British Standard

BRITISH STANDARD

BS 5955-6: 1980

Incorporating Amendment Nos. 1 and 2

Plastics pipework (thermoplastics materials) —

Part 6: Code of practice for the installation of unplasticized PVC pipework for gravity drains and sewers

UDC 621.643:678.073:628.2:678.743.22

Cooperating organizations

The Plastics Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

British Plastics Federation*
British Resin Manufacturers' Association
Chemical Industries Association*
Department of Industry (Chemicals and Textiles)
Department of the Environment (Building Research Establishment)
Department of the Environment (PSA)*
Department of Trade (Metrology, Quality Assurance, Safety and Standards Division)
Electrical, Electronic and Insulation Association (BEAMA)
Electrical Installation Equipment Manufacturers' Association (BEAMA)
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Ministry of Defence*
Plastics and Rubber Institute*
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National Association of Plumbing, heating and Mechanical Services Contractors
National Water Council
Oil Companies Materials Association
Society of Chief Building Regulation Officers
Water Companies' Association
Water Research Centre
Welding Institute

This British Standard, having been prepared under the direction of the Plastics Standards Committee, was published under the authority of the Executive Board and comes into effect on 28 November 1980

The following BSI references relate to the work on this standard:
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Amendments issued since publication

Amd. No.	Date of issue	Comments
3891	January 1982	
4410	December 1983	Indicated by a sideline in the margin

Contents

Foreword

The preparation of the various Parts of this standard has been authorized in order to present the details of comparative physical, chemical and mechanical properties of the various plastics pipes, to guide the selection for different applications and consequently, to define sound practice in the installation of such pipes.

This code of practice was originally intended to be published as a new Part of CP 312 "*Plastics pipework (thermoplastics material)*", but, as the existing three Parts of that code are under revision, a new series has been started as BS 5955, into which the three Parts will be revised. Parts 4 and 5 will be published at a later date.

Part 1 of CP 312[1)] deals with the selection of the most suitable pipework materials. Part 2 of CP 312[1)] makes recommendations for the installation of unplasticized PVC pipework for the conveyance of liquids under pressure and Part 3 of CP 312[1)] deals similarly with polyethylene pipework.

This Part of this standard provides recommended practice for the use of unplasticized PVC pipes and fittings to convey by gravity surface water, foul sewage and sub-soil water. It supplements the information in CP 301 and CP 2005.

It should be noted that pipes and fittings dealt with in this Part of this standard are those which comply with the requirements either of BS 4660 or of BS 5481, and are available with the Kitemark, indicating that their manufacture is subject to supervision under a BSI Certification Scheme.

Unplasticized PVC pipes and fittings manufactured in accordance with the appropriate British Standard may differ in certain design details between manufacturers and attention is, therefore, drawn to the specific installation instructions available from the appropriate manufacturer.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] To be revised as the corresponding Part of BS 5955, in due course.

1 Scope

This Part of BS 5955 sets out information supplementary to that given in CP 301 and CP 2005 on the use of unplasticized PVC (uPVC) pipes and fittings for the conveyance by gravity of surface water, foul sewage and sub-soil water.

This code relates to unplasticized PVC pipes and fittings manufactured in accordance with BS 4660 in respect of 110 mm and 160 mm sizes and with BS 5481 in respect of sizes 200 mm to 630 mm, and used in the construction of gravity drains and gravity sewers. Details of the sizes of pipes specified in BS 4660 and BS 5481 are given in Table 1.

If it is proposed to use these pipes and fittings with untreated trade waste or with prolonged discharges at high temperature (> 60 °C) reference should be made to CP 312-1 and/or to the manufacturer. It should be noted that it is normally a requirement that the temperature of trade effluent at the point of discharge to public sewers should not exceed 43 °C.

The information given is considered to be good practice in normal conditions in the United Kingdom, but it is appreciated that in certain localities there may be special conditions which will require modifications to these recommendations.

Building drainage installations are required to comply with regulations and byelaws (administered by local authorities) the details of which are dependent on the geographical location of the installations.

Unplasticized PVC pipes for gravity drains and gravity sewers differ from pipes considered in CP 312-2 in that they are not normally subject to internal hydraulic pressures except in unusual circumstances, e.g. when a blockage occurs or in an inverted siphon. However, they are subject to external loads due to the backfill and those transmitted from traffic.

Attention is drawn to the possible hazards involved in the site work of the installation of pipes; due attention should be paid to relevant safety regulations including the Health and Safety at Work etc, Act 1974.

This code is not applicable to pipes laid at depths exceeding 6 m to the top of the pipes.

Table 1 — Sizes of pipe specified in BS 4660 and BS 5481

Relevant British Standard	Nominal size[a]	Mean outside diameter[b] mm		Extreme individual outside diameter mm	
		min.	max.	min.	max.
4660	110	110.0	110.4	108.0	112.4
	160	160.0	160.6	157.1	163.5
5481	200	200.0	200.6	196.3	204.3
	250	250.0	250.7	245.4	255.4
	315	315.0	315.9	309.2	321.8
	(355)	355.0	356.0	348.4	362.6
	400	400.0	401.0	395.2	408.5
	(450)	450.0	451.0	441.5	459.5
	500	500.0	501.0	490.5	510.5
	(560)	560.0	561.0	549.3	571.7
	630	630.0	631.0	617.9	643.1

[a] Non-preferred sizes are indicated in parentheses.
[b] Mean outside diameter is defined as the arithmetic mean of any two diameters at right angles to each other.

2 References

The titles of the publications referred to in this code are listed on the inside back cover.

3 Flow properties

For the purpose of calculating flow rates through unplasticized PVC pipes, reference should be made to the Colebrook-White equation, Figure 1 and Figure 2 have been derived using values for roughness (k_s) given in the "Hydraulic Research Station Charts"[2)], 4th edition (metric), 1978 and "Tables for the hydraulic design of pipes"[2)] (metric edition), 1977 for the sizes of unplasticized PVC pipes dealt with in this code.

It is recommended that the information given in Figure 2(b) is used only for velocities less than 1 m/s.

These values of roughness are for guidance only and may need future modification in the light of continuing research work.

[2)] Obtainable from HMSO.

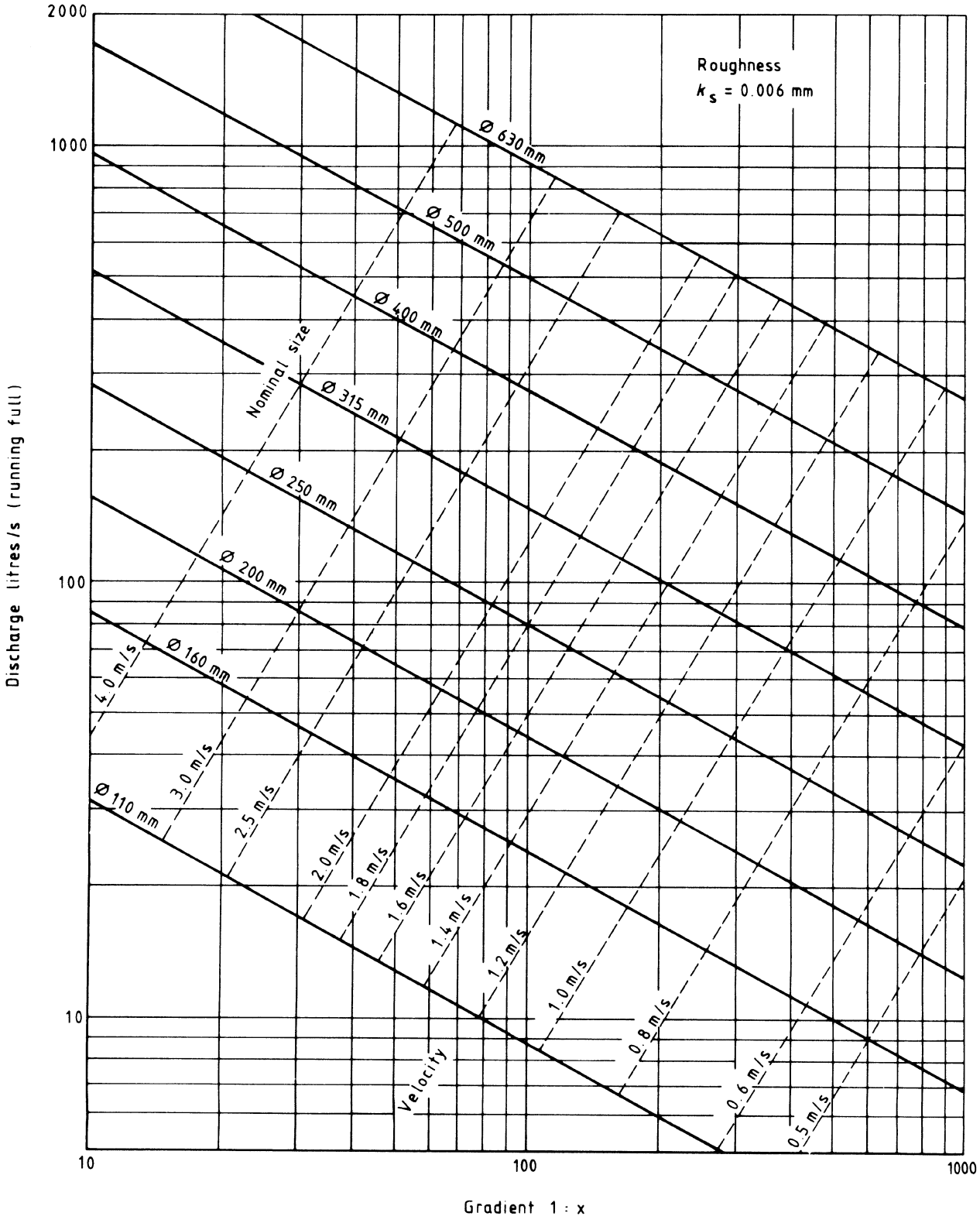
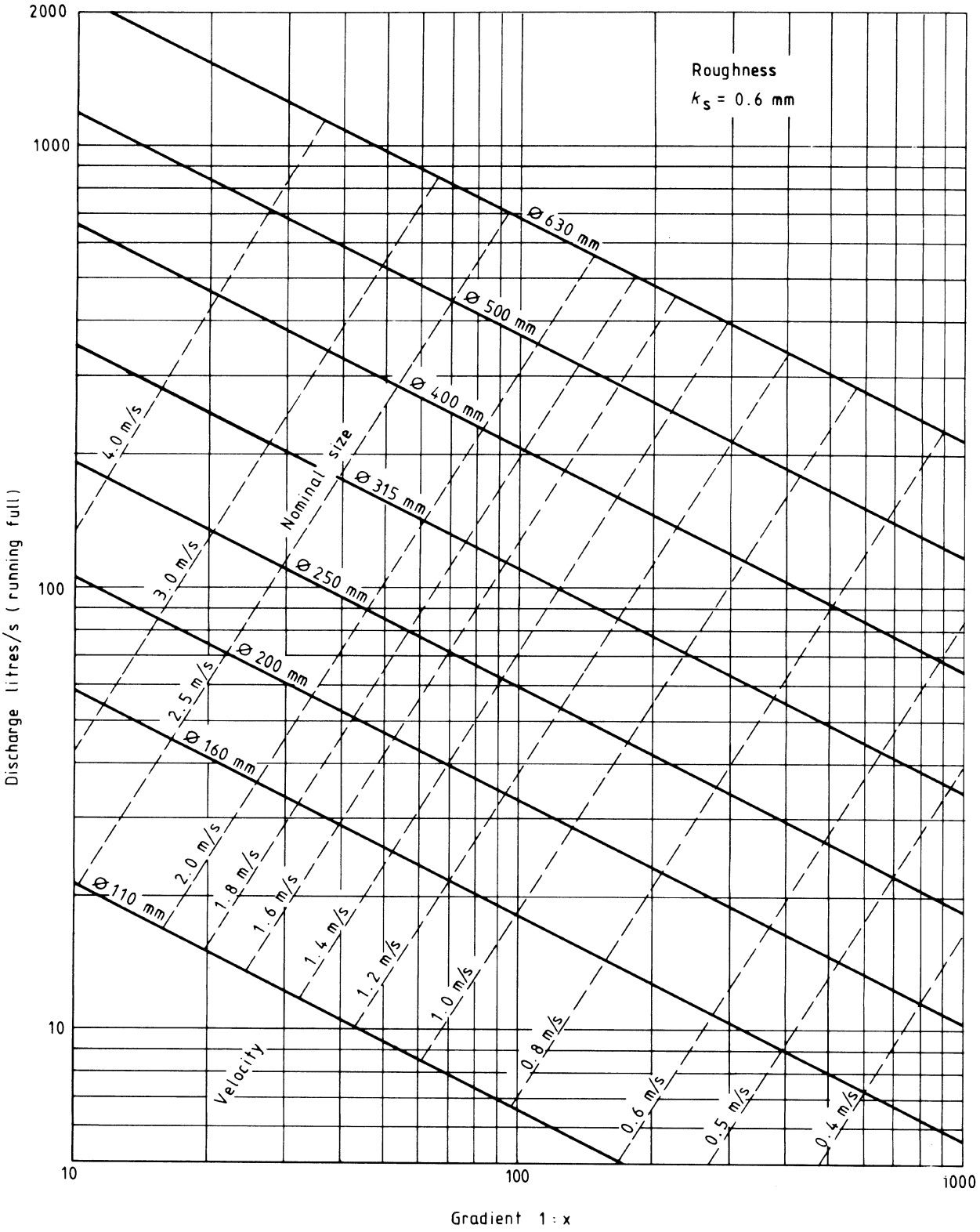
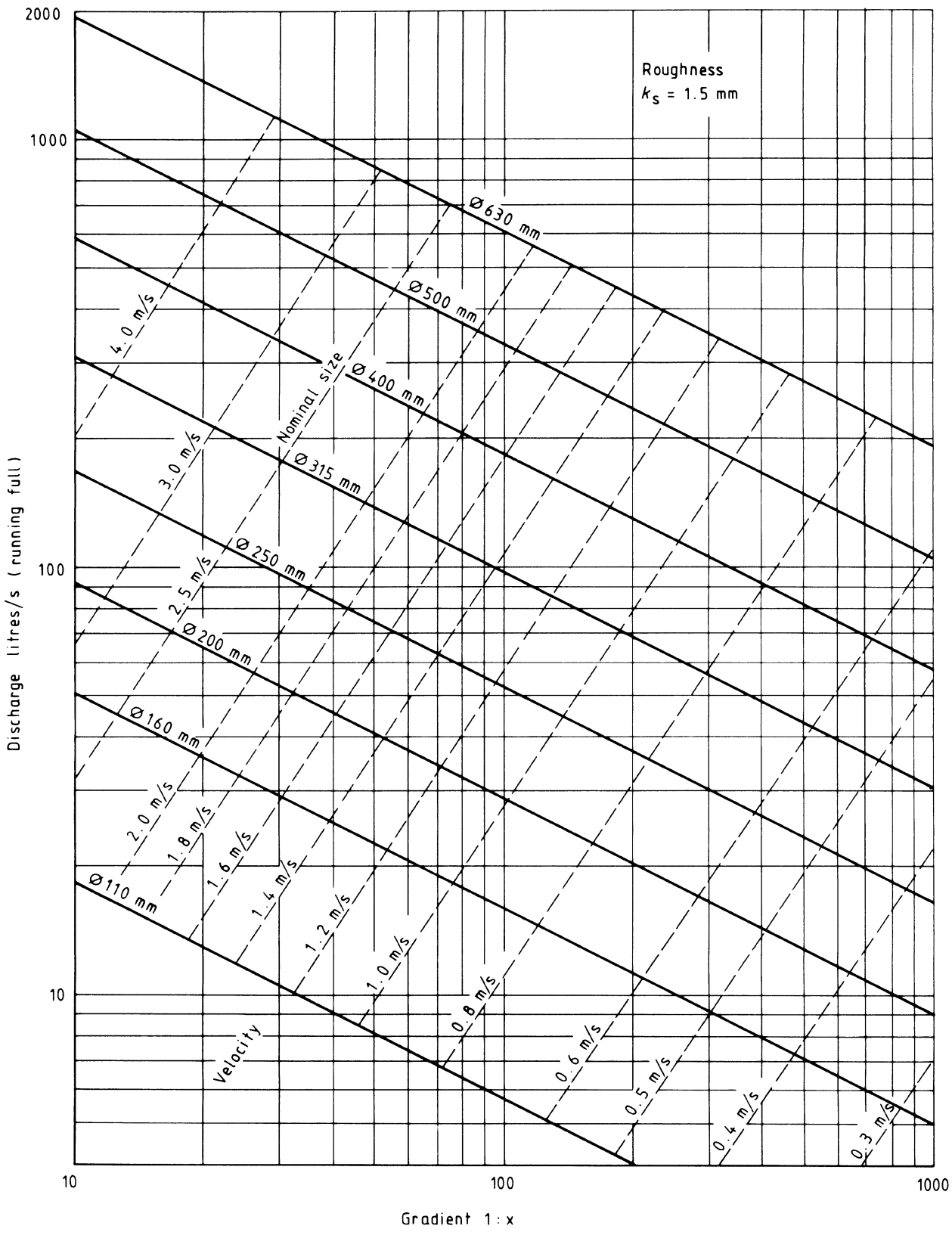


Figure 1 — Discharge rates of clean sewers made from unplasticized PVC in the nominal size range from 110 to 630 for different gradients based on a roughness, k_s, of 0.006 mm



(a) Based on a roughness, k_s, of 0.6 mm

Figure 2 — Discharge rates of mature sewers made from unplasticized PVC pipes in the nominal size range from 110 to 630 for different gradients



(b) Based on a roughness, k_s, of 1.5 mm

Figure 2 — Discharge rates of mature sewers made from unplasticized PVC pipes in the nominal size range from 110 to 630 for different gradients *(concluded)*

4 Types of joints

4.1 General

4.1.1 *Introduction.* Unplasticized PVC pipes and fittings complying with the requirements of BS 4660 and BS 5481 are jointed preferably by push-fit (insertion) joints. For pipe up to 315 nominal size, it is permitted to use solvent cement joints.

A pipe can be plain ended for jointing by means of separate double-socketed couplings. Alternatively it can have an integral socket, either formed upon or fixed to one or both ends. For insertion of junctions in an existing pipeline or for effecting repairs, double-socketed couplings without a central register should be used.

4.1.2 *Push-fit (insertion) joints.* The push-fit joint, in which the elastomeric sealing ring is automatically compressed to form a seal when the spigot is inserted into the socket, provides a rapid method of jointing pipes.

Sealing rings should be made from natural or synthetic rubber complying with the requirements of BS 2494.

The sealing ring is housed in the socket, and its cross section, and that of the socket, varies according to the manufacturer[3)]. It is therefore important that the sealing rings used should be only those supplied by the manufacturer for the particular joint. The rings are often supplied captive in position, but if they are supplied loose, care has to be taken to use the correct rings.

Satisfactory assembly of a push-fit joint requires provision of a chamfer on the pipe and proper lubrication of the spigot end before insertion into the socket. Only the lubricant supplied or recommended by the supplier should be used.

4.1.3 *Solvent cement joints.* A solvent cement joint is one in which a solvent cement is applied to both the pipe end (spigot) and to the socket before assembling by pushing the spigot fully home into the socket. The solvent cement forms a "cold weld". This technique becomes less easy in sizes greater than nominal size 160 and is not normally recommended for sizes in excess of 315 nominal size without reference to the manufacturer.

For pipes complying with the requirements of BS 5481, only cements complying with the requirements of BS 4346-3 should be used. For smaller pipes complying with the requirements of BS 4660, either this cement or one recommended by the manufacturer may be used.

4.2 Jointing procedure

4.2.1 *Push-fit joints.* Jointing should be carried out strictly in accordance with the pipe manufacturer's instructions. The following is the normal jointing procedure.

a) In the case of a pipe cut on site, the end to be jointed should be cut square and chamfered in a similar manner to the pipes and fittings supplied by the manufacturer, and all swarf removed.

b) The pipe end, the socket and the ring location should be thoroughly cleaned and the sealing ring seated correctly into its location.

c) The correct lubricant should be applied all round the chamfered end.

d) The pipe end should be carefully aligned with the adjoining pipe socket and pushed in without delay, to the correct insertion depth. If a lever is used on the pipe to push the joint home, a block of wood should be inserted between the lever and the end of the pipe to prevent damage.

e) It is unnecessary to allow any waiting period before applying a pressure test to a push-fit joint.

4.2.2 *Solvent cement joints.* Jointing should be carried out strictly in accordance with the instructions of the manufacturer of the pipe and the manufacturer of the solvent cement. The use of solvent cements and degreasing agents may involve fire and toxic hazards; particular care has to be taken in following instructions on these matters. The following is the normal jointing procedure.

a) In the case of a pipe cut on site, the end to be jointed should be cut square and chamfered in a similar manner to the pipes and fittings made by the manufacturer, and all swarf removed.

b) The pipe end and the socket should be thoroughly cleaned.

c) The cleaned surfaces should then be lightly and uniformly roughened with clean medium grade glass paper or emery cloth and then cleaned using a suitable degreasing solvent (e.g. methylene chloride).

d) One even coat of cement should be applied to both of the surfaces to be jointed, stroking the cement along, and not around, the surfaces. Application of excessive cement should be avoided.

e) The pipe end should immediately be pushed fully home, without twisting, and held for not less than 10 s. If a lever is used on the pipe to hold the joint in position, a block of wood should be inserted between the lever and the end of the pipe to prevent damage. Surplus cement should be removed.

[3)] Typical designs of sockets are illustrated in BS 5481.

f) After completion, allow 1 h for the joint to set before applying a pressure test.

5 Storage, handling and transport

5.1 Storage. The following recommendations relate to the storage of unplasticized PVC pipes under the normal climatic conditions of the United Kingdom.

a) Pipes should be stacked on a reasonably flat surface free from sharp projections, stones and other protuberances. Side support should be provided at intervals of not more than 1.5 m and these supports should preferably consist of battens not less than 75 mm wide.

b) Pipes should be preferably uniformly supported throughout their length. If this is not possible, timber battens at least 75 mm wide, at spacings not greater than 1 m centres, should be placed beneath the pipes. Preferably, pipes of different size and wall thickness should be stacked separately, or where this is not possible, those with larger diameters and thicker walls should be at the bottom. It is preferable that pipes should not be stored one inside another.

c) If spigot and socket pipes are stacked, sockets should be placed at alternate ends of the stack with sockets protruding so that pipes are evenly supported along their entire length. Pipe stacks should not exceed 7 layers, with a maximum height of 2 m.

5.2 Handling. Pipes made from unplasticized PVC are strong, though lightweight, and are therefore very easily handled. However, it is necessary to take care to prevent damage; in particular, pipes should not be thrown, dropped or dragged along. If pipes are moved by rolling, it is necessary to ensure that they are adequately supported along their length and properly restrained on inclines.

If pipes are loaded or unloaded by mechanical means (fork lift truck, cranes, etc.) care should be exercised to avoid damaging them. They should be suitably supported at two places when being lifted. Preferably, protected slings should be used, but if metal hooks, chains, etc. are used, padding should be placed between them and the pipes. If pipes are delivered one inside the other, special care should be taken to avoid damage during unloading.

The impact strength of unplasticized PVC is reduced in cold weather during which extra care in handling should be exercised.

5.3 Transport. Vehicles with a flat bed should be used for the transport of pipes. The bed should be free from nails and other projections. Each pipe should be supported uniformly along its length.

Vehicles should have adequate side supports at not more than 1.5 m spacing and pipes should be effectively secured during transit. All uprights should be flat and free from sharp edges.

When loading spigot and socket pipes, they should be stacked in alternate layers so that the sockets do not carry any load.

If pipes are transported one inside another, it is essential to take necessary precautions to prevent them damaging each other.

Pipes should be loaded on to a vehicle in such a way that any overhang does not exceed 1 m.

Thick-walled pipes should be loaded before thin-walled pipes.

6 Inspection

The pipes and fittings should be visually checked for any damage immediately prior to installation.

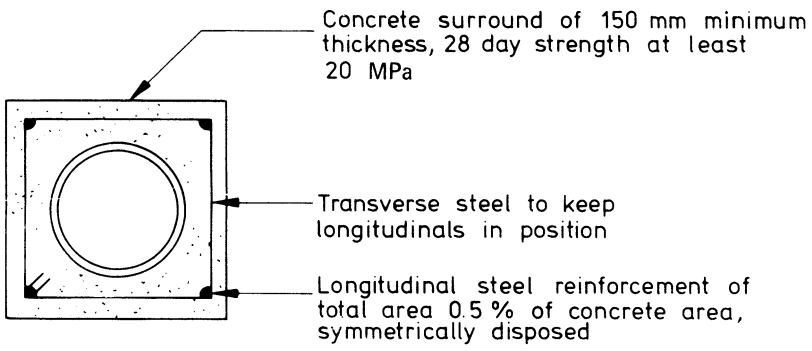


Figure 3 — Details of concrete surround

7 Installation

7.1 General. The ability of a rigid pipe to support the total load transmitted to it is established by reference to actual crushing tests to cause fracture. Flexible pipes such as those made from unplasticized PVC do not fracture under load but they are liable to deformation. The extent of this deformation depends largely upon the compaction of the immediate surrounding fill. For this reason, flexible pipes should always be surrounded with non-cohesive material in accordance with the recommendations of Appendix A. This surround should extend to the trench width in normal trench situations. The external loads (backfill and surcharge) imposed on a pipe of rigid material (such as vitrified clay, concrete, asbestos cement or cast iron) are supported mainly (sometimes wholly) by the resistance of the pipe to circumferential bending. On the other hand unplasticized PVC pipes, being relatively flexible, offer less resistance to circumferential deformation and rely partly on external support to resist deformation. Therefore, it is of primary importance for unplasticized PVC pipes that fill material, particularly the bedding and sidefill, should be properly compacted in order to prevent excessive deformation.

It is desirable that vertical deformation should be limited to 5 % on completion of the backfilling, which can only be achieved by proper compaction of the backfill.

It is essential to avoid high stress concentrations, and sharp objects such as large stones or flints should not be allowed to come into contact with the surface of the pipe. Attention is drawn to Appendix A which details tests for determining the suitability of "as dug" material for use as bedding and surround.

The flexible nature of unplasticized PVC pipes helps them to accommodate deformations resulting from ground movement or from other differential settlement under normal circumstances.

Except in special circumstances, e.g. at very shallow cover depths or where it is necessary to safeguard the foundations of existing structures, the use of concrete for bedding or surrounding the pipes is unnecessary. Figure 3 and Figure 4 illustrate the use of concrete in special local circumstances.

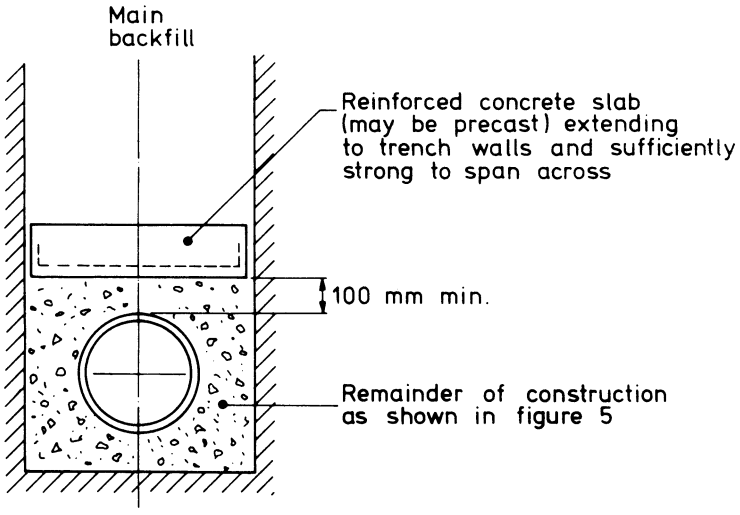


Figure 4 — Alternative to concrete surround as shown in Figure 3

Normally drainage pipework is laid in straight lines. However, in special circumstances and subject to approval it may sometimes be acceptable to "spring" the jointed pipes to a slight curve to avoid an obstacle, or to follow the curvature of a street. In such cases, accurate records should be kept to assist subsequent relocation. If jointed pipes are laid in a slight curve, and the joints are of the push-in type, care has to be taken not to spring the pipework to too sharp a curve or the joints may be over-strained and fail later. The manufacturer should be consulted as to the minimum radius that can be accommodated in this way. As a guide, the minimum cold-bend radius for unplasticized PVC pipes is about 20 m per 100 mm of diameter. Straining of the joints can be minimized by firmly backfilling a short length of pipe following a joint before bending the remaining length of pipe. The pipe should be anchored in this position by further backfilling before the next joint is made, and the process repeated as necessary. The trench may need to be widened on the outside of the curve to accommodate the pipe in its straight position. It is essential that jointing is always carried out in the straight position.

7.2 Trench preparation. (See Figure 5 and Figure 6.) The trench should not be opened too long in advance of pipe laying and should be backfilled as soon as possible. It is essential to ensure that the sides of the trenches are adequately supported in accordance with the requirements of BS 6031. To minimize a possible hazard, a trench should be open for the minimum time practicable.

At the crown of the pipe and for 300 mm, or one pipe diameter if greater, above it the width of the trench within any timbering should be as narrow as is practicable, but not less than the outside diameter of the pipe plus sufficient extra width (usually about 150 mm) on each side of the pipe to provide access for making the joints and placing and compacting sidefill. Above this level, the trench may be of any convenient width.

If the as-dug material is suitable for use as bedding, the bottom of the trench may be trimmed to form the pipe bed. Otherwise, the trench should be excavated to an adequate depth below the invert level of the pipe to allow for the necessary thickness of bedding material. The thickness of bedding under the barrel of the pipes should be a minimum of 100 mm, but in very wet or soft conditions or where the trench bottom is very irregular, it may be necessary to increase this thickness. Bedding should be properly compacted and finished so as to provide uniform support for the pipe. It is essential that bricks or other hard materials are not placed under the pipes for temporary or permanent support.

Material to be used for bedding and surrounding the pipes should be selected granular material, either available locally or, if necessary, brought to the site. Suitable materials are described in Table 2.

Table 2 — Suitable materials for bedding and surrounding pipes

Nominal pipe size	**Material** (complying with the requirements of BS 882-2)
mm	
110	10, nominal single-sized aggregate
160	10 or 14, nominal single-sized aggregate or 14 to 5 graded aggregate
225 and over	10, 14, or 20, nominal single-sized aggregate, or 14 to 5 or 20 to 5 graded aggregate

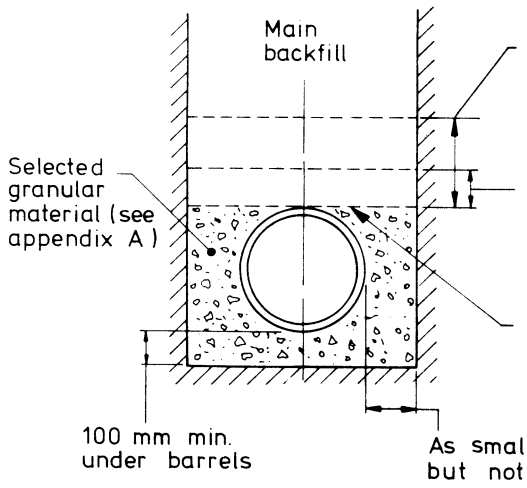
Alternatively, granular material in accordance with the recommendations of Appendix A and having a particle size not exceeding that specified above, depending on pipe size, may be used.

7.3 Pipe laying. The pipes should be jointed in the trench and laid on the prepared bed so that the barrel of the pipe maintains substantially continuous contact. Small depressions should be made to accommodate the pipe sockets or couplings, which should be carefully filled after the pipe has been laid, taking care that no voids remain under or around the socket.

Traffic, including heavy construction vehicles, should not be allowed to pass over pipes which have less than 0.9 m of cover, unless suitable protection is provided (see Figure 3 and Figure 4).

Care should be taken to prevent pipes from deviating from their designed level and line due to flotation prior to backfilling. Any struts used for this purpose should be removed as backfilling proceeds.

Where a pipe is required to go through the wall or foundation of a building or other rigid structure other than at an inspection chamber or manhole, a sleeve should be built into the wall or structure. The inside sleeve diameter should be not less than the outside diameter of the pipe plus 20 mm. The annular space between pipe and sleeve should be stopped with a suitable material which is compatible with the pipe material and which should be non-hardening, non-cracking and resistant to moisture and gas. Pipe joints should not occur within the sleeve (see Figure 7).



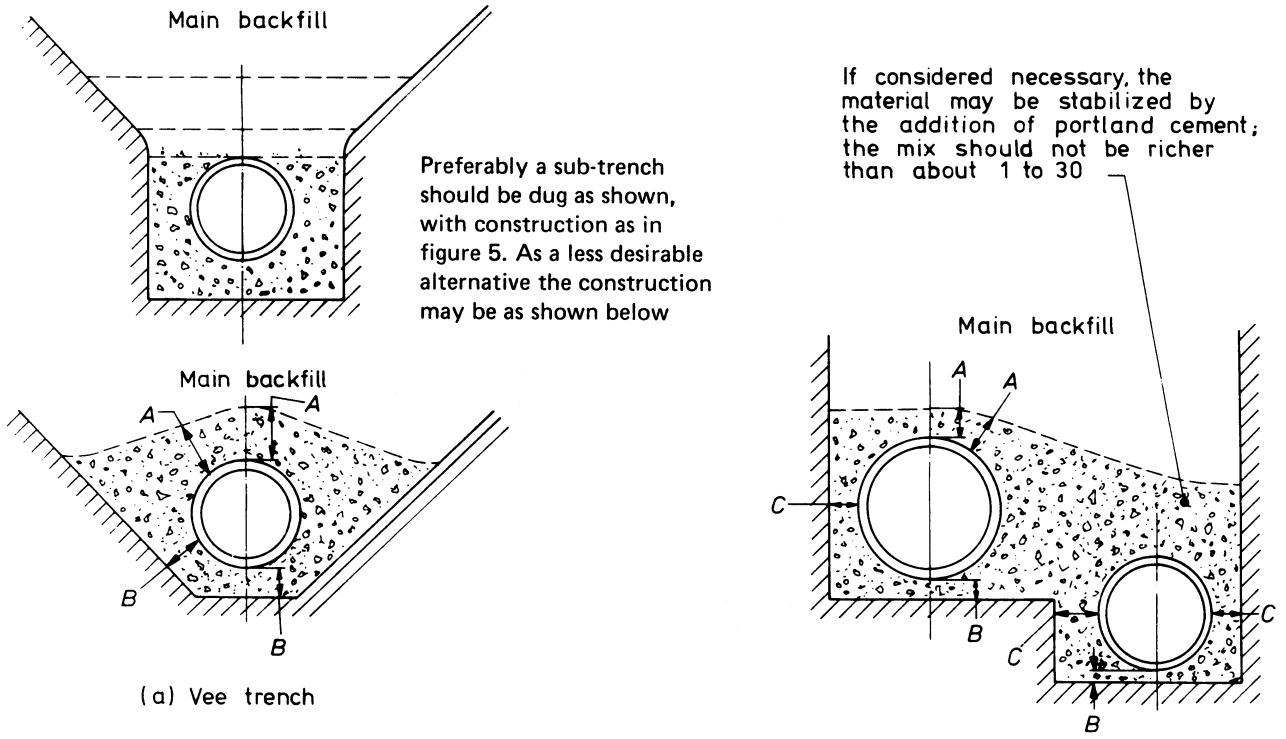
First 300 mm of backfill selected to be free from stones exceeding 40 mm (unless the granular material extends 100 mm above the pipe crown — see below)

Where the backfill above the pipe contains stones larger than 40 mm or where the pipework is deeper than 2 m in poor ground the selected granular material should extend to at least 100 mm above the pipe crown

In other cases the selected granular material should extend to at least the level of the pipe crown

NOTE The 100 mm bed thickness and 150 mm side thickness should be doubled in unstable soil when the cover depth exceeds 2 m to 3 m.

Figure 5 — Bedding details for a pipe in a narrow trench



A Selected granular material (see appendix A) extending at least 100 mm above the pipe. Sides may be sloped off at a flat angle as shown

B 100 mm minimum under barrels

C As small as possible but not less than 150 mm

NOTE *B* and *C* should be doubled in unstable soil when the cover depth exceeds 2 m to 3 m.

Figure 6 — Bedding details for a pipe in a wide trench

Alternatively, a lintel or relieving arch may be formed in the structure to leave 20 mm clearance above the crown of the pipe which should be filled as indicated above.

Where a pipe passes through a wall at a point below the level of the natural water table, a puddle-flanged pipe or a purpose-made unplasticized PVC sleeve-coupler should be used to prevent ingress of water.

The provision of at least one flexible joint is recommended within 300 mm of the external face of the wall of any building and at each entry or exit point of all manholes and inspection chambers. Where abnormal settlement is expected, it is desirable to incorporate two flexible joints to form a "rocker" length of pipe.

7.4 Sidefill and backfill. After the pipes have been laid and tested, more of the selected granular material should be placed evenly on both sides of the pipes up to a level above the pipe crown and compacted. Pipes larger than 315 mm may require an intermediate stage of compaction. If the main backfill over the pipes is liable to contain particles exceeding 40 mm, or where the trench is deeper than 2 m to 3 m in unstable soil, the granular material should extend to at least 100 mm above the pipe crown. Any trench supports should be withdrawn in stages so that the sidefill can be properly compacted between the pipe and the trench walls. In all cases material should be worked under the sides of the pipes to eliminate voids as much as possible.

It may be advantageous, if the pipes are tested by water pressure, to carry out the backfilling operation with the pipes full of water.

Unless otherwise specified or the statutory authorities require a different material, the material excavated from the trench may be used for the remainder of the backfill, but if the granular material does not extend to at least 100 mm above the pipe crown the first 300 mm of backfill should be selected to be free of stones exceeding 40 mm in size. The backfill should be compacted in 300 mm layers or in compliance with the requirements of statutory authorities. Heavy compactors should not be used until the pipes have at least 300 mm of cover, but suitable light vibratory tampers may be used with discretion at any stage of the work to aid compaction.

Pipes at depths less than 0.6 m not under a road should, where necessary, be protected against risk of damage, for example, by placing over them a layer of concrete paving slabs with at least 75 mm layer of granular material between pipes and slabs. Pipes laid at a depth less than 0.9 m below the finished surface of a road should be suitably protected with a reinforced concrete surround or by means of reinforced bridging slabs of adequate strength.

When pipes are laid under buildings the rigidity of a concrete bed and surround may be undesirable and in this case only single-size aggregate or material having a compaction fraction of 0.20 or less, when tested in the manner described in Appendix A, should be used. The surround and the backfill should be continued with similar material up to the underside of the oversite concrete.

7.5 Connection into existing drains and sewers

7.5.1 *Sewers.* Connections to sewers should be made only as directed by the drainage authority responsible for the sewer, and should only be made using purpose-made junctions or saddles.

7.5.2 *Unplasticized PVC pipes.* A connection into an unplasticized PVC pipe can be effected by inserting a junction into the line. This is achieved by cutting out the appropriate length of unplasticized PVC pipe, preparing the cut ends for jointing and placing one repair coupling (or two if a plain ended junction piece is used) into position on the prepared ends. The junction pipe is fitted into position and repair coupling(s), which are double socketed and have no centre stop, are then slipped into position to complete the insertion, after which the new branch connection can be made.

As an alternative to the use of a junction, a saddle connection may be made. This may be either by means of solvent cementing or by mechanical means such as a purpose-made clamp and saddle incorporating a sealing ring. Care should be taken to avoid solvent cement entering the existing pipe. The saddle should be placed in its intended location and its position marked. The position of the inlet hole should be marked on the outside of the pipe using the saddle or a purpose-made template. The inlet hole can be made by drilling a small hole and cutting out the profile with a keyhole saw. It is essential to remove all swarf and rough edges.

If the saddle is to be solvent cement jointed, the surfaces of the pipe and saddle should be prepared as described in **4.2.2**, coated with cement and jointed. The joint should be held securely in position until sufficient strength has been achieved in the joint as indicated by the manufacturer; in general, at least 15 min should be allowed.

Saddle connections by mechanical means should be made in accordance with the manufacturer's instructions.

7.5.3 *Jointing to pipes of other materials.* Branch connections into pipes of other materials should be made using a junction piece or saddle appropriate to the existing pipeline. The connection to the branch can be made using an appropriate unplasticized PVC adaptor (see Figure 8).

Where a cement mortar joint is to be used, the unplasticized PVC fittings should be treated and the surfaces prepared to ensure adhesion to the cement mortar when required. The unplasticized PVC surface should be roughened and cleaned, coated with solvent cement and immediately sprinkled with clean dry sand. When this has dried it will provide a suitable key for the cement mortar.

The adaptors shown in Figure 8 are also suitable for use to effect a change of material along a straight pipeline. Connectors with flexible joints are available for some sizes of pipes and are generally to be preferred.

7.6 Inspection chambers, manholes and access points. Unplasticized PVC channel fittings for benching in cement mortar are available for use in brick manholes, constructed in accordance with CP 301, or pre-cast concrete manholes complying with the requirements of BS 5911-2. Where retaining clips or other mechanical devices are not incorporated into channel fittings, the surface in contact with cement mortar should be treated to promote adhesion (see **7.5.3**).

Connection to an inspection chamber or manhole constructed entirely of other materials may be made in the manner indicated in **7.5.3**.

Unplasticized PVC drop pipes may be placed inside the chamber and should be supported at intervals not greater than 1.8 m. Where a back drop is used outside a chamber, which is to be surrounded by concrete, the back drop should be incorporated into the concrete surround. In other cases, subject to regulations, granular material may be placed and compacted around the drop pipe connection and under the bend to ensure support.

Special access units, inspection chamber bases and complete inspection chambers manufactured from various plastics materials, are available for use with unplasticized PVC underground drains. These should be installed strictly in accordance with the manufacturers' or suppliers' instructions.

Where access is required for rodding at the head of the drain or at a branch, a rodding eye may be used (see CP 301). This may be purpose-made or constructed from unplasticized PVC fittings complying with the requirements of BS 4660.

8 Inspection and testing

All newly installed pipes, manholes, inspection chambers and access points should be tested in accordance with appropriate regulations and bye-laws. Requirements may vary according to the locality of the installation.

Attention is also drawn to CP 2005 and clause **5** of CP 301:1971.

Compliance with the recommended limit on deformation (see **7.1**) may be checked by pulling a sphere, or similar object, of an appropriate dimension through the pipework.

9 Cleaning and repair

Conventional rods, implements and specialist power assisted equipment may be used for cleaning unplasticized PVC drains. It is necessary to ensure that cleaning equipment, particularly the end implement, will not cause damage to pipe walls.

In the event of a repair being necessary to an unplasticized PVC drain a new section of pipe may be inserted using repair couplings (see **7.5**).

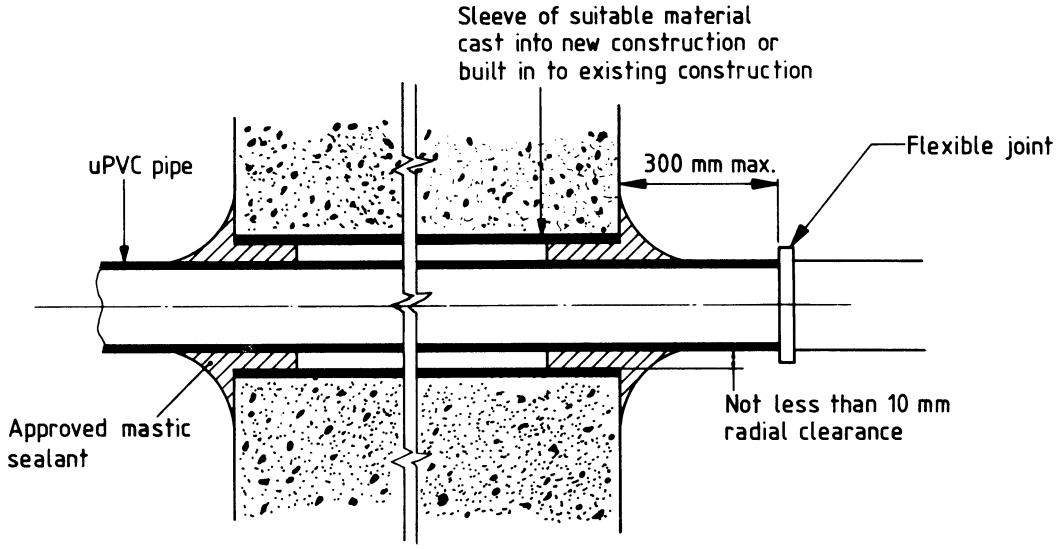


Figure 7 — Unplasticized PVC pipe passing through a wall

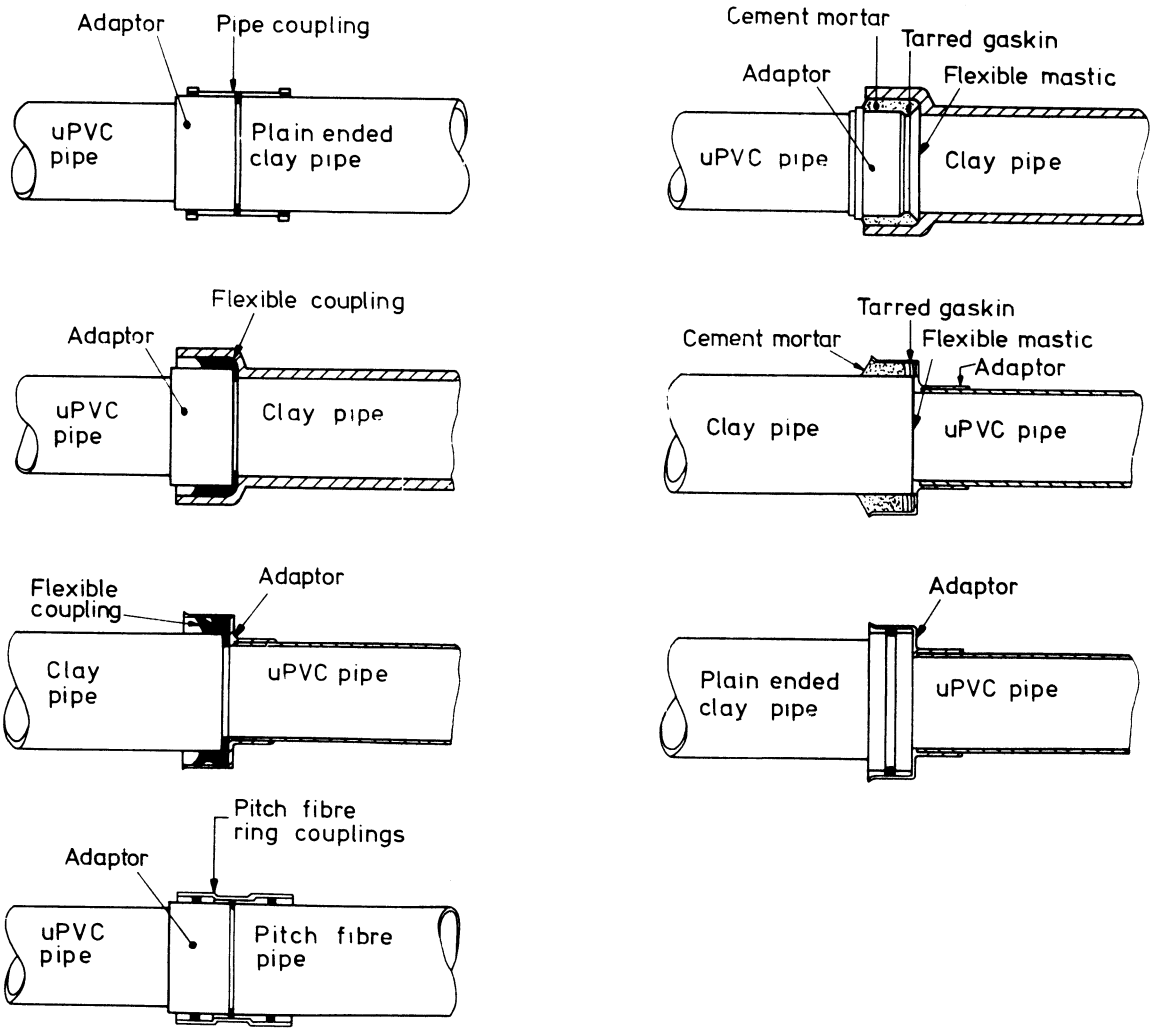


Figure 8 — Sections through typical adaptors to join unplasticized PVC pipes to pipes of other materials

Appendix A Tests for suitability of soil material (imported or local) for surrounding buried plastics pipes

NOTE This appendix is based on the appendix to TRRL Supplementary Report 375 "The structural design and laying of small underground drains on flexible materials".

A.1 Visual examination. Examine the material and reject any which contains pieces with sharp edges.

A.2 Particle size. The maximum particle size should generally not exceed 20 mm. The presence of an occasional particle between 20 mm and 40 mm is acceptable provided the total quantity of such particles is only a very small fraction of the whole. If particles over 40 mm are present, the material should be rejected. The following test will ensure compliance with this recommendation.

A weighed representative sample of material (about 2 kg) should be sieved, using test sieves of 19 mm and 38 mm nominal mesh size (see BS 410).

NOTE 1 To obtain a representative sample, about 50 kg of the proposed material should be heaped on a clean surface and divided with a spade down the middle. One of these halves should then be similarly divided, and so on until the required mass of sample is left.

NOTE 2 In the sieving, clumps of material that break up under light finger pressure may be helped through the sieve, but considerable force should not be used to squeeze oversize clumps through the mesh.

The material is not recommended if:

a) any particles are retained on the 38 mm sieve, or

b) more than 5 % by mass of the sample is retained on the 19 mm sieve.

A.3 Ease of compaction

A.3.1 *Apparatus*. The following apparatus is required.

A.3.1.1 *Open-ended cylinder* 250 mm long and 150 ± 6 mm internal diameter (150 mm diameter unplasticized PVC pipe is suitable).

A.3.1.2 *Metal rammer* with striking face 40 mm diameter and weighing 1.0 ± 0.1 kg.

A.3.1.3 *Rule*.

A.3.2 *Procedure*. Obtain a representative sample (see **A.2**, note 1) more than sufficient to fill the cylinder (about 11 kg). It is important that the moisture content of the sample should not differ materially from that of the main body of material at the time of its use in the trench.

Place the cylinder on a firm flat surface and gently pour the sample material into it, loosely and without tamping. Strike off the top surface level with the top of the cylinder and remove all surplus spilled material. Lift the cylinder clear of its contents and place on a fresh area of flat surface. Place about one quarter of the contents back in the cylinder and tamp vigorously with the metal rammer until no further compaction can be obtained. Repeat with the second quarter, tamping as before, and so on for the third and fourth quarters, tamping the final surface as level as possible.

Measure down from the top of the cylinder to the surface of the compacted material. This distance in millimetres divided by the height of the cylinder (250 mm) is referred to as the "compaction fraction".

A.3.3 *Interpretation of results*

Compaction fraction (equivalent measurement from top of the cylinder)	(mm)	**Suitability for use**
⩽ 0.20	(50)	Material suitable
> 0.20 ⩽ 0.3	(50 to 75)	Material may be suitable for
		applications other than installations carried out in compliance with the Civil Engineering Specification for the Water Industry but requires extra care in compaction. Not suitable if the ground is subject to waterlogged conditions after laying.
> 0.3	(75)	Material unsuitable

Publications referred to

BS 410, *Specification for test sieves.*

BS 882, BS 1201, *Aggregates from natural sources for concrete (including granolithic).*
BS 882-2, *Metric units.*
BS 2494, *Materials for elastomeric joint rings for pipework and pipelines.*
BS 4346, *Joints and fittings with unplasticized PVC pressure pipes.*
BS 4346-3, *Solvent cements.*
BS 4660, *Unplasticized PVC underground drain pipe and fittings.*
BS 5481, *Specification for unplasticized PVC pipe and fittings for gravity sewers.*
BS 5911, *Precast concrete pipes and fittings for drainage and sewerage.*
BS 5911-2, *Specification for inspection chambers and street gullies.*
BS 6031, *Code of practice for earthworks.*
CP 301, *Building drainage.*
CP 312, *Plastics pipework (thermoplastics material).*
CP 312-1, *General principles and choice of material.*
CP 312-2, *Unplasticized PVC pipework for the conveyance of liquids under pressure.*
CP 312-3, *Polyethylene pipes for the conveyance of liquids under pressure.*

CP 2005, *Sewerage.*

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