TECHNICAL SPECIFICATION

ISO/TS 10839

First edition
2000-03-15

Polyethylene pipes and fittings for the supply of gaseous fuels — Code of practice for design, handling and installation

Tubes et raccords en polyéthylène pour le transport de combustibles gazeux — Code de pratique pour la conception, la manutention et l'installation

Reference number
ISO/TS 10839:2000(E)

© ISO 2000

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS

Not for Resale

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

© ISO 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Contents

Page

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publically Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by more than 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

Attention is drawn to the possibility that some of the elements of this Technical Report may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 10839 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

Annexes A and B are for information only.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Polyethylene pipes and fittings for the supply of gaseous fuels — Code of practice for design, handling and installation

1 Scope

This Technical Specification presents a code of practice dealing with polyethylene (PE) pipes and fittings for buried pipeline systems outside buildings and designed to distribute gaseous fuels within the temperature range – 20 °C to + 40 °C and gives appropriate temperature-related requirements.

The code of practice covers mains and service lines whose components are prepared for jointing by scraping and/or machining, and gives instructions for the design, storage, handling, transportation, laying conditions and fusion quality control of PE pipes and fittings up to and including 630 mm outside diameter, as well as subsequent joint testing, backfilling, pipe system testing, commissioning and decommissioning.

The jointing methods covered by this Technical Specification are heated-tool fusion jointing (butt, socket and saddle fusion), electrofusion jointing and mechanical jointing.

No special precautions are necessary for areas exposed to the influence of mining and earthquakes other than those precautions mentioned in this code of practice.

Existing and new national regulations take precedence over this Technical Specification.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Technical Specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Technical Specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4437:1997, *Buried polyethylene (PE) pipes for the supply of gaseous fuels — Metric series — Specifications*.

ISO 8085-1:—[1], *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 1: Fittings for socket fusion heated tools.*

ISO 8085-2:—[1], *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 2: Spigot fittings for butt or socket fusion using heated tools and spigot fittings for use with electrofusion fittings.*

ISO 8085-3:—[1], *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings.*

ISO 10838-1:2000, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 1: Metal fittings for pipes of nominal outside diameter less than or equal to 63 mm.*

1) To be published.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

ISO 10838-2:2000, *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 2: Metal fittings for pipes of nominal outside diameter greater than 63 mm.*

ISO 10838-3:—[2)], *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels — Part 3: Thermoplastics fittings for pipes of nominal outside diameter less than or equal to 63 mm.*

ISO 10933:1997, *Polyethylene (PE) valves for gas distribution systems.*

ISO 11413:1996, *Plastics pipes and fittings — Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting.*

ISO/TR 11647:1996, *Fusion compatibility of polyethylene (PE) pipes and fittings*.

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient.*

ISO 12176-1:1998, *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 1: Butt fusion.*

ISO 12176-2:—[2)], *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 2: Electrofusion.*

ISO 12176-3:—[2)], *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems — Part 3: Operator's badge*.

EN 12327:—[2)], *Gas supply systems — Pressure testing, commissioning and decommissioning procedures — Functional requirements*.

3 Terms and definitions

For the purposes of this Technical Specification, the following terms and definitions apply.

3.1
butt fusion machine pressure
pressure indicated on the manometer or on a pressure display on a butt fusion machine, giving an indication of the interface force applied to the pipe and/or fitting ends

3.2
clearance
shortest distance between the outer limits of two objects

3.3
drag resistance
frictional resistance due to the weight of the length of pipe fixed in the moveable clamp at the point at which movement of the moveable clamp is initiated (peak drag), or the friction occurring during movement (dynamic drag)

3.4
electrofusion control box
unit implementing the output fusion parameters of voltage or current and time or energy to execute the fusion cycle as specified by the electrofusion fitting manufacturer

3.5
frictional losses in the butt fusion machine
force necessary to overcome friction in the whole mechanism of a butt fusion machine

---

2) To be published.

--`,,`,`,,,,`,```-`-`,,`,,`,`,,`---

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

3.6
interface force
force between the fusion surfaces of the pipe(s) and/or fitting(s) during the fusion cycle, as specified in the fusion diagram

3.7
operator
person authorized to build PE systems from pipes and/or fittings, based on a written procedure agreed by the pipeline operator

3.8
overall service (design) coefficient
C
overall coefficient, with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system

3.9
pipeline operator
private or public organization authorized to design, construct and/or operate and maintain a gas supply system

3.10
soil cover
vertical distance between the top of a buried pipe and the normal surface after finishing work

4 Symbols and abbreviated terms

d_e external diameter of pipe

MOP maximum operating pressure

MRS minimum required strength

RCP rapid crack propagation

SDR standard dimension ratio

5 Design

5.1 General

A written laying procedure, authorized by the pipeline operator, shall be made available prior to the construction of a pipeline. The laying procedure shall include specification of the jointing procedure, the pipe and fitting materials to be used, the trenching and backfilling requirements, the pressure testing and commissioning requirements, and the data to be collected for the traceability system.

The selection of materials, SDR series, dimensions and assembling techniques shall be the responsibility of the pipeline operator.

There are two SDR series in common use for gas supply systems: SDR 17,6 and SDR 11. Other SDR series can also be used, such as SDR 26 for renovation.

The training and the level of skill of the operator shall be in accordance with the requirements of the jointing procedures.

General guidelines for supervision and quality control are given in clause 8.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

5.2 Materials, components and jointing equipment

The PE materials and components used shall conform to the relevant ISO standards: ISO 4437, ISO 8085-1, ISO 8085-2, ISO 8085-3, ISO 10838-1, ISO 10838-2, ISO 10838-3 and ISO 10933.

Other components not covered by the above-mentioned standards shall conform to the relevant national standards.

If pipes and fittings are to be stored outside, requirements on maximum storage time shall be given in the laying procedure. PE materials shall be stabilized to give protection against a UV radiation level of 3,5 GJ/m^2. It is desirable that national bodies give recommendations for allowed storage times in their countries. Annex B gives, as an example, the average radiation levels in Europe.

The fusion equipment used for the construction of the pipeline shall comply with the requirements of ISO 12176-1 or ISO 12176-2. If the operation of the fusion equipment requires an operator's badge, the badge shall conform to ISO 12176-3.

5.3 Maximum operating pressure

The maximum operating pressure (MOP) of the system shall be selected by the pipeline operator on the basis of the gas supply system operating requirements and the materials used. The MOP of a PE system depends upon the type of resin used (the MRS), the pipe SDR series and the service conditions, and is limited by the overall service (design) coefficient C and the RCP criteria.

The overall service (design) coefficient C for thermoplastics materials is specified in ISO 12162. This coefficient is used to calculate the MOP of the pipeline. C shall be greater than or equal to 2 for PE pipeline systems for natural gas.

The MOP shall be calculated using the following equation:

$$\text{MOP} = \frac{20 \times \text{MRS}}{C \times (\text{SDR} - 1) \times D_\text{F}}$$

NOTE The derating factor D_F is a coefficient used in the calculation of the MOP which takes into account the influence of the operating temperature. Derating factors for various operating temperatures are given in annex A.

The ratio of the critical RCP pressure to the MOP shall be $\geqslant$ 1,5 at the minimum operating temperature. The critical RCP pressure is dependent upon temperature, pipe size and type of PE material used. It is defined here in accordance with ISO 4437:1997, which specifies a test temperature of 0 °C.

Where the pipe temperature decreases below 0 °C, the p_RCP/MOP ratio shall be recalculated using a p_RCP value determined from the minimum expected operating temperature of the pipe. If necessary, the value of the MOP shall be reduced so as to maintain the p_RCP/MOP ratio at a value $\geqslant$ 1,5.

5.4 Assembly techniques

Jointing procedures may vary depending upon the type of PE material and the pipe size used.

Fusion is the preferred jointing method. Preference shall be given to butt fusion and electrofusion.

Care shall be taken when making fusion joints with PE materials which are not compatible (see ISO 4437).

A written jointing procedure, authorized by the pipeline operator, shall be available prior to the construction of a pipeline. The jointing procedure shall include specification of the jointing method, the fusion parameters, the fusion equipment, the jointing conditions, the level of skill of the operator, and the quality control methods to be used.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

5.5 Squeeze-off properties

When squeeze-off techniques are considered, the suitability of the pipe for squeeze-off shall be established in accordance with ISO 4437.

6 Installation

6.1 Jointing procedure

The jointing operation shall be performed in accordance with the pipeline operator’s written procedure and shall take into account any advice from the pipe, fitting and accessory manufacturers.

Polyethylene pipes, fittings and accessories may be jointed by heated-tool fusion jointing, electrofusion jointing or mechanical jointing. The jointing and quality control methods used for the construction of the gas supply system shall be appropriate to the design of the network.

6.2 Training

The operator shall be competent in the appropriate laying and jointing methods. He shall possess the necessary skill and knowledge to produce joints of consistently high quality.

Operators shall receive formal training under the supervision of a qualified instructor. The gas company may require a certificate indicating that he has reached an adequate standard in accordance with national or local regulations.

6.3 Heated-tool fusion jointing (butt, socket and saddle fusion)

6.3.1 General

Heated-tool fusion joints shall be made under defined conditions of pressure, time and temperature, using a written procedure (see 6.1). Mating surfaces are heated to their fusion temperature and then brought into contact with one another.

6.3.2 Fusion temperature

The production of a strong fusion bond depends, among other things, upon the fusion temperature of the polyethylene material: overheating may degrade the material, and insufficient heating will not soften it adequately.

The temperature range over which any particular polyethylene material may be satisfactorily jointed shall be considered. The jointing procedure shall specify the heating cycle and the temperature levels for the polyethylene material chosen.

Cold weather and wind can adversely affect the fusion temperature. Under these circumstances, special precautions such as shielding, end caps and longer heating times shall be considered.

6.3.3 Fusion equipment

The butt fusion equipment used shall conform to ISO 12176-1. Socket and saddle fusion equipment shall comply with a relevant ISO standard or a national or company standard which guarantees a high-quality product fit for the purpose intended.

As high-quality fusion joints cannot be made with fusion equipment in poor condition, maintenance of the fusion equipment is very important and shall be carried out on a regular basis. The cleanliness and integrity of the heating surfaces, the ability of the heating tools to produce the correct temperature and the correct alignment and operation of the equipment when used are of paramount importance.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

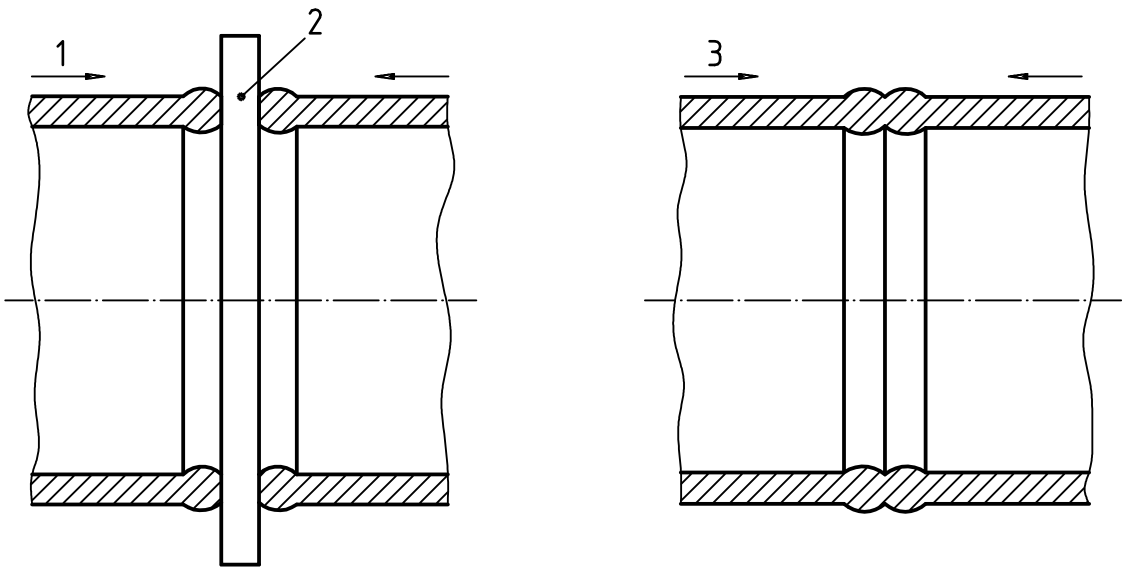
The heating tools are designed to maintain uniform temperatures within the fusion temperature range of the particular polyethylene material and shall have calibrated means of measuring and indicating the temperature. A precise temperature measurement device such as a pyrometer or a digital thermometer with a surface temperature sensor may be used to check the surface temperature of the heating tools, although additional care is necessary to avoid inconsistency of readings when such a device is used.

All heating tools used shall be electrically heated.

6.3.4 Butt fusion

6.3.4.1 Principle

The butt fusion technique consists of heating the planed ends of the mating surfaces by holding them against a flat heating plate until molten, removing the heating plate, pushing the two softened ends against one another, holding under pressure for a prescribed time and allowing the joint to cool (see Figure 1).



a) Heating **b) Fusion**

Key

1 Pressure during heating

2 Heating plate

3 Pressure during fusion

Figure 1 — Butt fusion

Butt fusion is not recommended for pipes < 63 mm in diameter. Pipes and/or fittings with fusion ends of different SDR values shall not be jointed by butt fusion.

6.3.4.2 Butt fusion cycle

The butt fusion cycle can be represented by a pressure/time diagram for a defined fusion temperature. Different butt fusion cycles are available, depending on the PE material used, the pipe diameter and the working conditions. The butt fusion cycle to be used shall be specified in the written procedure.

An example of a butt fusion diagram is given in Figure 2.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

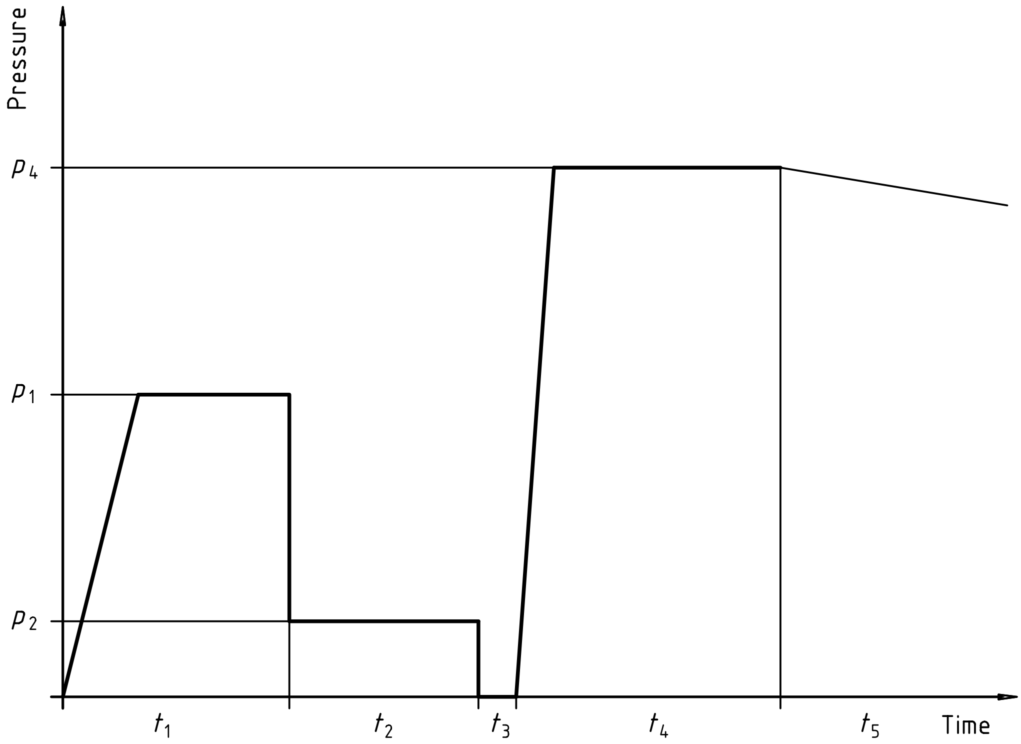


Figure 2 — Example of a butt fusion diagram

Table 1 — Parameters of butt fusion diagram shown in Figure 2

Period of time	Description	Pressure at interface
t_1	Formation of a bead measuring 1 mm to 4 mm, depending on the pipe diameter	p_1
t_2	Heating of the material (heat soak)	p_2
t_3	Removal of the heating plate	—
t_4	Building up the fusion pressure and the fusion-jointing operation	p_4
t_5	Cooling of the fusion joint	—

The pressures shall be chosen so that the required force is produced at the interface, irrespective of frictional and pressure losses in the butt fusion machine and drag resistance from the pipe system.

In the case of machines with hydraulic power rams, the force is normally indicated in terms of the applied cylinder pressure. For such machines, a specific calibration table is provided that gives the relationship between the real interface pressure and the pressure indicated by the manometer (pressure gauge).

6.3.4.3 Butt fusion temperature

The butt fusion temperature is normally situated between 200 °C and 235 °C and is given in the jointing procedure.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

6.3.4.4 Butt fusion jointing

The following gives an overview of the minimum operations necessary to produce a but fusion joint with a specified butt fusion cycle and temperature:

— Reduce the drag resistance as much as possible, for example by using pipe rollers.

— Clamp the spigot ends of the pipe(s) and/or fitting(s) in the butt fusion machine.

— Clean the spigot ends.

— Check that the butt fusion machine is compatible with the pipe diameter and the prescribed butt fusion cycle.

— Plane the pipes parallel by moving the movable clamp against the planing tool (see Figure 3). The closing pressure shall be sufficient to produce a steady flow of PE slivers on both sides of the planing tool. Planing is complete when the pipe face(s) and/or fitting face(s) are plane and parallel to each other.

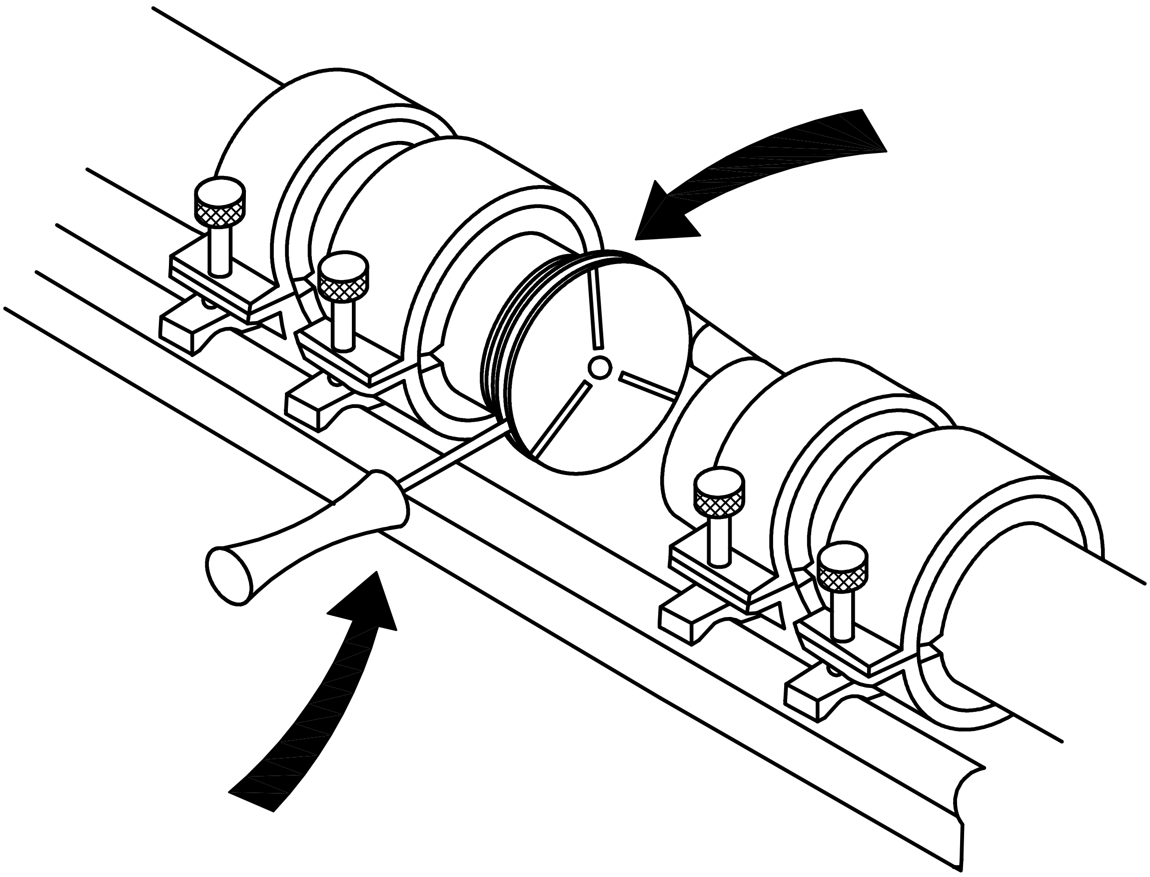


Figure 3 — Planing the spigot ends

— Lower the pressure, keeping the planing tool rotating in order to avoid a burr on the pipe and/or fitting faces. Move the movable clamp backwards and remove the planing tool.

— Close the butt fusion machine and check that the pipes are aligned. The spigot ends of pipe(s) and/or fitting(s) shall be aligned as much as possible and not exceed the maximum misalignment given in the jointing procedure.

— The gap between the pipe and/or fitting faces after planing shall be as small as possible and shall not exceed the maximum gap given in the jointing procedure.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

© ISO 2000 – All rights reserved

— Measure the additional pressure caused by the frictional losses in the butt fusion machine and the drag resistance by moving the movable clamp forwards, and add this pressure to the required butt fusion pressure.

— If necessary, clean the fusion surfaces and the heating plate. Polyethylene residues shall only be removed from the heating plate with a wooden spatula.

— Check that the surface coating of the heating plate is intact and without scratches.

— Check that the heating plate is at the correct fusion temperature.

— Place the heating plate between the pipe faces. Close the butt fusion machine against the heating plate to apply the fusion pressure, including the measured additional pressure, until the specified bead width has been reached (see Figure 4).

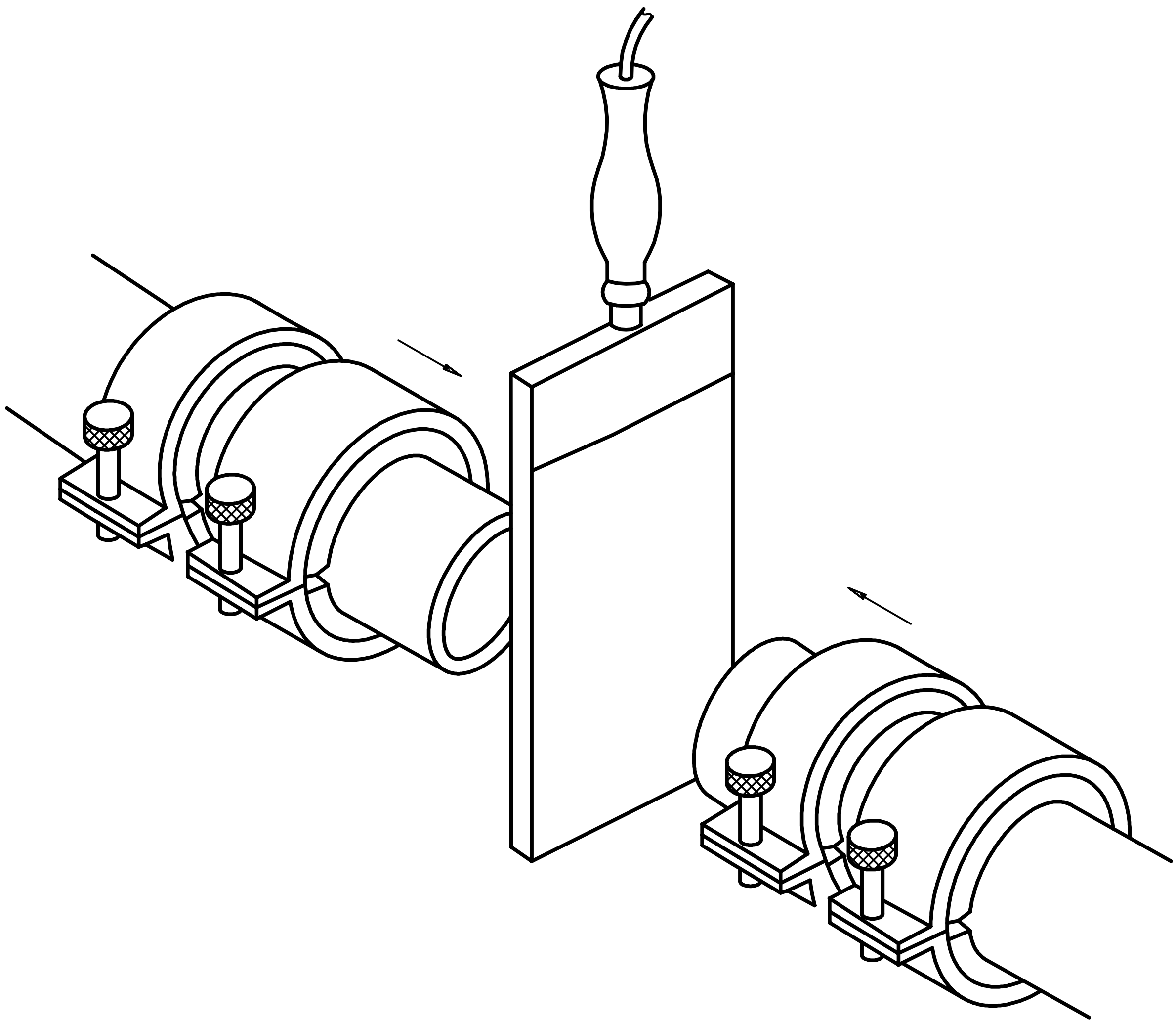


Figure 4 — Heating the spigot ends

— Reduce the pressure to a level at which contact is just maintained between the pipe ends and the heating plate.

— When the heat soak time has elapsed, open the butt fusion machine and remove the heating plate. Check the heated pipe ends quickly for possible damage to the melted ends caused by the removal of the heating plate, and close the butt fusion machine again. The period between opening and closing shall be within the maximum time given in the jointing procedure.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

— Store the heating plate in a protective enclosure when not in use.

— The butt fusion machine shall remain closed and under pressure during the whole butt fusion time and subsequent cooling period. It is important that the cooling period is respected.

— When the butt fusion and cooling times have elapsed, release the pressure in the butt fusion machine.

— When removed, the pipe shall be handled with care.

6.3.5 Socket fusion

6.3.5.1 Principle

This technique consists of simultaneously heating both the external surface of the pipe and the internal surface of a socket until the polyethylene has melted sufficiently, inserting the pipe end into the socket and holding it in place until the joint cools.

Socket fusion machines are recommended for diameters $\geqslant 63$ mm to ensure high-quality joints.

With diameters < 63 mm, socket fusion can be performed manually using re-rounding tools.

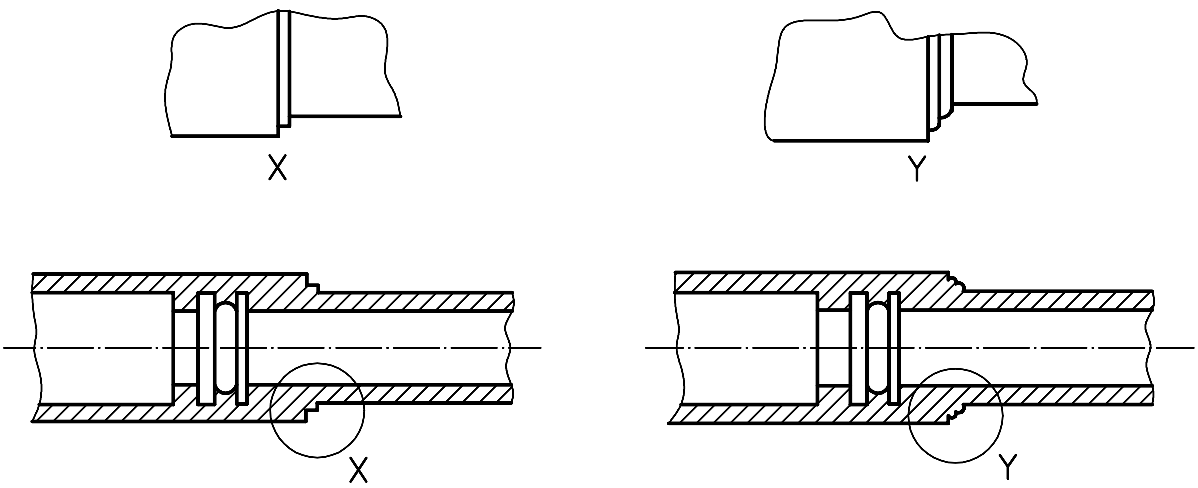
Socket fusion is not recommended with diameters > 125 mm.

6.3.5.2 Types of socket fusion joint

There are two kinds of socket fusion joint: type A and type B.

Type A joints have flat beads, and the pipe end is not calibrated, whereas type B joints have round beads, and the outside diameter of the pipe end is calibrated by removing a thin layer of material by means of a calibration tool (see Figure 5).

Type A and B fittings and the corresponding socket fusion machines and auxiliary equipment are not compatible.



a) Type A **b) Type B**

Figure 5 — Types of socket fusion joint

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

6.3.5.3 Socket fusion parameters

The socket fusion parameters, i.e. the heat soak time and temperature, the heating-tool removal time, the fusion time and the cooling period, shall be specified in the written procedure

The socket fusion parameters depend on the PE material used, the pipe diameter and the SDR value.

6.3.5.4 Machine socket fusion jointing

The following procedure gives an overview of the minimum operations necessary to produce a machine socket fusion joint:

— Check that the socket fusion machine and auxiliary equipment are compatible with the pipe diameter and fitting type.

— Clamp the fitting in the socket fusion machine.

— Check, and adjust if required, the alignment of the fitting using the alignment mandrel.

— Cut the pipe square with the pipe axis and deburr the edges.

— The outside diameter of pipes intended to be joined to type B fittings shall be calibrated with the calibration tool (see Figure 6).

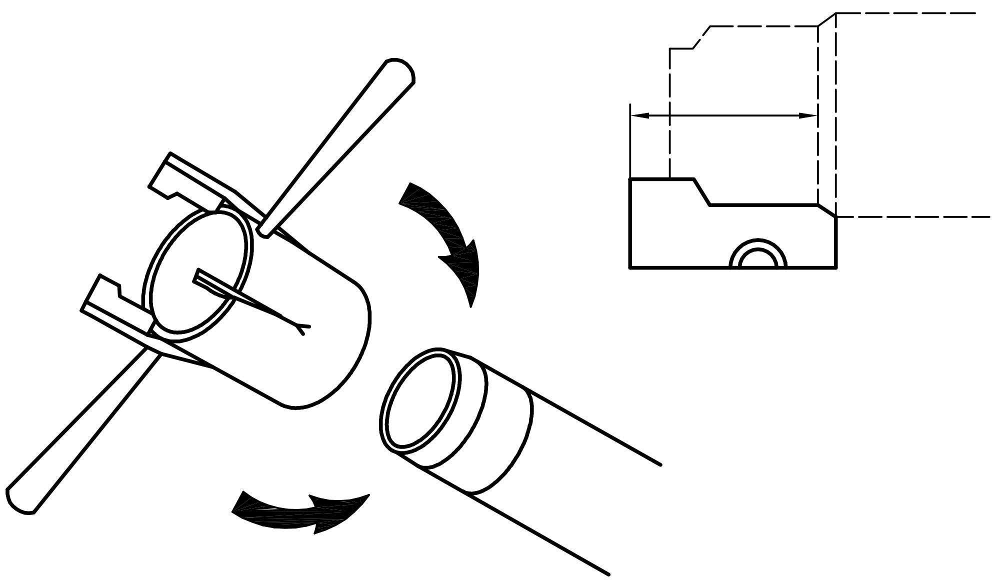


Figure 6 — Calibration tool

— Place the pipe in the pipe clamp. Check the extension of the spigot end of the pipe with a depth gauge. For pipes intended to be joined to type B fittings, the calibration tool is often used for this purpose.

— Clean the fusion surfaces of pipe and fitting.

— If necessary, clean the fusion surfaces of the heating tool. Polyethylene residues shall only be removed with a wooden spatula.

— Check that the surface coating of the heating tool is intact and without scratches.

— Check that the heating tool is at the correct fusion temperature.

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

— Place the heating tool between pipe and fitting (see Figure 7).

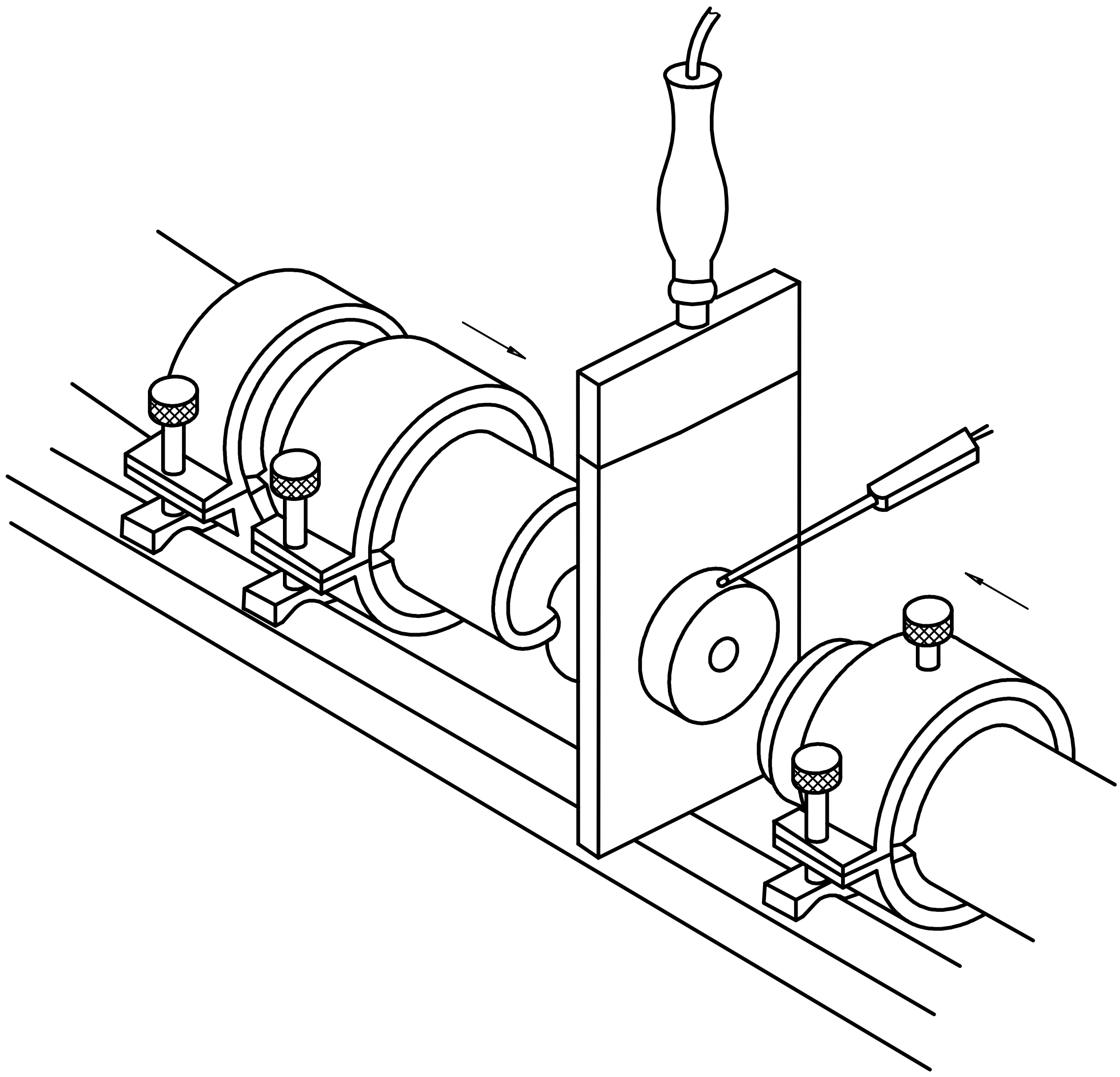


Figure 7 — Socket fusion machine

— Close the socket fusion machine slowly and steadily until the heating tool has fully covered the area of the pipe to be heated and, on the other side, has fully penetrated the socket of the fitting. Maintain this position for the whole of the heat soak time (see Figure 8).

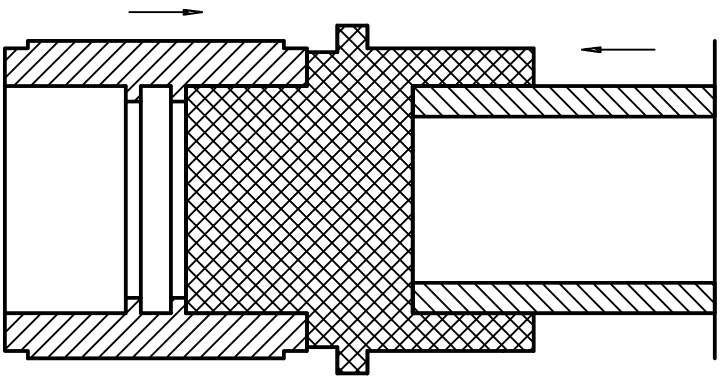


Figure 8 — Socket heating

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

— The heat soak time commences when the pipe and the fitting are pressed home.

— When the heat soak time has elapsed, open the socket fusion machine and remove the heating tool. Check the heated areas quickly for possible damage and for uniform visual appearance and close the socket fusion machine again. The period between opening and closing shall be within the prescribed time.

— Make sure that the spigot end of the pipe has penetrated fully into the socket of the fitting.

— The socket fusion machine shall remain in this position during the whole of the fusion time.

— Remove the fusion machine but do not expose the joint to excessive stress until at least an additional 10 min cooling period has elapsed.

— Store the heating tool in a protective enclosure when not in use.

6.3.5.5 Manual socket fusion jointing

The following procedure gives an overview of the minimum operations necessary to produce a manual socket fusion joint:

— Check that the heating tool and auxiliary equipment are compatible with the pipe diameter and fitting type.

— Cut the pipe square with the pipe axis and deburr the edges.

— The outside diameter of pipes intended to be fused with type B fittings shall be calibrated with the calibration tool. If re-rounding tools are used, place them at least 50 mm from the nearest fusion surface before calibration is carried out.

— Place the depth gauge on the spigot end of pipes intended to be fused with type A fittings and fix the re-rounding tool just behind it (see Figure 9).

— Clean the fusion surfaces of pipe and fitting.

— If necessary, clean the fusion surfaces of the heating tool. Polyethylene residues shall only be removed with a wooden spatula.

— Check that the surface coating of the heating tool is intact and without scratches.

— Check that the heating tool is at the correct fusion temperature.

— Place the heating tool between pipe and fitting and press slowly and steadily until the heating tool has fully covered the area of the pipe to be heated and, on the other side, has fully penetrated the socket of the fitting. Maintain this position during the whole of the heat soak time.

— The heat soak time commences when the pipe and the fitting are pressed home.

— Remove the pipe and fitting from the heating tool when the heat soak time has elapsed. Check the heated areas quickly for possible damage and for uniform visual appearance and press the spigot end of the pipe into the heated socket of the fitting. The period between removal of the heating tool and insertion of the pipe in the fitting shall be within the maximum time given in the jointing procedure.

— Make sure that the spigot end of the pipe has penetrated fully into the socket of the fitting.

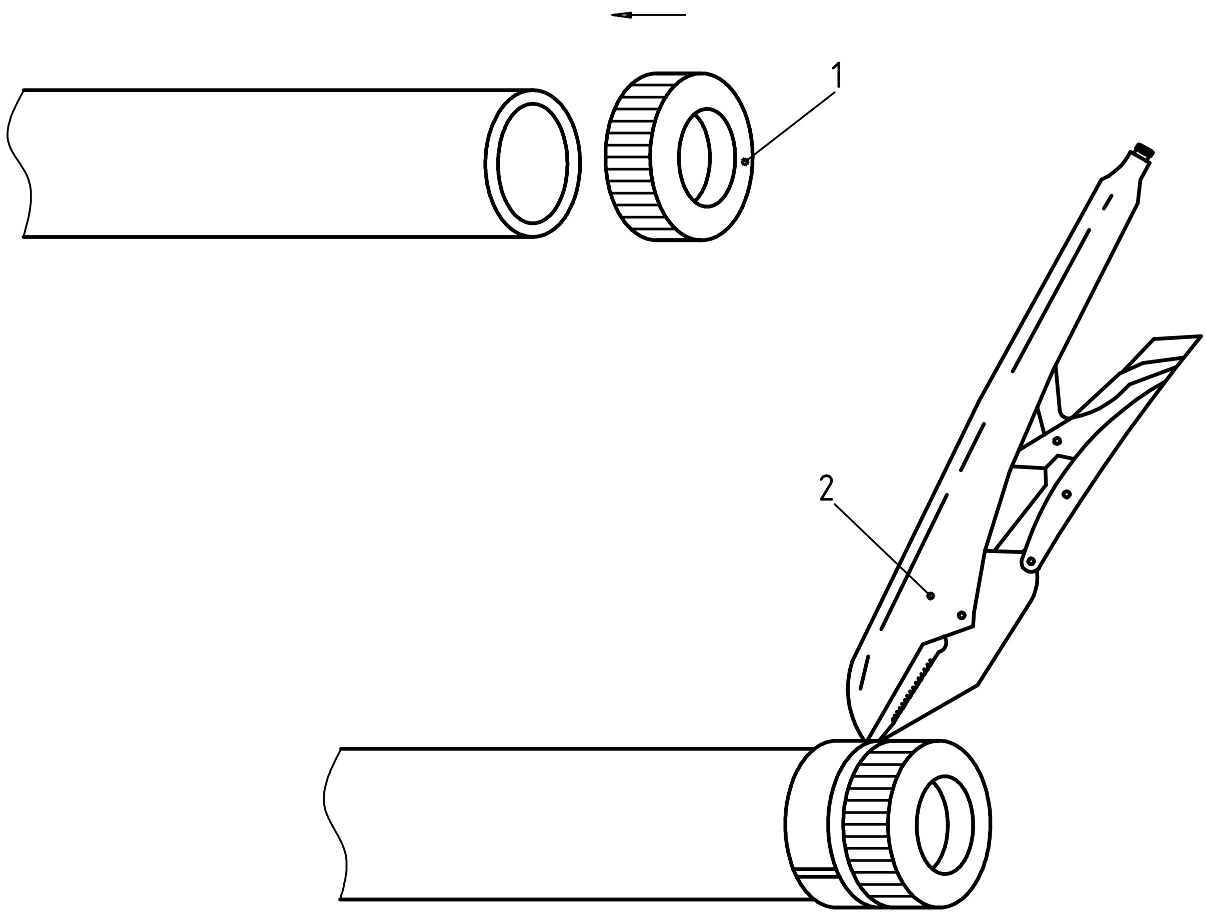
— Keep the joint in this position during the whole of the fusion time.

— Do not expose the joint to excessive stress until at least an additional 10 min cooling period has elapsed.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

— Store the heating tool in a protective enclosure when not in use.



Key

1 Depth gauge

2 Re-rounding tool

Figure 9 — Manual fusion-jointing tools

6.3.6 Saddle fusion

6.3.6.1 Principle

This technique consists of simultaneously heating both the external surface of the pipe and the external surface of a saddle until the polyethylene reaches fusion temperature, placing the saddle on the pipe and holding it in place until the joint has cooled.

Saddle fusion machines are recommended for all pipe dimensions to ensure high-quality joints.

6.3.6.2 Types of saddle fusion fitting

There are two types of saddle fusion fitting (see Figure 10):

— type I Saddles for branching off the side of a pipe;

— type II Saddles for branching off the top of a pipe (type II saddles can include an integral mains pipe cutter).

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

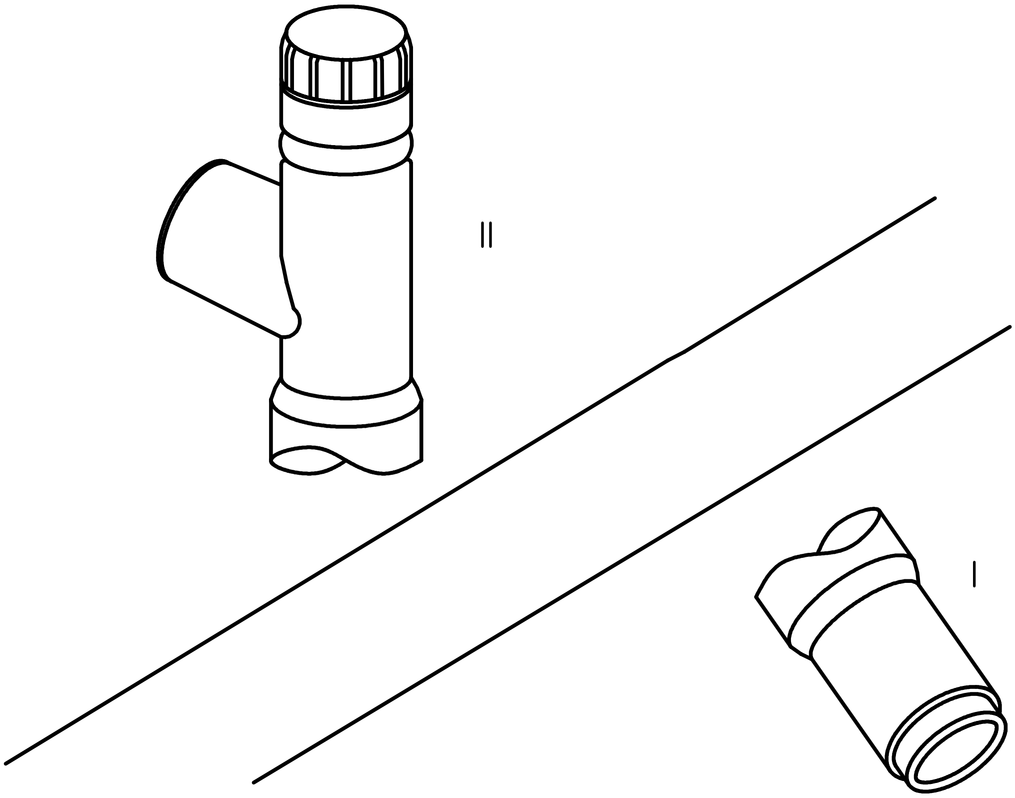


Figure 10 — Type I and II saddle fusion fittings

6.3.6.3 Saddle fusion parameters

The saddle fusion parameters, i.e. the heat soak time, pressure and temperature, the heating-tool removal time, the fusion time and the cooling period, shall be specified in the written procedure.

The saddle fusion parameters depend on the PE material used, the pipe diameter and the SDR value.

6.3.6.4 Saddle fusion jointing

The following procedure gives an overview of the minimum operations necessary to produce a saddle fusion joint:

— Check that the saddle fusion machine and its auxiliary equipment are compatible with the pipe diameter and fitting type.

— Prepare the fusion area by scraping a thin layer of material from the pipe (see Figure 11).

— Mount the fusion machine on the pipe and clamp the saddle in the fusion machine.

— Check that the entire fusion area of the saddle fits the pipe. Adjust, if necessary, the alignment of saddle and pipe.

— Clean the fusion surface of pipe and fitting.

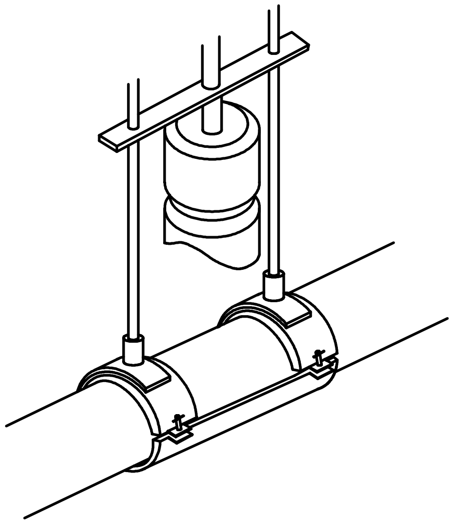
— If necessary, clean the fusion surfaces of the heating tool. Polyethylene residues shall only be removed with a wooden spatula.

— Check that the surface coating of the heating tool is intact and without scratches.

— Check that the heating tool is at the correct fusion temperature.

— Place the heating tool between pipe and fitting (see Figure 12).

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale



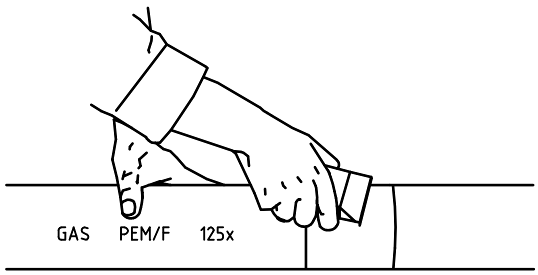


Figure 11 — Surface scraping

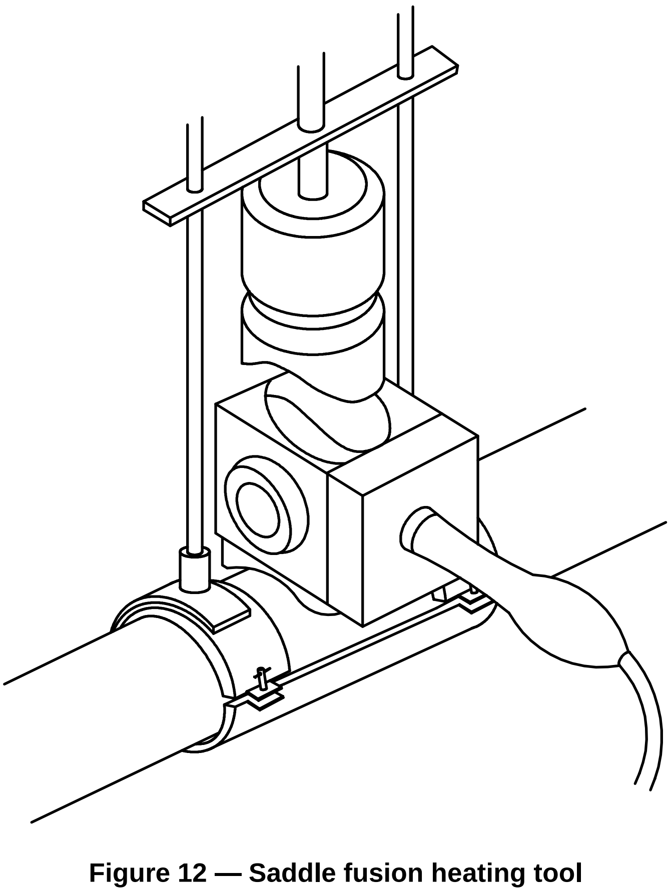


Figure 12 — Saddle fusion heating tool

— Close the fusion machine slowly and steadily until the prescribed heating pressure is reached. Hold the pressure during the whole of the heat soak time.

— When the heat soak time has elapsed, open the fusion machine and remove the heating tool. Check the heated areas quickly for possible damage and for uniform visual appearance and close the fusion machine again. The period between opening and closing shall be within the maximum time given in the jointing procedure.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

— Build up the specified fusion pressure and maintain it for the time specified in the jointing procedure.

— Remove the saddle fusion machine but do not expose the joint to excessive stress, for example by joining up the service line or tapping the main, until at least an additional 15 min cooling period has elapsed.

— Store the heating tool in a protective enclosure when not in use.

6.4 Electrofusion jointing

6.4.1 General

Electrofusion fittings include sockets, saddles, reducers, equal tees, unequal tees and bends.

The basic principle of joining such fittings by electrofusion consists of heating, using the Joule effect, an electrical coil incorporated in the internal surfaces (fusion surfaces) of the fitting, causing the material adjacent to the coil to melt and making the pipe and fitting surfaces fuse.

Electrofusion fittings can be used to join in-line and branch pipe or spigot fittings made from different types of polyethylene and from materials with different melt flow rates.

6.4.2 Temperature

The fusion operation may be carried out without any special precautions for variations in ambient temperature, provided these variations are within the limits specified in the jointing procedure. If some adjustment in the electrical power supplied to the fitting is necessary to cater for extreme ambient temperatures, the jointing procedure shall specify suitable electrofusion equipment.

6.4.3 Electrofusion equipment

The electrofusion equipment shall conform to ISO 12176-2.

As high-quality fusion joints cannot be made with fusion equipment in poor condition, maintenance of the fusion equipment is very important and shall be carried out on a regular basis.

As some types of fusion equipment are only suitable for use with fittings of a particular make and other types for use with electrofusion fittings of other makes, the jointing procedure shall specify the type of fusion equipment to be used.

The electrofusion control box is designed to provide, using an electrical power source (generator or domestic supply), the correct fusion parameters for the fitting, taking into account, if required, the ambient temperature. The fusion parameters are the applied voltage and/or current and the fusion time.

If a generator is used as the electrical power source, it shall be able to deliver the power required by the fitting, taking into account the electrical characteristics of the control box and the generator. Generators shall have suitable protection and security devices in accordance with relevant standards.

In some cases, the control box and generator may be available as a combined unit.

6.4.4 Electrofusion

6.4.4.1 Preparation

The following procedure gives an overview of the minimum operations necessary to prepare for electrofusion jointing:

a) General

Electrofusion fittings shall be kept in their protective wrapping until they are ready to be joined to a pipe or spigot fitting. The surfaces to be fused shall be dry before beginning the jointing procedure.

Ensure that the electrofusion fitting is suitable for use within the ambient temperature range and for the pipe or spigot fitting series or SDR value concerned.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Use re-rounding and alignment clamps for all types of electrofusion fitting to minimize pipe ovality, misalignment and movement during the jointing and cooling phases.

Scrape the outer fusion surface of the pipe or spigot fitting to remove oxidized material. Perform this operation with a suitable tool such as a manual or mechanical scraper. The use of a mechanical scraper is recommended. Scraping shall be performed round the entire circumference of the pipe or spigot fitting end. When using a saddle or tapping tee, scrape at least the fusion area of the pipe. The scraping depth shall be specified in the jointing procedure.

b) Electrofusion fittings with socket ends

Cut the pipe square to the pipe axis using either a plastic-pipe cutter or a fine-toothed saw with a cutting guide. Deburr the inside edges with a knife.

Scrape the fusion area of the pipe or spigot ends. If required and/or necessary, clean the fusion area.

Make sure that the penetration can be checked (for example by marking the penetration depth). Slide the socket fitting onto the spigot ends and locate it correctly.

If tie-ins are used (see Figure 13), push the full length of the electrofusion socket onto one of the pipe ends and, after clamping both pipe ends, push it back so that both pipe ends are covered. Check the depth of penetration of both pipe ends.

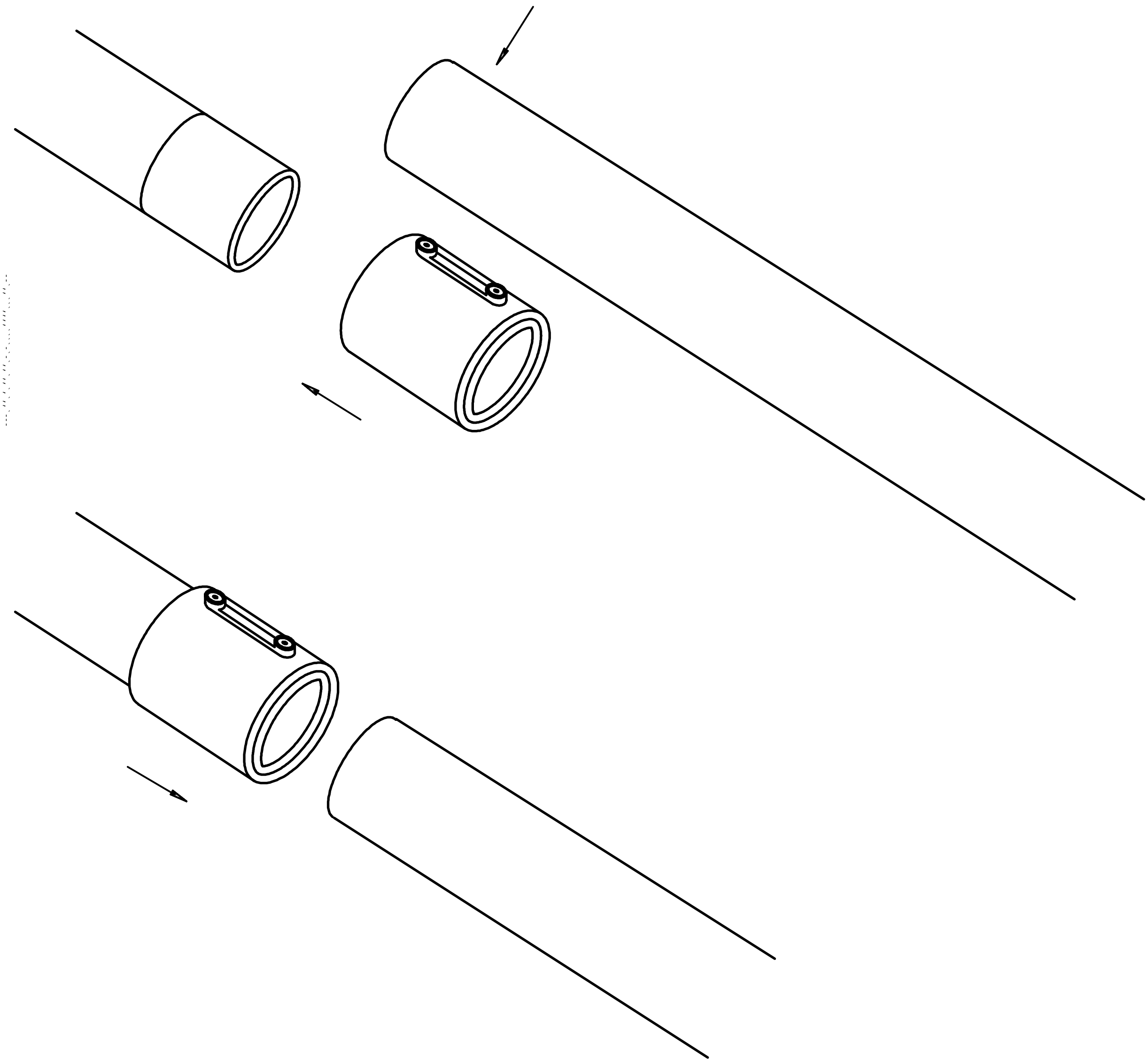


Figure 13 — Use of tie-ins

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Fit an alignment clamp and/or positioning clamp and check the alignment of the pipe ends.

c) Electrofusion saddle fittings

Scrape the fusion area of the pipe. If required and/or necessary, clean the fusion area.

Place the saddle on the pipe in accordance with the installation instructions. If required, put an assembly tool on the pipe and/or saddle in accordance with the fitting manufacturer's installation instructions (see Figure 14).

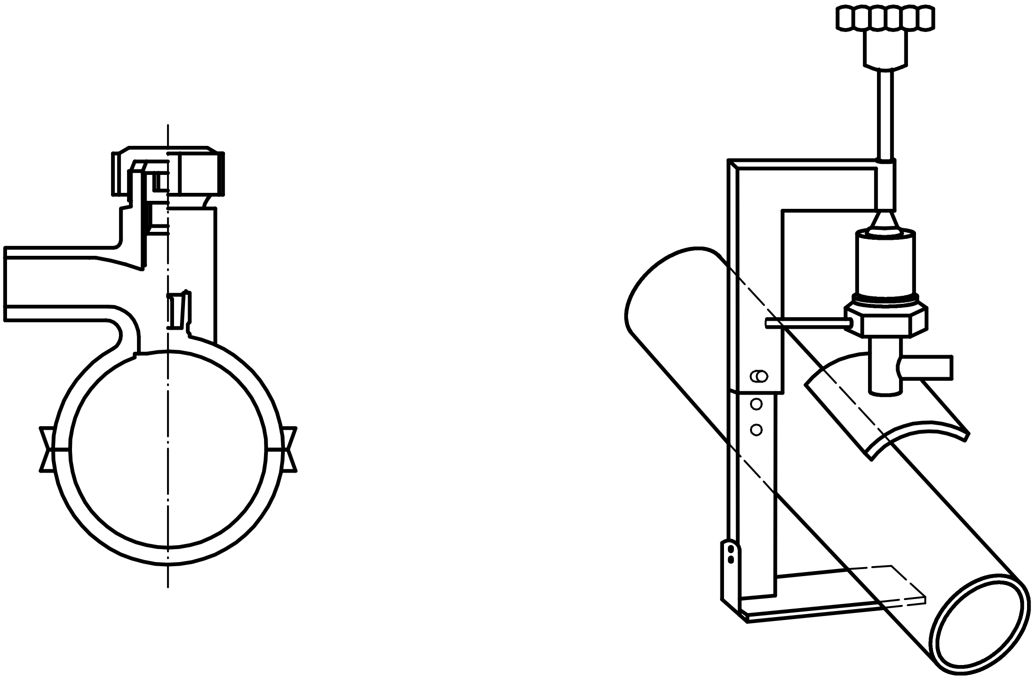


Figure 14 — Example of installation of a saddle

6.4.4.2 Electrofusion operation

Set the control box to give the correct fusion parameters (for example voltage or current, times).

In the case of an automatic process, use the procedure suitable for the fitting and the control box concerned.

Check that the fusion cycle has been completed correctly.

6.4.4.3 Cooling

Leave the joint clamped for the time required for it to cool. Cooling times are normally prescribed by the manufacturer and are given in the jointing procedure.

When the clamps are removed, the pipe shall be handled with care.

6.5 Mechanical jointing

All mechanical joints shall be resistant to end load as specified in ISO 10838-1, 2 or 3, as applicable.

The metal parts of fittings shall be corrosion-resistant or protected against corrosion.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

All mechanical joints shall be assembled as specified in the jointing procedure and in accordance with the manufacturer's instructions, the design pressure of the network and the materials used. The joint shall be assembled free of stress.

Mechanical jointing systems include:

a) polyethylene stub flanges with a loose backing flange;

b) steel stub flanges, pre-mounted to a polyethylene pipe, and with a loose backing flange;

c) pre-mounted steel-to-polyethylene transition fittings;

d) field-assembled steel-to-polyethylene transition fittings;

e) heat-shrinkable adhesive-bonded couplers with an internal wire heater;

f) compression-type couplings and fittings;

The polyethylene pipe shall not be weakened in the coupling and any lubricant used shall not be detrimental to the polyethylene pipe.

PE pipes shall not be threaded.

6.6 Laying

6.6.1 General

Care shall be taken to prevent damage to the pipes and fittings during the whole of the laying process.

Changes in direction of a polyethylene pipeline when laying can be made using pre-formed bends or elbow fittings or by making use, within limits, of the natural flexibility of the pipe. Natural flexibility may be used for bend radii $\geqslant 25 \times d_e$, and also for smaller radii for certain SDR values and materials provided this is consistent with operational experience and good engineering practice.

Machine-bending of pipes or bending after the application of heat shall not be used.

PE pipes, fittings and valves installed above ground shall be protected against mechanical interference and UV degradation.

When tightening or untightening a mechanical joint, it is essential that movement is not transmitted to the pipe.

The normal minimum clearance shall be $\geqslant$ 200 mm. If this minimum clearance cannot be observed, a protection barrier shall be installed. Special precautions shall be taken if the gas pipeline crosses or is laid alongside a hot-water or steam pipeline, a petrol-carrying pipe, a petrol station or a high-voltage cable.

The position of the pipeline shall be recorded before backfilling.

To minimize the possibility of damage to the pipeline by external influences, one of the following measures can be taken:

a) place a warning device, for example a hazard tape, along the top of the pipe;

b) place a tracer wire at the same depth as the pipe to enable the pipe to be located again in future;

c) install permanently visible above-ground markings, especially at road, railway and water crossings, at blow-off devices, on private land, at boundaries between plots of land, and at points where the pipeline changes direction.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

6.6.2 Trench

Excavating and backfilling of the trench shall be in accordance with the written procedure.

The width of the trench bottom shall be large enough to allow correct installation and backfilling.

If it should be necessary to perform any fusion jointing in the trench, the width of the trench may need to be larger, depending on the type of fusion jointing and the type of equipment used.

In uniform, relatively soft, fine-grained soils free of large flints, stones and other hard objects, and where the bottom of the trench can readily be brought to an even finish providing uniform support for the pipes over their whole length, it may be permissible to lay pipes of all nominal sizes without the need for special preparation of the trench bottom.

6.6.3 Drag forces

Pipes shall not be overstressed by tensile forces during laying. If the pipe is laid by drag, care shall be taken that the drag force is not greater than the values given by the following equation:

$$F = \frac{14\pi d_e^2}{3 \times \mathrm{SDR}}$$

where

F is the maximum drag force, in newtons;

SDR is the standard dimension ratio;

d_e is the external diameter of the pipe.

Stresses caused by differences in temperature between laying and operation shall also be taken into consideration.

6.6.4 Valves

Valves are available with either a steel or a plastics body. With steel-body valves, special precautions shall be taken against corrosion.

PE valves shall conform to ISO 10933.

Valves shall be installed so that they do not expose the PE pipe to unnecessary stress during opening or closing.

6.6.5 Connection to existing systems

Where there can be a release of gas in the working area, static-charge accumulation shall be avoided.

In order to avoid static charges, the pipeline system shall be connected to earth during manipulations, for example by draping water-soaked cloths made of natural fibre over all pipes and fittings likely to be handled so that the cloths touch both the pipe and the ground.

6.6.6 Backfilling

Unless otherwise specified, buried pipelines and casings shall have a minimum soil cover of 0,6 m. Exceptions may be made for pipes entering metering or regulating boxes, but such pipes shall be protected against external interference. Greater soil cover shall be provided in areas of deep ploughing, drainage, roads with heavy traffic, and railway or waterway crossings.

Excavated materials may be used as backfill provided that they are free from stones and sharp objects likely to damage the pipe. If not, imported backfill may be used.

NOTE Attention is drawn to the need to take account of any applicable national or local regulations concerning backfill materials.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

The pipe shall be uniformly supported;

Material around the pipe shall be compacted so as to avoid excessive pipe ovality. This shall be done layer by layer.

6.6.7 Pressure testing and commissioning

Pressure testing and commissioning shall be in accordance with EN 12327.

The test pressure selected for a pipeline shall be appropriate to its MOP.

NOTE It may be necessary to take into account national regulations concerning pipeline pressures.

Consideration shall be given to the need for any special precautions to be taken to protect persons and property if air or inert gas is used as the test medium.

For test temperatures below 0 °C, the possibility of a reduction in critical RCP pressure shall be taken into account in the pipeline preparation and test procedure adopted.

Pressurized PE pipelines at ambient temperature are subject to expansion by creep that could affect the results of pressure testing. At higher test pressures, this effect can be significant. Appropriate allowance shall be made for pressure losses due to creep when interpreting pressure test results.

If air is used, oil from the compressor shall be prevented from entering the pipeline and the air temperature shall not exceed 40 °C, to prevent damage to the pipes and/or fittings.

7 Storage, handling and transport

7.1 General

Polyethylene pipes are available in coils, drums or straight lengths. Fittings are normally individually packed.

Mishandling of the pipes and fittings shall be avoided. Since polyethylene pipes are relatively soft, poor handling techniques may result in gouges, scratches, cuts or holes (see 8.3.1).

7.2 Storage

Straight pipes shall be stacked on a reasonably flat surface free from stones or other projections or sharp objects likely to deform or damage the pipes. Pipes and fittings shall be stored in such a way as to minimize the possibility of the material being damaged by crushing, piercing or extended exposure to direct sunlight.

Pipes may be stored outside in direct daylight provided the storage time is monitored and minimized to avoid exposure to excessive levels of UV radiation likely to impair the properties of the product relative to its “as purchased” condition. Maximum permissible storage times will vary depending upon geographical location, for example in Northern Europe a 2-year outside-storage time would be considered acceptable, whilst storage at sites exposed to strong UV light could require exposure limits as low as 3 months. Guidance from the product manufacturer should be sought to establish local requirements. Care shall be taken during the storage of PE pipes with protective coatings to avoid coating damage and increased vulnerability to UV attack.

The distances x between support frames holding packs of pipes together shall be equal in order to allow the frames to be stacked (see Figure 15).

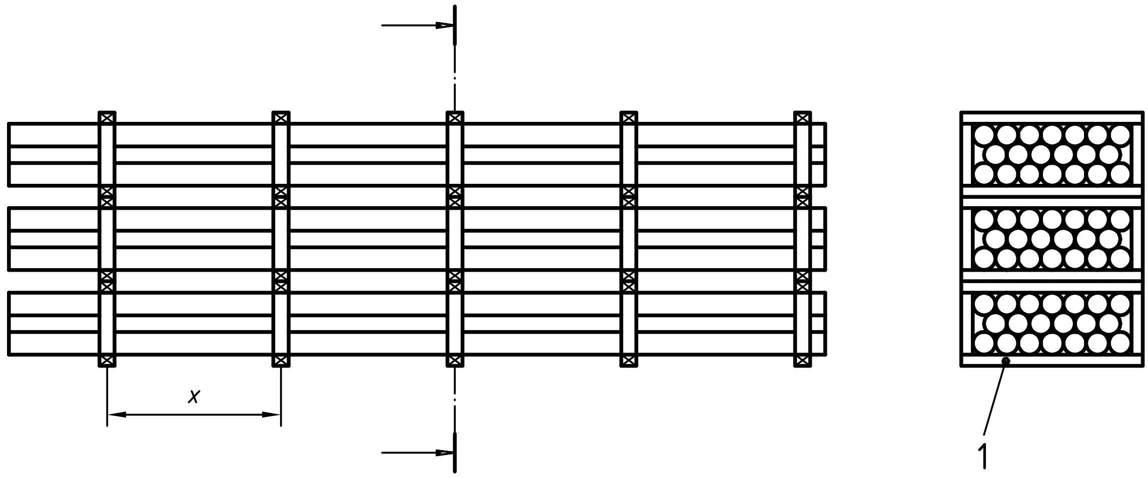
Straight pipes shall rest evenly over their whole length.

The support frame shall not be nailed together and shall be constructed in such a way that the load is directly supported by the frame and not by the pipes.

--`,,```,,,,````-`-`,,`,,`,`,,`---

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale



Key

1 Support frame

Figure 15 — Support frame

The exact height to which straight pipes can be stacked depends on many factors such as material, size, wall thickness and ambient temperature. At no time shall stacking cause the pipe cross-section to be distorted. The manufacturer's stacking recommendations shall be followed.

Polyethylene pipes may be coiled or wound on drums. Coils of large-diameter pipes with $d_e \geqslant 110$ mm shall be stored vertically in purpose-built racks or cradles. Consideration shall be given to providing facilities which avoid single-point contact between the coils.

Where individual pipe lengths and coils are stacked in pyramidal fashion, deformation may occur in the lower layers, particularly in warm weather. Therefore, such stacks shall not exceed a height of 1 m.

Fittings shall be stored in their original packing until ready for use.

Contact with aggressive reagents or solvents shall be avoided.

In general, most manufacturers store polyethylene pipes outside prior to shipment. The exposure time can be minimized by shipping from the store on a “first in, first out” basis with the extrusion date used as the control. The pipes with the earliest extrusion date shall be shipped first for installation. Pipes which have been stored outside for longer than the period recommended shall only be used if tested prior to installation for conformity with ISO 4437.

It is recommended that the same “first in, first out” principle be used with fittings.

7.3 Handling

Do not drag or throw the pipes along the ground. If handling equipment is not used, choose techniques which are not likely to damage the pipes and/or fittings.

The flexibility of polyethylene pipes is reduced in cold weather, and more care needs to be taken when handling them in winter. If the temperature falls below – 15 °C for straight pipes and for fittings, or below 0 °C for coiled pipes, special handling instructions shall be followed.

Initial handling and storage of straight pipes shall be made with the pipes in packaged form, thus minimizing damage during this phase. When loading, unloading or handling, it is preferable to use mechanical equipment to move or stack the packs.

Coils of pipe stacked on pallets are easily handled using a forklift truck. Individual coils shall not be rolled off the edge of a vehicle load platform. Coils shall be slung individually when off-loading with a crane. Personnel shall not be required to climb on to a lorry or trailer during slinging operations.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

In view of their mass, drums shall be handled with the assistance of mechanical equipment. Care shall be taken during this operation since the mass of a loaded drum may be from about 1 000 kg to about 2 000 kg.

Before laying a pipe, ensure that the drum is positioned correctly and that its axle will remain stable during the unrolling operation.

While unrolling, check the speed of rotation and ensure that the pipe is not damaged.

If the pipe has already been unrolled, be careful when cutting off the required length at the bent section near the drum, especially at low temperatures.

7.4 Transport

When transporting straight pipes, flatbed vehicles with a partition shall be used. The bed shall be free from nails and other protuberances. The pipes shall rest uniformly on the vehicle over their whole length. The vehicle shall have side posts which are flat with no sharp edges. During transport, the pipes shall be securely held in such a way that movement between the pipes and the posts is minimized.

Coiled pipes shall be transported on a pallet or as individual coils, depending on the diameter. The coils shall be firmly secured to the vehicle.

The height of the top of a drum when loaded on a vehicle shall be checked against the heights of any bridges, tunnels and other overhead obstructions which the vehicle will encounter on its route. Drums shall be firmly secured to the vehicle.

8 Quality control

8.1 General

The pipes, fittings and associated equipment shall be inspected to confirm the conformity with the laying procedure.

The inspection may be carried out by the personnel engaged in jointing. Additional inspections shall be carried out by a competent person at a frequency depending on the conditions of use. The results of each inspection shall be recorded.

Destructive testing on joints made in the field may also be carried out to ensure that the quality conforms to the jointing procedure.

8.2 Inspection prior to laying

Pipes, fittings and associated equipment shall be inspected prior to laying to confirm conformity with the required ISO standard, pipe and fitting diameters, SDR and MRS and tolerance class as given by the pipe and fitting marking information.

Pipes and fittings showing obvious defects or excessive scoring shall be discarded, clearly identified as unsuitable, and, where appropriate, returned to the source of supply.

Limitations on outside storage of pipes or fittings shall not have been exceeded.

The equipment used shall be in accordance with the relevant standards. A written jointing procedure shall be available.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

8.3 Inspection during laying

8.3.1 Laying

Soil and trench conditions shall conform to the written procedure.

If surface defects with a depth of more than 10 % of the nominal wall thickness are found, the section concerned shall be cut out or repaired in accordance with the relevant procedure.

Inspection during the laying of pipelines and the construction of associated installations shall include the following:

a) inspection of the pipes for serious surface defects immediately prior to and during laying;

b) inspection of the trench to ensure that it is the correct depth and width and that it provides the minimum clearance with respect to other buried structures;

c) inspection of the bottom of the trench immediately prior to lowering the pipeline into place and during backfilling of the trench to ensure that the pipeline is not damaged by sharp objects, such as stones or pieces of metal;

d) inspection during the lowering of the pipeline into the trench to ensure that this takes place correctly, that no damage occurs and that the pipeline is placed in the correct position.

8.3.2 Joint integrity

8.3.2.1 General

The quality of the joint depends on strict adherence to the written jointing procedure, the use of well maintained equipment conforming to the relevant standard and the competence of the operators.

Quality control shall be performed on site by the persons involved in the work concerned. Further, supervision and inspection may be carried out by a supervisor who shall guarantee the quality of the work performed and in addition provide a quality control report.

8.3.2.2 Visual inspection criteria

8.3.2.2.1 Butt fusion joints

8.3.2.2.1.1 Bead symmetry

Joints shall have a smooth symmetrical bead around the entire pipe circumference as shown in Figure 16. The depth A of the bead depression shall not extend below the pipe surface.

An asymmetrical bead profile between the same components shall initially be considered as indicative of poor joint quality subject to a confirmation assessment by an authorized person. The effect on bead symmetry of differences in melt flow rate (MFR) between the parts to be joined shall be considered in the secondary assessment.

Where the pipes and/or fittings have different MFRs, the bead may be asymmetrical but still satisfactory. In assessing the results of the joint tests under standard conditions, acceptable levels of asymmetry shall be determined.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

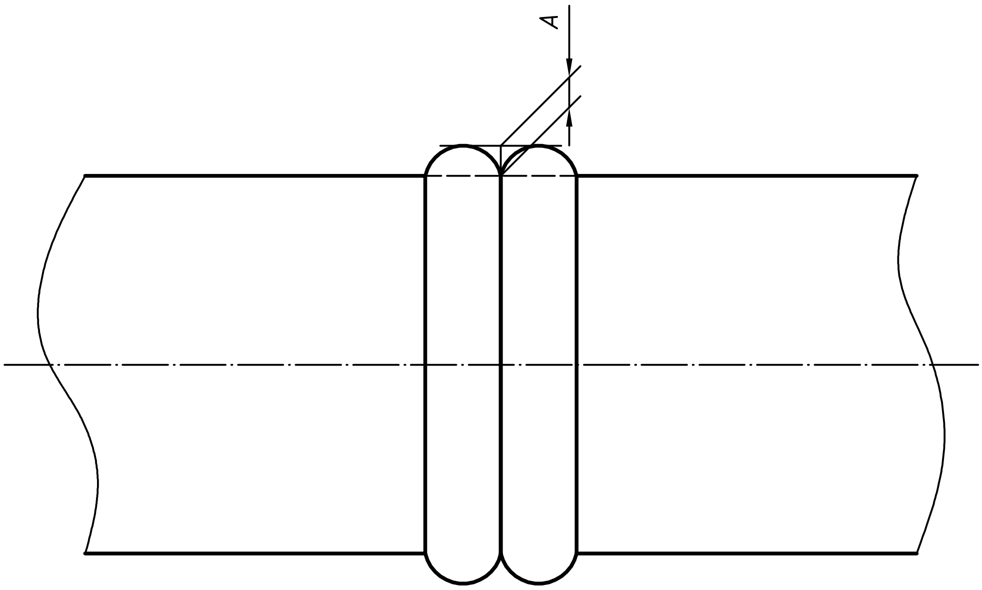


Figure 16 — Bead symmetry

8.3.2.2.1.2 Alignment

Pipes, fittings and valves shall be as closely aligned as possible.

The misalignment V shall not exceed 0,1e_n (e_n = is the nominal wall thickness). Where this leads to values of less than 1 mm, testing of joints shall be undertaken to identify the maximum allowable misalignment (see Figure 17).

This value shall not be exceeded anywhere around the circumference of the two parts adjacent to the fusion bead.

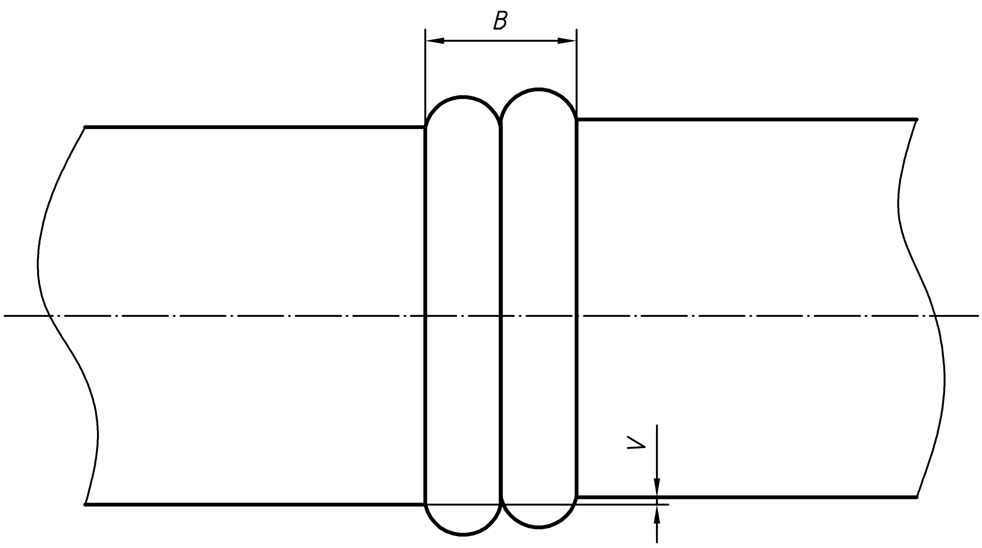


Figure 17 — Alignment

8.3.2.2.1.3 Bead width

The bead width B (see Figure 17) is influenced by the type of PE material, the production process (extrusion or injection moulding), the type of heating plate used, its temperature and the fusion cycle used. Consequently, it is difficult to specify a single set of bead width values. It is however a good indicator that the specified jointing procedure has been followed.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

One method of determining an acceptable bead width value B is experimentally, using pipes and a butt fusion machine operating at the specified conditions. The mean value B_m is determined from several joints made under the conditions defined in the jointing procedure. It is recommended, for quality control purposes on site, that the measured bead width B does not exceed ± 20 % of B_m.

The use of GO/NO-GO gauges, manufactured to these recommended limits, could facilitate checking (see Figure 19).

8.3.2.2.1.4 Bead removal

Removal of the external fusion bead, using appropriate tools, is possible without damage to the pipe (see Figure 18). The removed bead is then available for inspection.

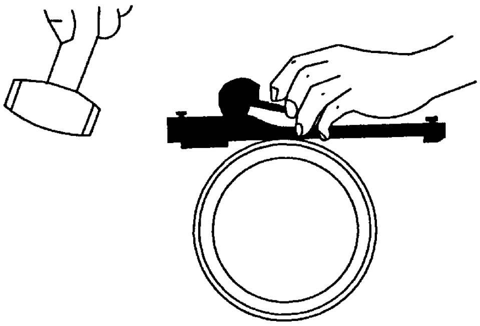


Figure 18 — Bead removal

Bead gauges may be used to assess the bead width (see Figure 19). A visual examination of the underside of the bead may be undertaken. Evidence of contamination, holes, offset or damage by molten material shall be cause for rejection.

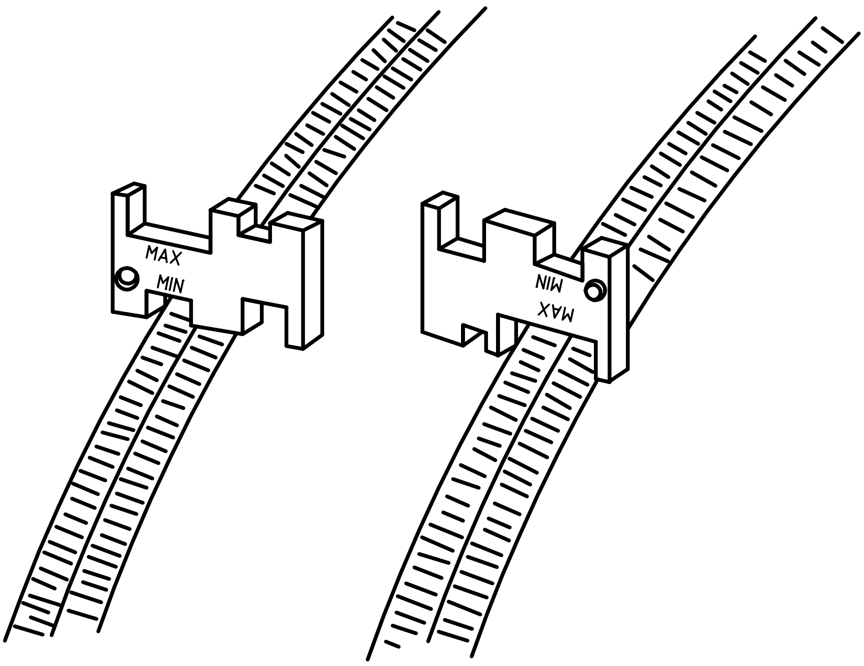
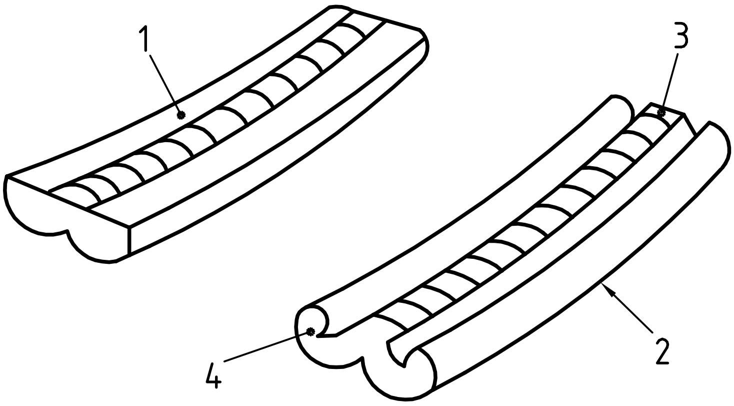


Figure 19 — Bead gauges

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

The bead shall be solid and rounded, with a broad root, as shown in Figure 20. Hollow beads with a thin root and curled appearance may have been formed with excessive pressure or no heat soak.



Key

1 Correct bead root
2 Rejected bead root
3 Thin root
4 Curling

Figure 20 — Bead root

A bend-back test (see Figure 21) shall be made every few centimetres to examine for the presence of slit defects. Slit defects are indicative of fine-dust contamination within the fusion interface, possibly arising from contact with a dirty heating plate.

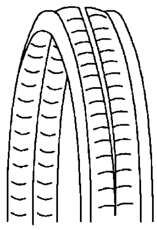


Figure 21 — Bend-back test

8.3.2.2.2 Electrofusion socket joints

8.3.2.2.2.1 Pipe alignment

A check shall be made that the pipes and fittings have been properly aligned in conformity with the written jointing procedure.

Guidance on permissible misalignment is given in ISO 11413.

8.3.2.2.2.2 Scraping

A check shall be made that scraping in accordance with the written jointing procedure has been carried out over the entire circumference of the pipe (see Figure 22).

There shall be clear evidence of scraping on either side of the socket. Particular attention shall be given to inspecting the underneath of the pipe.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

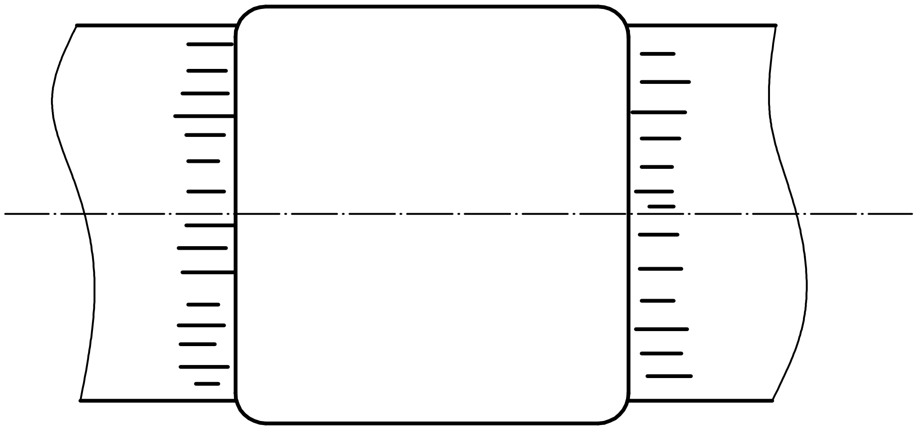
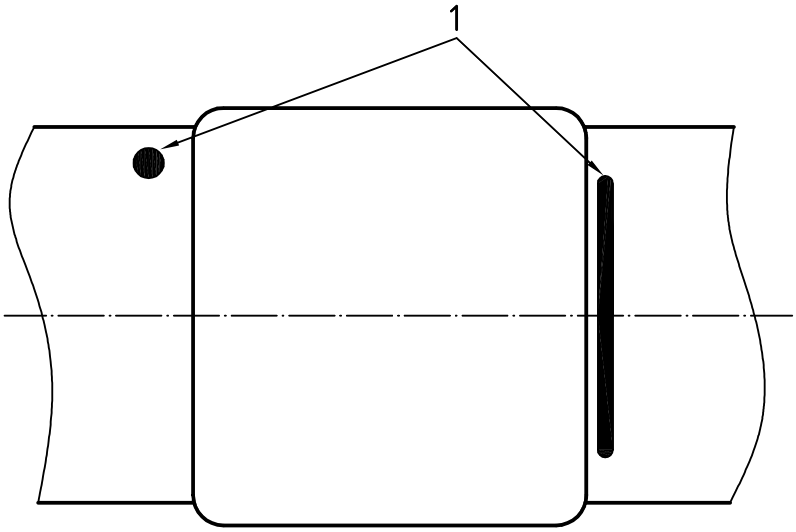


Figure 22 — Scraping

8.3.2.2.2.3 Penetration

Penetration markings shall be checked to confirm that complete penetration of the pipe or spigot ends has been achieved (see Figure 23).



Key

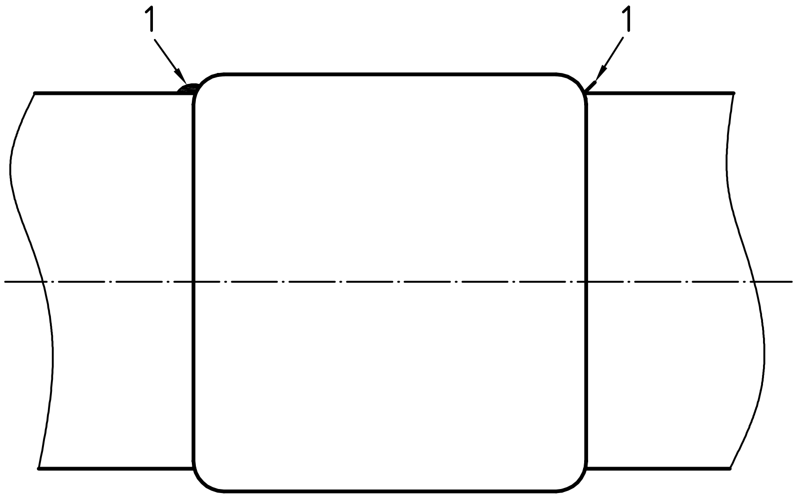
1 Penetration markings

Figure 23 — Penetration markings

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS Not for Resale

8.3.2.2.2.4 Molten material

A check shall be made that molten material from the fusion process or fusion wires has not exuded out from inside the fitting (see Figure 24).



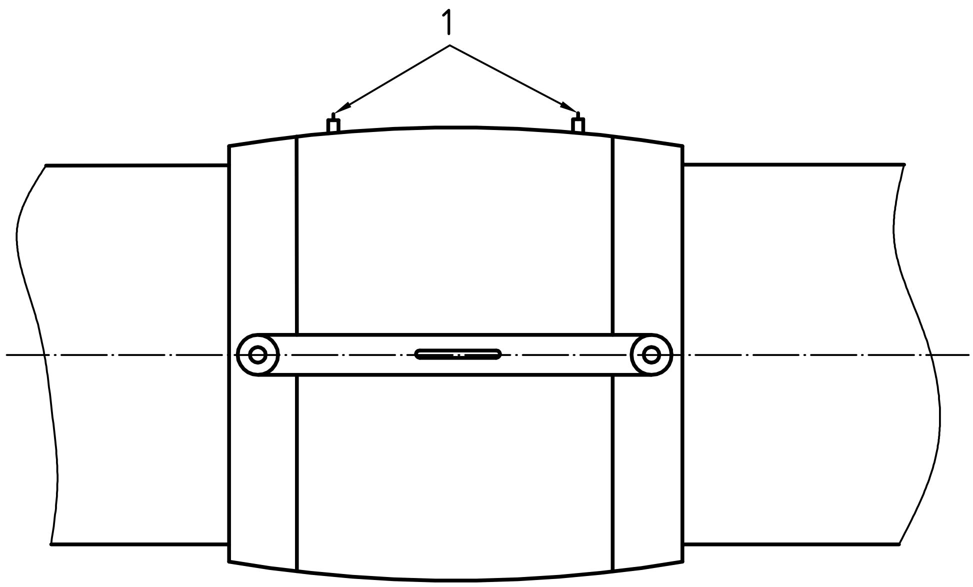
Key

1 Exuded molten material

Figure 24 — Molten material

8.3.2.2.2.5 Heating indicators

If the fitting is designed with heating indicators, they shall be in positions complying with the manufacturer's instructions after jointing has been completed (see Figure 25).



Key

1 Heating indicators

Figure 25 — Heating indicators

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

8.3.2.2.2.6 Cooling time

The clamps shall not be removed before the cooling time has elapsed.

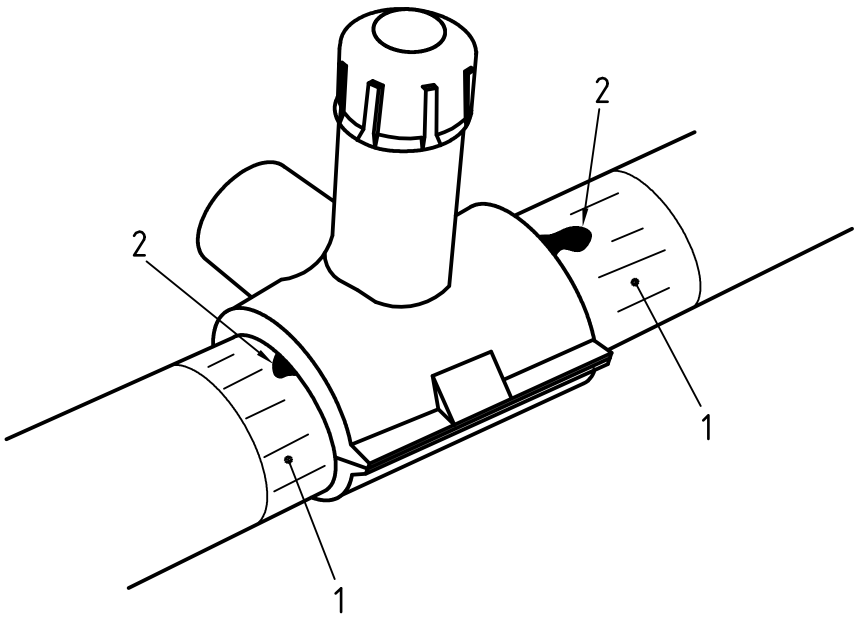
8.3.2.2.2.7 Position of electric wiring

Following fusion jointing, the electric coils shall not show any abnormal displacement.

8.3.2.2.3 Saddles and tapping tees

8.3.2.2.3.1 Scraping

A check shall be made that scraping has been carried out in accordance with the written jointing procedure over the entire fusion area (see Figure 26). When the fusion area includes the entire circumference of the pipe, particular attention shall be given to inspecting the underneath of the pipe.



Key

1 Scraping
2 Exuded molten material

Figure 26 — Checking saddles and tapping tees

8.3.2.2.3.2 Further visual checks

The stack of the saddle or tapping tee shall be perpendicular to the centreline of the pipe.

The pipe wall shall show no signs of collapse.

Nowhere shall molten material from the fusion process have exuded out from inside the fitting (see Figure 26).

8.3.2.2.3.3 Heating indicators

If the saddle or tapping tee is designed with heating indicators, they shall be in positions complying with the manufacturer's instructions after jointing has been completed.

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

8.3.2.2.3.4 Cooling time

When a special clamp is required for saddles or tapping tees, it shall not be removed nor the joint disturbed before the specified cooling time has elapsed.

8.3.2.2.3.5 Ancillary tooling

The use of ancillary tooling, such as pipe clamps, shall not result in significant damage to pipe surfaces adjacent to the joint.

8.3.2.2.4 Socket and saddle fusion joints

8.3.2.2.4.1 Scraping

A check shall be made that scraping has been carried out in accordance with the written jointing procedure over the entire fusion area of the pipe. There shall be clear evidence of scraping on either side of the socket and around the saddle fusion area. Particular attention shall be given to inspecting the underneath of the pipe.

NOTE Scraping is not required for type B socket fittings.

8.3.2.2.4.2 Alignment

Pipes and socket fittings shall be properly aligned in conformity with the written jointing procedure.

The stack of a saddle fitting shall be perpendicular to the centreline of the pipe.

8.3.2.2.4.3 Appearance of fusion bead

Molten material squeezed out from between a socket fitting and pipe and either flattened by the pipe clamp (type A fittings) or in the shape of two or three beads (type B fittings) shall be uniform in size over the entire circumference.

Evidence of the use of fusion-jointing equipment can be obtained by checking for the obvious marks that fitting clamps leave behind in the flattened bead.

An asymmetrical bead profile shall initially be considered as indicative of poor joint quality, subject to a confirmation assessment by an authorized person.

8.3.2.2.4.4 Inclusions and damage

The fusion area shall not show any inclusions, porosity, cracks or other damage.

The surface of the fusion area shall show no evidence of exposure to excessive temperatures.

8.3.2.2.4.5 Internal defects

Defects such as collapse of the pipe wall due to too high a fusion temperature or fusion pressure, too large fusion beads or incorrectly shaped fusion beads, which restrict the flow in the pipe, can only be inspected during the construction of the main.

Any indication of such defects shall initially be considered as indicative of poor joint quality, subject to a confirmation assessment by an authorized person.

8.3.2.2.5 Mechanical fittings

Mechanical joints shall be visually inspected following procedures approved by the pipeline operator.

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Annex A
(informative)

Derating coefficients for various operating temperatures

Table A.1 gives derating coefficients for various operating temperatures.

Table A.1 — Temperature derating coefficients

Average temperature	Derating coefficient, D_F
10 °C	0,9
20 °C	1,0
30 °C	1,1
40 °C	1,3

For intermediate temperatures, interpolation is permitted. When using a derating factor of 0,9, the overall service (design) coefficient C should not be less than 2 when calculated from the following equation:

$$C = \frac{20 \times \text{MRS}}{D_F \times \text{MOP} \times (\text{SDR} - 1)}$$

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

Annex B
(informative)

Average UV radiation levels for Europe

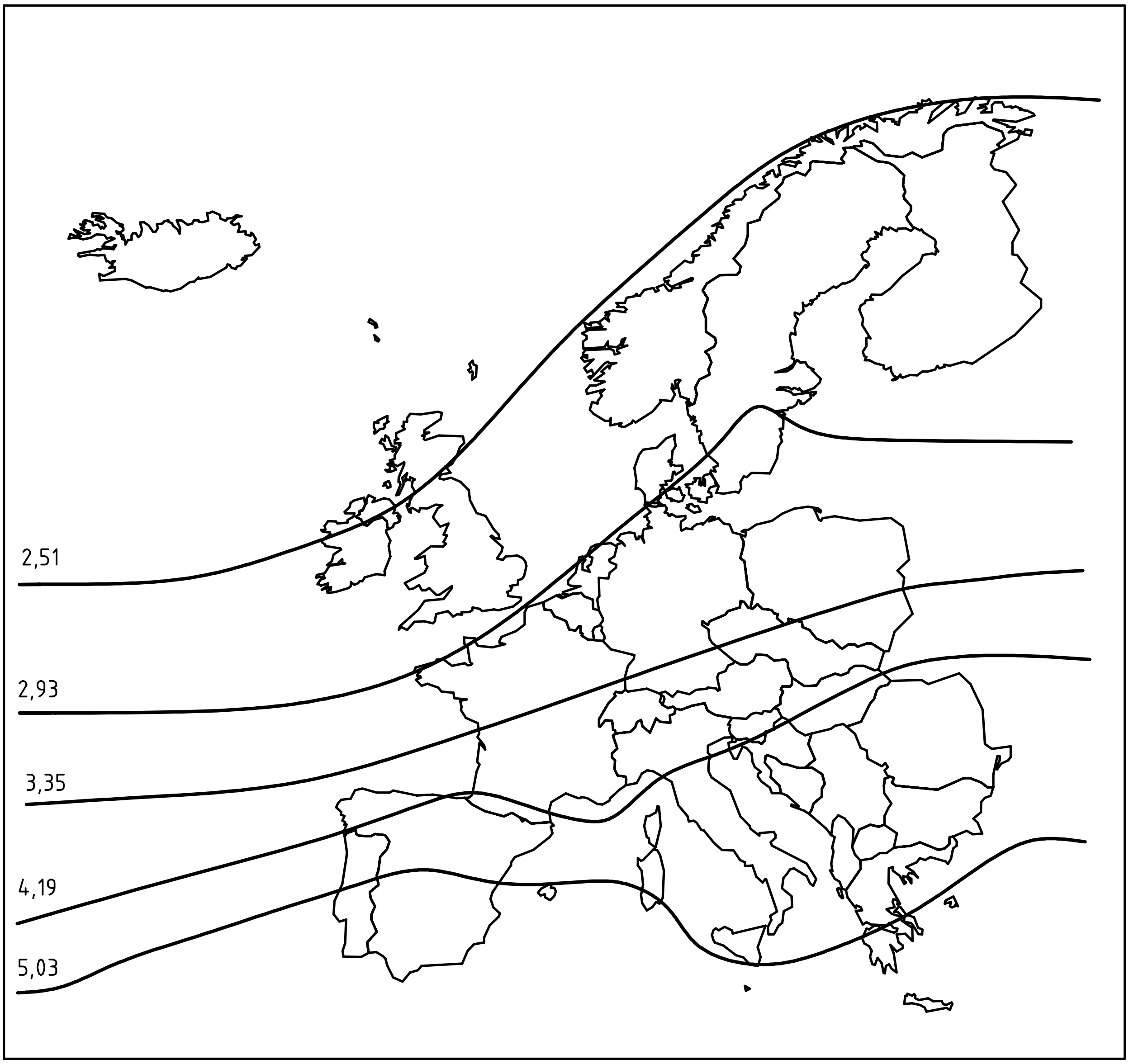


Figure B.1 — Average UV radiation levels in GJ/m²/year

© ISO 2000 – All rights reserved
Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale

ICS 75.200

Price based on 34 pages

© ISO 2000 – All rights reserved

Copyright International Organization for Standardization
Provided by IHS under license with ISO
No reproduction or networking permitted without license from IHS
Not for Resale