taken to avoid contact with the skin and eyes.

9. PREPARATION OF CONTACT SURFACES

To ensure a good surface-to-surface bond, 'Perspex'® components should be degreased if necessary, using petroleum ether or white spirit, then thoroughly washed in clean hot water. Antistatic agents should not be used prior to cementing operations. The best bond strength is obtained if gloss surfaces have been lightly sanded or wiped with a cloth moistened with chloroform or ethylene dichloride.

9.1 STRESS-RELIEF

A fully satisfactory joint is only obtained if a stress-relief operation is carried out both before and after the cementing operation. The purpose of stress-relief before cementing is twofold. Firstly, it removes local stresses which may be present in as-cast 'Perspex'® or which may have been caused by prior machining or shaping, and secondly, it dries the material. Both these factors, but particularly the relief of stresses, contribute towards reducing the risk of subsequent crazing of the 'Perspex' around the cemented joint. The drying of the material makes it less likely that haze will develop. Annealing after cementing removes as much solvent as possible and relieves stresses set up by the polymerization process and by the clamping attachments. If possible, this final annealing operation should be carried out with the cemented parts assembled together to form the complete article, including any retaining metal frame, bolts, and so on. For successful stress relief an oven with good temperature control is required, and the best results are obtained when the temperature at any point within the heating enclosure does not vary by more than +/- 2°C. This requirement is most easily achieved with air circulation ovens.

9.2 MASKING

Solvent attack on the 'Perspex'® surface is an essential feature of bonding with 'Tensol'® cements and it is necessary to mask areas around the joint from such attack.

Commonly used methods of masking are:
(1) Self-adhesive tapes, low-tack adhesive being preferred.
(2) Aluminium foil fixed to the 'Perspex'® by means of soft soap.

Regardless of the method of masking, a pointed knife is used to cut through the excess cement before it is completely hard, thus facilitating removal of the masking material.

9.3 APPLICATION TO THE JOINT

It is an essential feature of an acrylic joint that there should be an adequate thickness of cement. For all but solvent joints, the cement film should never be less than 0.125 mm thick. The method of application of cement is mainly dependent upon its viscosity and to a lesser degree upon the type of joint being made. It is important to prevent a skin forming on the cement surface before the joint is complete. The following methods are recommended for the application of the various types of cement:

Dipping: for solvents only:
A pool of solvent is poured on to a glass plate or other flat surface. The machined edge of the 'Perspex'® is then held in the pool of solvent until it is uniformly soft throughout the joint area; this takes about one minute using chloroform. The 'Perspex'® is then removed, excess solvent is shaken off, and the edge is applied to the second 'Perspex'® surface. One end is applied first and the edge is gradually lowered, forcing air out in front of the advancing point of contact. The joint is then lightly clamped while solvent evaporates.
Dispensing: for solvents, 'Tensol'® 12, 17 and 30
After masking with self-adhesive tape, the edges to be cemented are brought together and held in a suitable jig as shown in Figure 1 so that these edges form a V-shape into which solvent or cement is dispensed. A suitable dispenser is a dropper fitted to a polyethylene bottle, such as that in which 'Tensol' 7 component B is supplied. Such a dispenser is shown in use in Figure 2. After being allowed to stand for about 30 seconds the V-shaped gap is firmly closed and the joint lightly clamped. Before the cement is completely hard, a pointed knife is used to cut through the excess, thus facilitating removal of the masking material.

Brushing: for ‘Tensol’® 7
Where it is desirable to limit the amount of excess cement round the joint, this cement, which is fairly viscous, may be applied to the ‘Perspex’® surfaces with a brush or spatula.

Figure 1: Dispensing

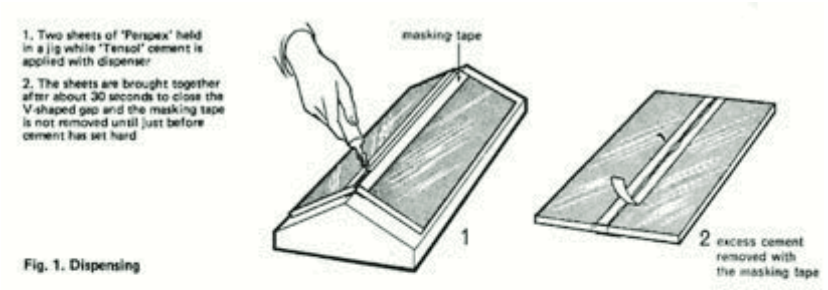


Fig. 1. Dispensing

Eliminating air bubbles
Air bubbles may mar both the strength and appearance of an acrylic joint. They can be avoided if care is taken not to shake the cement before application and by careful application to the joint. Bubbles can also occur because of incomplete wetting of the 'Perspex'® surfaces by the cement, as a result of the presence of grease or dirt, or where a machined 'Perspex' surface retains small pockets of air. Wiping the surface with chloroform or methyl methacrylate monomer will help to eliminate both these difficulties. Air bubbles should not be confused with contraction voids.

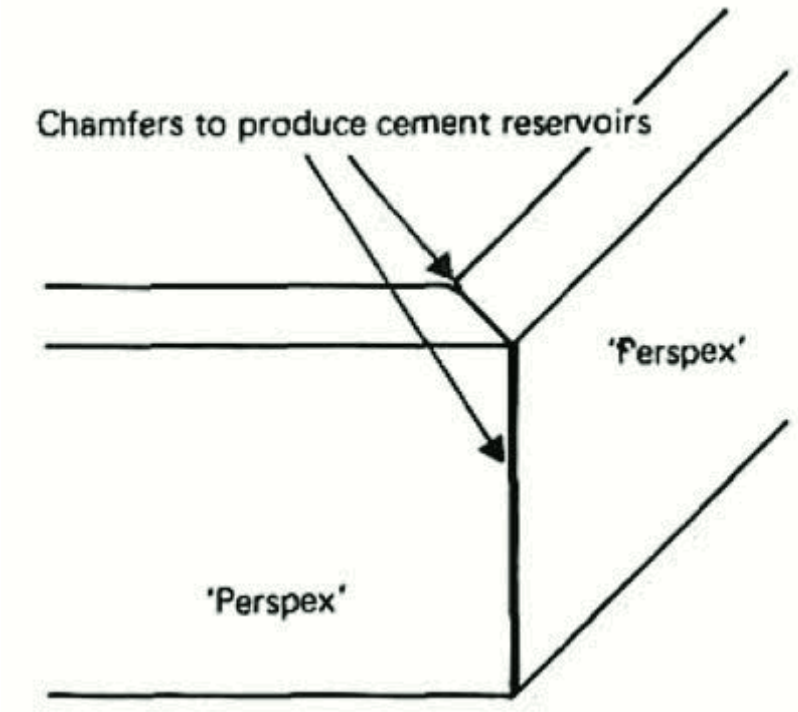
Eliminating contraction voids
Contraction of the cement occurs whether setting is by polymerisation or by evaporation of solvent. Polymerising cements contract much less and are therefore preferable to solvent cements. Contraction marks can be eliminated by the following techniques. Preferably, both should be employed.

1) The surfaces being joined must be held together throughout the setting process. The clamping should therefore be arranged so that pressure is maintained irrespective of contraction, and the contraction movement is allowed to take place. When making a joint, the two surfaces should be brought together gently to avoid forcing too much cement out of the joint. Clamping should be light and even; not exceeding about 18 gf/cm2 pressure.
Heavy pressure does not merely cause loss of cement but can result in crazing of the 'Perspex'® where it is highly stressed. Either spring13 loading or gravity-loading is to be recommended because this permits pressure to be maintained during the period the cement is setting and contracting. It should be noted that spring-loaded clothes pegs exert localized high pressure and should only be used as clamps in conjunction with packing strips to spread the applied load.

2) Small cement 'reservoirs' should be provided at the edges of the joints to prevent air from being drawn into the joint as contraction takes place. Small chamfers, such as can be produced with a scraper, on the joint edges are usually adequate.

See **Figure 2**.

Figure 2: Mitre jointing



10. MAKING SPECIFIC JOINTS

10.1 LAMINATING

This operation is only satisfactorily carried out using cements of low viscosity such as 'Tensol'® 7. The essential point is to avoid trapping air bubbles between the two laminate. In small-area lamination this is achieved by pouring a small pool of cement on to the centre of one lamina, allowing air bubbles formed in the pouring to come to the surface and burst, and then lowering the second lamina slowly so that contact is first made at a single point. This forces the cement out sideways without occluding any air. For large-area lamination it is more convenient to pour a strip of cement along one edge and to lower the top sheet so that contact is first made along the whole edge and then a wave of cement forced across the lamination. This procedure is particularly successful when the upper sheet is thin enough to be flexible.

If air bubbles are trapped in a large-area lamination it may be possible to ease them to the edges before the cement sets by moving small weights about the surface of the laminate. This will result in cement being forced from the edges and a liberal quantity of cement must be used in order to allow for this.

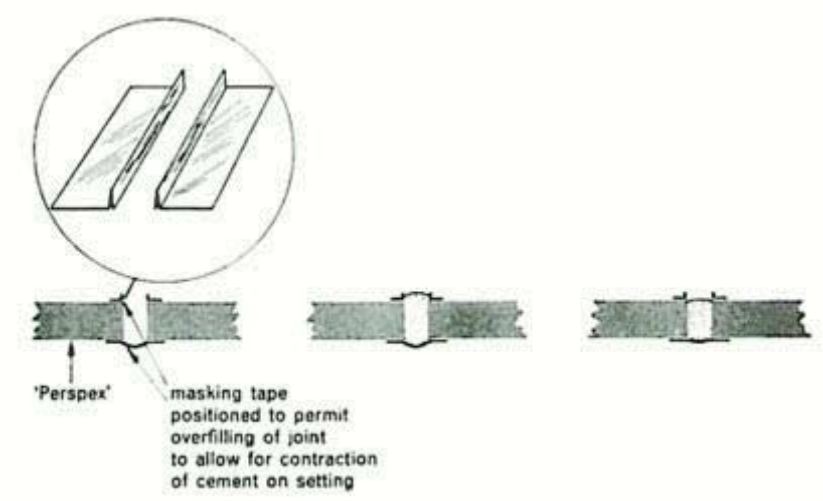
As a rough guide to quantities, approximately 1 kg/m2 should be used for small areas, but a higher proportion of cement is likely to be required for areas of several square feet. The lower sheet is best protected by masking near the edges with selfadhesive tape and by carrying out the whole operation on a sheet of polyethylene film, to which the cement does not adhere.

10.2 BUTT JOINTING

Machined or sawn edges of 'Perspex'® may be cemented together forming a bun joint. Some degree of roughness is desirable but too much prevents the cement wetting the 'Perspex'® completely. The adjacent areas are masked and the joint area is coated with cement. The two edges are then joined and held together until the cement sets.

If the edges to be joined form part of a larger assembly, or if they are irregularly machined so that large spaces need to be filled, the gap should be taped-over at the lower surface and the upper edges protected adjacent to the joint, as shown in Figure 3. The tape may usefully be built up above the surface of the 'Perspex'® to provide a reservoir of cement to allow for contraction of the cement on setting. Cement is then poured into the gap from a beaker or injected with a hypodermic syringe. The gap width needs to be large, of course, in order to admit cement. For example for 25 mm sheet, a gap of about 3 mm has been found necessary. Heavy sheets to be butt jointed in this way should be mounted so that they are free to follow the cement contraction; this may involve resting the work on rollers. With thick joints a subsequent machining operation is usually necessary if the appearance of the finished work is of great importance.

Figure 3: Butt Jointing



10.3 ANGLE (OR T-) JOINTING

The essential requirement in this operation is to ensure that sufficient cement is retained in the joint during the setting period. If a cement of low viscosity is being used, the edge to be in contact with the flat surface should be chamfered, as shown in **Figure 4** to provide an approximately 5° angle, and the cement then applied with a syringe. Because leverage may easily be applied to this type of joint, it is advisable to cement a 'Perspex'® fillet in position as shown. As an alternative, angle joints can be prepared as illustrated in **Figure 5**, using wire packing (withdrawn after application of the cement) to promote capillary attraction and ensure a sufficiently thick layer of cement.

Figure 4: Angle jointing using a cement of low viscosity

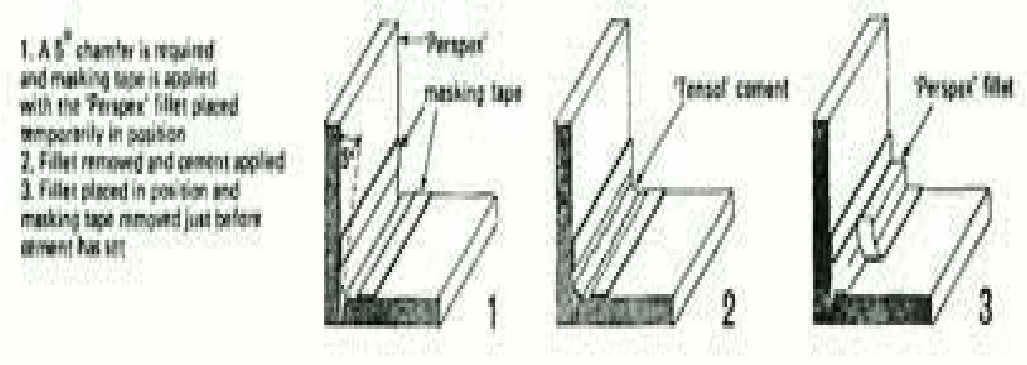


Figure 5: Angle jointing using a low viscosity cement with wire packing to promote capillary attraction and ensure a sufficiently thick cement layer.

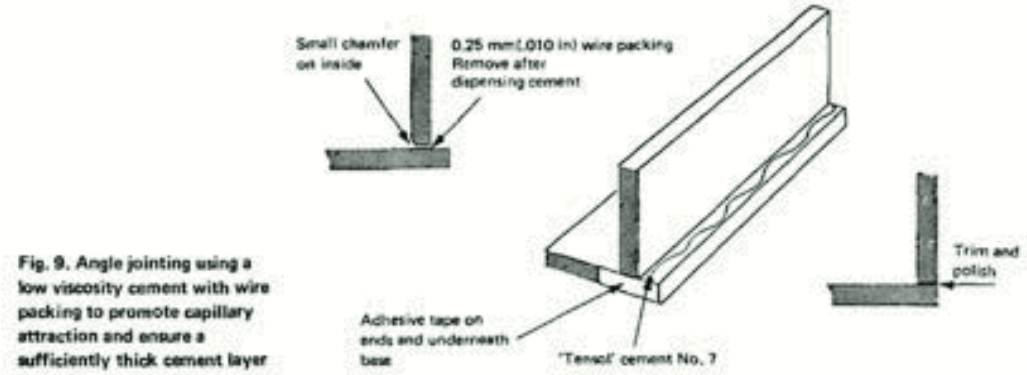


Fig. 9. Angle jointing using a low viscosity cement with wire packing to promote capillary attraction and ensure a sufficiently thick cement layer

10.4 COLOURING

'Tensol'® 7 is the only cement which can be satisfactorily coloured. It may be coloured by the use either of artists' oil colour or of pigments and dyes. Oil colours have the advantage that the colouring matter which they contain is already in a completely dispersed form, so that it is easy to disperse in the cement. On the other hand, it may not always be possible to produce exact matches to the 'Perspex'® colours by this method because the range available in oil colours is limited. If pigments are used, it is almost always possible to obtain a good colour match, but it is necessary to wet-out pigments with a minimum quantity of monomer or dibutyl phthalate prior to addition to the cement.

10.5 CARE OF EQUIPMENT

Benches may be protected from cement by polyethylene film, to which 'Tensol'® cements do not adhere. Cement may be removed from benches, containers or brushes by using solvents such as chloroform, trichorethylene, ethylene dichloride or acetone. Surplus cement should be poured out of the mixing vessel before it sets hard. It is most easily removed from open-top glass or ceramic containers by adding hot water and allowing to stand, whereupon the skin of cement will be loosened and may be removed in one piece.

11. JOINING ‘PERSPEX’® TO OTHER MATERIALS

11.1 CEMENTING

Two problems have to be faced when cementing ‘Perspex’® to other materials. The first is that the high order of bond strength obtained with ‘Tensol’ cements for bonding 'Perspex'® results from a controlled degree of solvent attack on the surfaces by the cement. Such attack obviously will not occur with other plastics, but the degree of attack is seldom within the range which permits a good bond to be formed. If the non-‘Perspex’® material is porous, a good bond may be obtained by the penetration of cement into it. The second problem is that of the difference in coefficient of expansion between ‘Perspex’® and most non-plastic materials, which can lead to the weakening of an inflexible bond if it is exposed to significant temperature changes. For instance. ‘Perspex’® has a coefficient of expansion about 7 times that of steel. The cement film in such cases needs to be of such a type as to remain permanently flexible unless a constant temperature environment is anticipated for the component. These two problems may be overcome by the use of rubber-based adhesives or non-hardening, pressure-sensitive adhesives. Joints formed from these latter materials do not have the outdoor weathering properties of a ‘Tensol’® cement joint, and have appreciably lower bond strength. Another method of obtaining a flexible joint between ‘Perspex’® and other materials is to use an interlayer of rubber which can be bonded to ‘Perspex’® with ‘Tensol’® cement as described in the section immediately following. The rubber may be bonded to other materials using an epoxy resin adhesive.

‘Perspex’® To Glass

The following method using plasticised ‘Tensol’® 7 may be employed to obtain a flexible joint between ‘Perspex’® and glass, but it is suitable for small indoor applications only. The glass is primed with a 5% solution of vinyl trichlorosilane in petroleum ether (boiling range 100/120°C) Dibutyl phthalate is mixed with component A of ‘Tensol’® 7 (in the proportions 1:3 by volume) before addition of component B. The ‘Perspex’® and glass surfaces may then be cemented together as for a ‘Perspex’® to ‘Perspex’® joint.

‘Perspex’® To Wood

The technique to be used depends on the nature of the wood. If it has an open grain, into which cement penetrates, 'Tensol'® 7 may be used successfully. With a smooth, close grained wood which will not allow penetration, a rubber-based adhesive will be more successful.

11.2 MECHANICAL FIXING

When attaching 'Perspex'® to other materials by mechanical means, allowance must be made, as in cementing, for differences in expansion coefficients. Some of the methods which are suitable are described below.

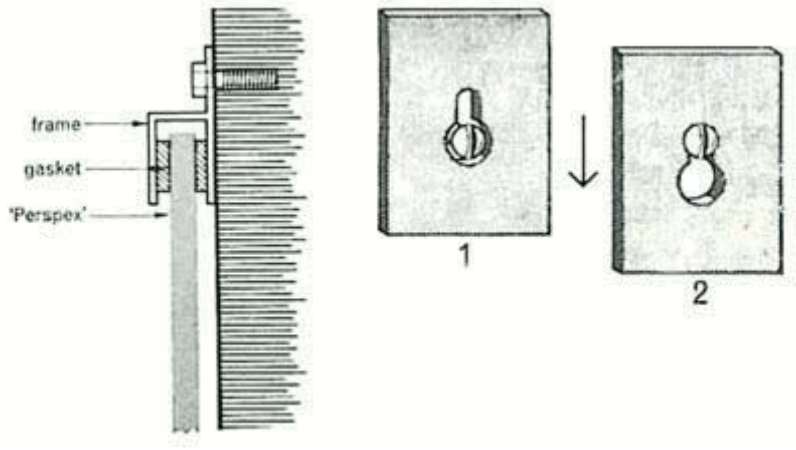
Bolting

When it is necessary to fix bolts through 'Perspex'®, the holes should be drilled oversize and the edges radiused and polished, because 'Perspex'® is notch-sensitive, and any minute cracks which originate at the hole could be propagated a large distance across the sheet. A flexible grommet should be inserted in the oversize hole to accommodate the bolt. This method is not recommended for structures loaded beyond 7 kgf/cm2. An expansion allowance of 5mm per metre is recommended for external applications or where large differentials in temperature are likely to be encountered.

Framing

For thick and heavy sheets of ‘Perspex’®, the material may be fixed, as shown in Figure 9, in a suitable channel section frame, usually of metal, which is bolted to the main structure. The edges of the ‘Perspex’® should be smooth and polished, and the sheet is held in position by a flexible gasket of appropriate cross-section, which takes up any expansion.

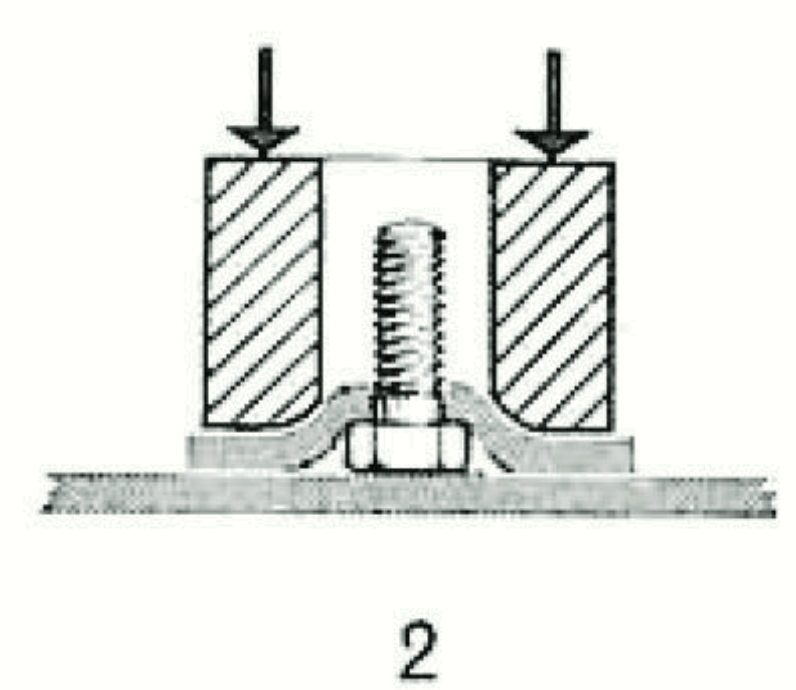
Figure 6: Framing



Keyhole Slotting

Another method of mechanical fixing which is useful for light-weight components, such as flat-backed 'Perspex'® letters produced by the sign industry, is to cement the back of the component to a 'Perspex'® block, into which has been routed a keyhole slot, as shown in **Figure 10**, so that the assembly may be slid on to a bolt or screw affixed to the main structure.

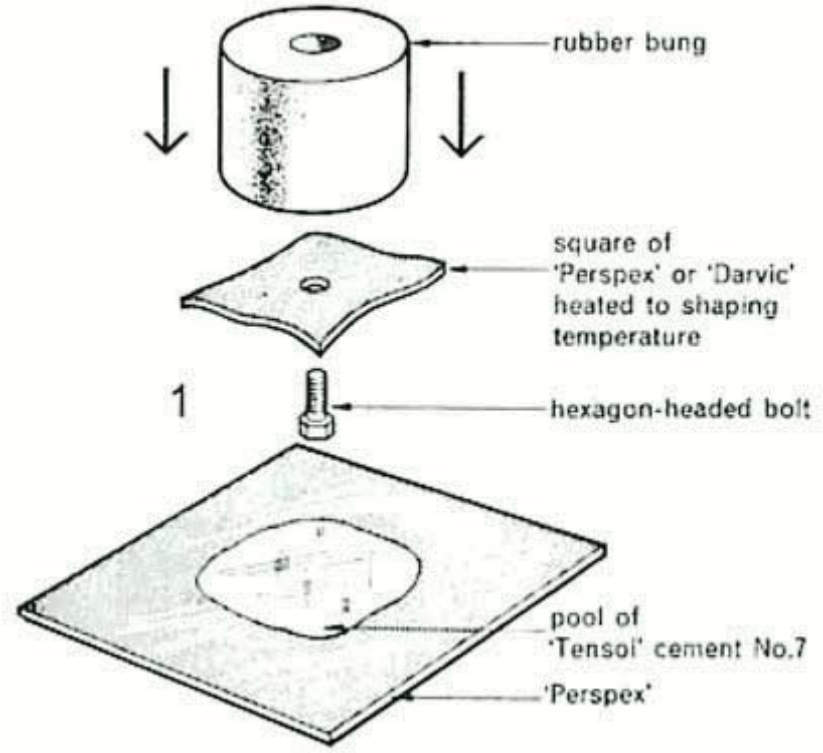
Figure 7: Keyhole slotting (far right)



Cementing Fixtures To 'Perspex'®

In some instances it is desirable to attach fixtures such as metal bolts, spring clips, press-studs to one side of a 'Perspex'® sheet or to a shaped article, without having to drill holes through the 'Perspex'®. This can be done in the manner indicated in Figure 12. A square piece of 'Perspex'® 3 mm thick and about 38 mm square, is drilled oversize to take a bolt, and is heated to shaping temperature 150 -170°C 'Tensol'® 7 is applied to the article where it is intended to fix the bolt. When at shaping temperature, the square piece of 'Perspex'® is removed from the oven and a hexagon-headed bolt pushed through it. This assembly is then applied to the cement so that the bolt-head is sandwiched between the two pieces of 'Perspex'®. Light pressure is applied with a suitably bored-out rubber bung for about 30 seconds, and the joint may be handled after about one hour.

Figure 8: Cementing fixtures to 'Perspex'®



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