



With Akatherm we have over 50 years of experience in drainage systems, focussing on innovation, quality and dedication.

Our specialist plumbing solutions are suitable for applications in the commercial and industrial building sector.

We offer international certification, full training, unique products and the service standards you would expect from high performance drainage experts and the worldwide backing of the Aliaxis group.

In this specification manual you will find the complete Akatherm polyethylene (HDPE) drainage product range. In addition to pipes, fittings, connection fittings, traps and sanitary fittings, you will find our products for electrofusion and laboratory fittings. This manual includes technical details of our complete drainage program. It will assist you with material properties and the application and design of HDPE drainage systems.



Information and safety recommendations

Validity

This Akatherm HDPE specification manual 2023 is valid from 2023. With the release of this edition all previous specification manuals are no longer valid. The latest valid technical information can be obtained at your Akatherm HDPE wholesaler, the Aliaxis export office and can be downloaded from www.akathermhdpe.com.

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This Specification Manual is produced with extreme care. All measurements and weights are approximate and errors and changes are reserved. Aliaxis Nederland B.V. does not accept any liability for damage caused by omitted or incorrectly referenced data in this manual.


Important information and pictograms

This manual contains pictograms to emphasize important or beneficial information:

 Important information to take into account.

 Consult the Akatherm HDPE sales office.

 Akatherm HDPE benefit.

 Additional information.

Safety and operating instructions

- Akatherm HDPE products may only be installed by professionals sufficiently trained in installing HDPE soil and waste systems.
- Read the safety and operating instructions for your own safety and the safety of others carefully and completely before start of installation.
- Store the operating instructions and keep them available.
- If the safety instructions or operating instructions are unclear, please contact the Akatherm HDPE sales office.
- The operating instructions and suggestions for use and safety are non-binding and do not in any way replace legal or other regulations, such as employer's liability insurance association regulations in the respective countries.

Recycling

HDPE pipes and fittings are 100% recyclable. Left over materials should be recycled as follows:

- Remainder pipe: residual waste
- Remainder fittings: residual waste
- Cleaning cloths: residual waste
- Wooden crating: recycled wood
- Carton boxes: recycled paper

Disclaimer

The instructions, specifications and guidelines in this manual apply only to Akatherm HDPE products described in this manual. Applications not covered in this Specification Manual (special applications) require consultation with our Technical Department. For specific advice consult the Akatherm HDPE sales office.

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1 System information

1.1 Intended Use

Akatherm HDPE is a durable and tough soil & waste drainage system, designed to be installed in accordance with EN12056 'Gravity drainage systems inside buildings'. The excellent characteristics of high density polyethylene makes it suitable for a wide range of applications. Akatherm HDPE is available in nominal diameters d40 to d315 mm with a full range of pipes, a comprehensive range of fittings including connection fittings, sanitary fittings, traps and tools.

1.2 Applications

Akatherm HDPE is designed to be installed in accordance with EN12056 and thereby meets the requirements for use in residential, commercial and public buildings.

Akatherm HDPE is a non-pressure drainage system, not intended for pressure applications.

Akatherm HDPE has a high temperature and chemical resistance which makes it ideal for drainage in:

- Residential housing
- Commercial kitchens
- Laundries

It is flexible and tough for installation:

- Underground
- Embedded in concrete
- In bridges and roads

Its closed system is perfect for applications where system integrity connections are critical like in:

- Storm water drainage
- Trade waste
- Industrial applications and laboratories
- Ceiling voids and hard to reach places

Furthermore Akatherm HDPE is a light weight plastic system, highly suited for prefabrication. It allows you to aim higher and answering all challenges of modern building design.

Application parameters

The pipes, fittings and seals can be used up to 80°C continuously. Exposure to temperatures up to 100°C is only allowed for a duration of 1 minute up to 400 times a year.

For a complete overview refer to the lifetime expectancy chapter. Akatherm HDPE is suitable for the drainage of chemically aggressive waste water with a pH value of 2 (acidic) to 12 (basic) by default. For installations in applications not listed in this manual or with chemicals not listed in the chemical resistance list of this manual, please contact your local Aliaxis for further advice. More information at www.akatherm.com.

Behavior in fire corresponds to B2 normal combustibility according to DIN 4102. When an HDPE pipe system passes through fire-rated building elements, it is mandatory to install fire protection collars that will not reduce the fire-rating of these building elements.

1.3 HDPE pipe, fittings and tools

Pipe

The Akatherm HDPE tempered pipes are produced according to the standard EN 1519. Akatherm HDPE pipe specifications ensure that pipe has minimal shrinkage when cooled down from high operational temperatures. This gives less stress on joints resulting in a longer life of the pipe systems.

The Akatherm HDPE pipes are suited for applications where the temperature of the pipe can get relatively high or vary considerably. Both can be caused by ambient temperature or temperature of the medium.

Akatherm HDPE pipe has a standard length of 5 m and is produced according to high quality standards with many international approvals.

Fittings

Akatherm HDPE fittings are high quality injection moulded products produced by Akatherm BV in The Netherlands under ISO9001 quality management. Prefabricated product exceptions are clearly listed in the product tables.

Akatherm offers a complete wide range of fittings including:

- Reducers
- Bends
- Elbows
- Branches
- End caps
- Electrofusion couplers
- Mechanical connection fittings
- Sanitary Fittings
- Traps
- Spare parts

All required fixing material for wall and ceiling construction is available from Aliaxis Nederland B.V. as well.

All Akatherm HDPE fittings are electrofusible, exceptions are clearly listed in the product tables.

In some situations, it is necessary to shorten fittings. Fittings with the dimension "k" included in the product table can be maximally shortened by the "k" dimension in order to still allow for butt-welding using a standard butt-welding machine. The k-dimension of the relevant spigot of most fittings is listed in the product tables.

The fittings are dimensionally standardized to improve prefabrication repetition work and to facilitate welding alignment. Each fittings contains a graduated arc at 15° intervals.

Marking

Akatherm Pipe and fittings are marked with:

- Akatherm brand
- Material type
- Nominal diameter
- Area of application
- Conformity of dimensions
- Information on approvals
- Information on recycling
- Production information
- Wall thickness (pipe only)
- EAN barcode (fittings only)
- Angle indication (fittings only)

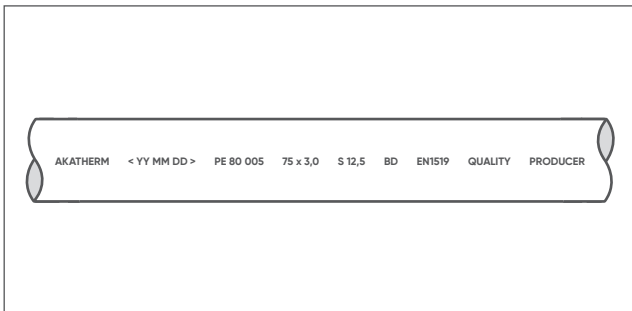


Illustration 1.1 marking on pipe

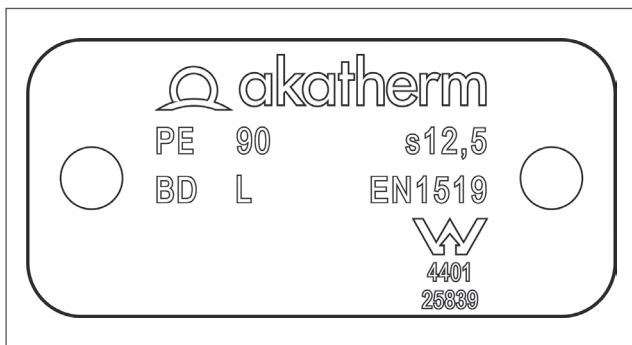


Illustration 1.2

Tools

Akatherm offers a full range of tools to be used for installation of HDPE:

- Electrofusion control boxes
- Butt-welding machines
- Manual butt-welding plates
- Pipe cutters
- Pipe and fittings scrapers
- PE cleaner and marking pencils

Refer to the chapter 'Tools' in the product tables.

2 Material properties and application limitations

Polyethylene (PE for short), is a semi crystalline thermoplastic and is a generic term for many variations of the polymer. The most common are:

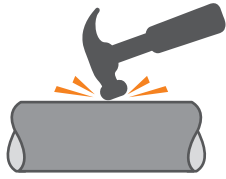
- LDPE (density: 0,9 - 0,91 g/cm³)
- MDPE (density: 0,93 - 0,94 g/cm³)
- HDPE (density: 0,94 - 0,965 g/cm³)

Aliaxis Nederland B.V. uses High Density Polyethylene (HDPE) for its products. The mechanical characteristics (elasticity, and stiffness) are important for the production of our pipes and different fittings. HDPE has a high resistance to damage from acids, bases and aqueous salt solutions. HDPE also has good resistance against light ionised radiation without becoming radioactive itself. The properties and benefits of Akatherm HDPE are highlighted in table 2.1 and 2.2.

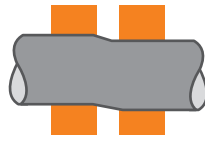
Property	Unit	Test method	Value
Density at +23°C	g/cm ³	ISO 1183	0,954
Elasticity modulus (secant betw. 0,05% and 0,25% expansion)	N/mm ²	ISO 527	850
Tensile creep modulus 1 hr. value 1000 hrs. value	N/mm ²	ISO 899	640 300
Bending creep modulus 1 min. value	N/mm ²	DIN 54852-Z4	1000
Tensile strength	N/mm ²	ISO 527 Test speed 50 mm/min	22
Elongation at break +23°C	%	ISO R 527	300
3,5% Bending stress	N/mm ²	ISO 178 Test speed 2 mm/min	19
Average linear expansion coefficient	mm/*K	DIN 53752	0,18
Shore hardness		ISO 868	61
Operational temperature range without mechanical stress	°C	-	-40 bis +100
Fire behaviour		DIN 4102	B2
Water absorption at +23°C (96h)	mg	ISO 62	< 0,5
Melt Flow Rate MFR 190 / 5	g/10 min	ISO 1133	0,43

Table 2.1

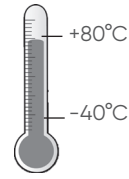
2.1 Material advantages



Impact-resistant and tough:
Unbreakable at temperatures above 5°C



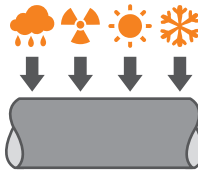
Elastic and flexible:
Adjusts to local ground movement for underground use



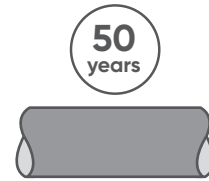
Thermal resistant:
Applications possible between -40°C and 80°C. Up to 100°C for short periods of time.



Chemical resistant:
Suitable for transport of polluted waste water

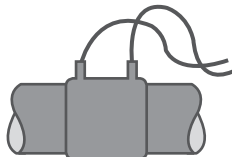


UV & weather resistant:
Unrestricted outside use through carbon black additives



Wear resistant:
Lower cost due to long lifetime

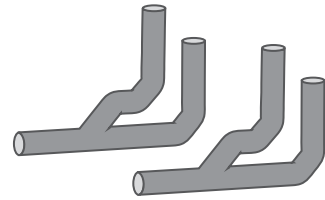
2.2. System advantages



Welded system:
Simple and secure installation using butt welding and electrofusion



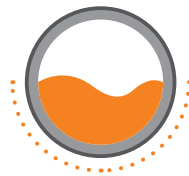
Homogeneous welded joints:
Pull tight and leak proof for a completely closed system



Prefabrication:
Fast and cost-saving installation of repetitive systems



Light in weight:
Cost saving in transport and handling



Low heat conductivity:
No condensation insulation required during short periods of cooling



Nontoxic:
100% recyclable and environmental friendly

2.3 Application limitations

The following limitations need to be taken into consideration in the design, installation and use phases of Akatherm HDPE:

- Akatherm HDPE is designed to be installed in accordance with EN12056. In respect to this standard pressurization of the pipe system is not allowed.
- Chemical resistance of Akatherm HDPE has to be taken into account. Refer to appendix A for a complete chemical resistance table of Akatherm HDPE. The lifetime of Akatherm HDPE can be affected when chemical resistance is not considered
- Akatherm HDPE pipes and fittings can be used continuously at elevated temperatures. However, drainage above 80 °C is limited to 400 times per year for a duration of 1 minute per time

3 Approvals, standards and quality

3.1 Approvals






















Country		Certificate of approval	Standard
The Netherlands			NEN EN 1519
Belgium			NBN EN 1519
Germany			DIN EN 1519 DIN EN 12666
Denmark			EN 1519
Sweden			EN 1519
United Kingdom			BS EN 1519
Austria			ÖNORM EN 1519
France			NF-EN 1519
Switzerland			EN 1519 EN 12666
Australia			AS/NZS 4401 AS/NZS 5065

Table 3.1

 The Akatherm HDPE pipe system is produced according to ISO 9001 and ISO 14001 standards.

3.2 Standards

Akatherm HDPE is a professional soil & waste drainage system and meets a number of quality and safety standards.

EN 1519

Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polyethylene (PE) - Part 1: Specifications for pipes, fittings and the system.

EN 12666

Plastics piping systems for non-pressure underground drainage and sewerage Polyethylene (PE) - Part 1: Specifications for pipes, fittings and the system.

AS/NZS 4401

Australia Standard: Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings - Polyethylene (PE).

AS/NZS 5065

Australia Standard: Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

ISO 8770

International standard for Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polyethylene (PE) - Part 1: Specifications for pipes, fittings and the system.

EN 1053

Plastics piping systems. Thermoplastics piping systems for non-pressure applications. Test methods for water tightness.

EN 1054

Plastics piping systems. Thermoplastics piping systems for soil and waste discharge. Test method for airtightness of joints.

DIN 11925-2

Reaction to fire tests Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test.

DIN 13501-1

Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests.

DIN 4102-1

Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests.

DS/ISO/TTR 10358

Plastics pipes and fittings - Combined chemical-resistance classification table.

EN 681

Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications.

3.3 Warranty

Of course you want the security that after the design and installation of specialist drainage systems it will perform without any problems. Aliaxis offers you the necessary services and tools to enable the proper functioning of your drainage system. Contact the Aliaxis local sales office for more information about training upfront, technical support during construction, and even (if required) inspection afterward.

4 Planning and design

4.1 Relevant standards

Akatherm HDPE is designed for drainage systems inside the building. The planning and design shall comply to:

EN12056 Gravity drainage systems inside buildings

Additionally planning, design, installation and commissioning shall comply to the guidelines as specified in this manual.

Approvals

Akatherm HDPE is made in conformity with:

- EN1519 Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings- Polyethylene (PE).
- DIN19535-10 High-density polyethylene (PE-HD) pipes and fittings for hot water resistant waste and soil discharge systems (HT) inside buildings - Part. 10 Fire behaviour, quality control and installation recommendations
- DIN19537 Pipes and fittings of high-density PE for drainage and sewerage.
- EN12666 Plastics piping systems for non-pressure underground drainage and sewerage - Polyethylene (PE) - Part 1: Specifications for pipes, fittings and the system.

Akatherm HDPE is certificated in many countries throughout the world and holds the certifications for pipes and fittings from size d40 to 315 mm (depending on the country).

The ISO equivalent of the EN1519 is ISO8770.

For a full overview of countries and certifications, please check the chapter about approvals, standards and quality.

4.2 Conversion tables

Akatherm HDPE is a metric system with diameters compatible to other metric systems like polypropylene based on the EN1451.

Drainage systems with inch dimensions have diameters different compared to the EN1519. Refer to the below conversion table for the relevant equivalent size.

DN	HDPE			ASME B36.10 & B36.19M			BS EN 1329 (waste)			BS EN 1401 (soil)		
	OD [mm]	e [mm] *	ID [mm]	NPS	OD [mm]	OD [inch]	OD [mm]	e [mm] **	ID [mm]	OD [mm]	e [mm] ***	ID [mm]
6				1/8"	10,26	0,4						
8				1/4"	13,72	0,5						
10				3/8"	17,15	0,7						
15				1/2"	21,34	0,8						
20				3/4"	26,67	1,1						
25				1"	33,4	1,3						
32	40,0	3,0	34,0	1 1/4"	42,16	1,7	36,4	3,3	29,9			
40	50,0	3,0	44,0	1 1/2"	48,26	1,9	43,0	3,3	36,5			
50	56,0	3,0	50,0	2"	60,33	2,4	56,0	3,3	49,5			
65	63,0	3,0	57,0	2 1/2"	73,03	2,9						
80	75,0	3,0	69,0	3"	88,9	3,5	82,2	3,3	75,7			
90	90,0	3,5	83,0	3 1/2"	101,6	4,0						
100	110,0	4,2	101,6	4"	114,3	4,5	110,2	3,5	103,2	110,2	3,5	103,2
115				4 1/2"	127	5,0						
125	125,0	4,8	115,4	5"	141,3	5,6						
150	160,0	6,2	147,6	6"	168,28	6,6	160,2	3,5	153,2	160,2	3,5	153,2
				7"	193,68	7,6						
200	200,0	7,7	184,6	8"	219,08	8,6	200,3	4,2	191,9	200,3	4,2	191,9
				9"	244,48	9,6						
250	250,0	9,6	230,8	10"	273,05	10,8	250,3	5,2	239,8	250,3	5,2	239,8
300	315,0	12,1	290,8	12"	323,85	12,8	315,3	6,7	302,0	315,3	6,7	302,0
350				14"	355,6	14,0						
400				16"	406,4	16,0				400,4	8,4	383,6

Table 4.1

4.3 Building drainage principles

These building drainage guidelines are meant for waste water drainage systems which operate under gravity. It is applicable for drainage systems within dwellings, commercial, institutional and industrial buildings that terminate maximally 0,5 m outside the external wall.

4.3.1 The challenges of drainage system

Waste water systems are based on the primary pressure relief system in which water and air flow occurs in the same pipe. Waste water and storm water have to be collected separately, or at least until a relief gully has been placed in the rainwater drainage system.

In a waste water drainage system it is important that pipes properly drain empty and that any soil is carried with the flow. By discharges from fixtures, air will be displaced causing over- and underpressure; these have to be minimised so that waste water or sewer gases do not enter the building through the fixtures.

Important as well is to prevent hydraulic closures in the pipe system in which a body of water will limit or fully block air movement thereby causing over- and underpressure.

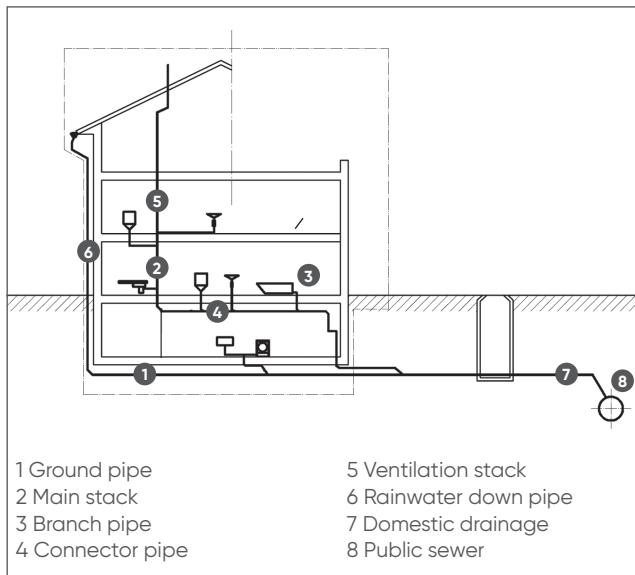


Illustration 4.1

Discharge water is introduced in a drainage system by cleaning, washing and drainage of waste. Drainage systems are referred to in different terms like a soil & waste system or a drain-waste-vent (DWV) system.

A soil & waste or drain-waste-vent system removes sewage and grey water from a building and regulates air pressure in the waste system pipes, facilitating flow. The term soil is used for sewage water (black water) that is discharged from toilets and urinals. Waste water is grey water discharge from a shower, bath and kitchen fixtures.

Soil or sewage water is a risk for human health while waste or grey water is not a direct risk. Typically soil & waste water are discharged on the same building drainage pipe system leading to the public sewer.

The building drainage system is an open system that is accessed on many points by fixture discharges that are different in temperature, volume and frequency. Due to hygienic, health and odour reasons each discharge opening must be closed by water traps.

The Akatherm HDPE Soil & Waste system is used to overcome these challenges and create a proper functioning drainage system.

4.3.2 System configuration

To prevent the traps from being blown or sucked empty, the under- and overpressure in a drainage system cannot exceed 300 Pa (30mm water column). The air must be able to escape (de-aerate) and enter (aerate) the system and this can be done with several different systems.

In primary ventilated system the downpipe itself is extended and vents through the roof of the building (see illustration 4.1). In a secondary ventilated system a separate vent pipe is build next to the downpipe or each collector pipe is fully vented to the downpipe. Further details are available in the EN12056-2: "Gravity drainage systems inside buildings - Part 2: Sanitary pipework, layout and calculation".

The advice and guidelines in this manual are based on the primary ventilated system.

4.3.3 Pipe fill rate

In order to maintain free air movement the pipe system must be designed so that the discharge volume, incline and centreline does not lead to a filling rate higher than 70%. The fill rate is based on a water depth of 0,70 x the pipe centreline and a stabilised flow. A stabilised flow will occur after a certain length after the fixture.

4.3.4 Pipe slope

A minimum flow speed is required to properly carry along waste in water preventing blockage. The minimum pipe slope is set at 1:200 (5mm/m). Shorter pipe sections can function on 1:500 provided the calculation has been made and the installation is done very precise. The maximum slope typically used is 1:50 (20mm/m) to prevent water moving too fast thereby creating a hydraulic seal.

4.3.5 Clean-out openings

Even in properly designed and installed drainage systems a blockage can occur due to deposits like solidified grease or improper use of the drainage system like food waste or other small objects. Clean-out branches must therefore be placed on key places in the drainage system.

Discharge fixtures and traps should be connected to the pipe system with the option to demount.

A clean out possibility should be placed in a horizontal pipe system when the pipe:

- is longer than 10 m
- has a total direction change greater than 135°

An additional clean out possibility should be placed when the horizontal pipe system is longer than 20 m. The clean out branches should be easy to reach and accessible for a plumbing snake, preferably with the opening on top so the clogged pipe system does not empty when opening the clean out branch. At the transition to the public sewer, a clean out possibility is required.

Downpipes and ventilation shafts on small buildings can be properly cleaned from the roof (if the cover can be removed). On higher buildings a clean out branch should be placed every 3 to 4 floors in the stack.

4.4 Thermal movement of HDPE

A physical principal is that all materials expand as the temperature increases. If the temperature drops, the material contracts. Each material has its own unique coefficient of expansion (α).

For Akatherm HDPE : $\alpha = 0,18 \text{ mm/m} \cdot \text{K}$
 The equotation for length change is:

$$\Delta L = L \times \alpha \times \Delta T$$

Equotation 4.1

ΔL = length change of pipe system [mm]
 L = total pipe length [m]
 ΔT = difference with installation temperature [°C]
 α = 0,18 mm/m · °K

! $\Delta T 50^\circ = 10 \text{ mm/m}$

When installed at 30° an Akatherm HDPE pipe of 5m long will behave as following:

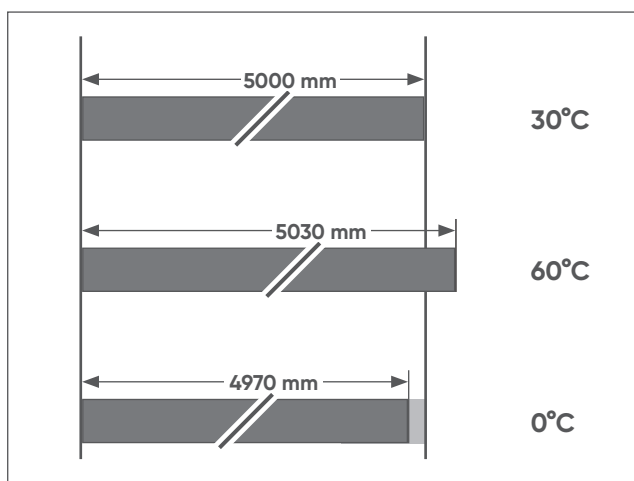


Illustration 4.2

In residential applications the maximum wall temperature difference of the connector and collector pipes is 40°C, even during short periods of 80°C to 90°C temperature water discharge.

For downpipes and ground pipes the maximum wall temperature difference is 20°C.

In general for a long-lasting discharge of high volume hot water the maximum wall temperature difference is 60°C.

Please note that this is the temperature difference over the complete circumference of the pipe, the variation in the discharge temperature can be a lot higher.

4.5 Transitions to other materials

4.5.1 Transition to PVC, PP Silent and PP-HT

Transitions to metric PVC, PP Silent and PP-HT pipe systems can be made using a rubber ring joint or by screw couplers.

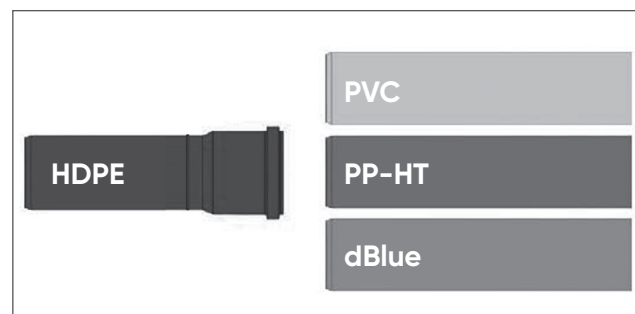


Illustration 4.3

Refer to the table below for the type of fittings, the dimensions and article numbers.

Fitting type	Diameter range (mm)	Akatherm Code
Plug-in socket	40-160	42xx50
Snap socket	40-200	40xx10
Expansion socket	40-315	4xxx20
Screw coupler	40-110	43xx30

Table 4.2

4.5.2 Transition to metal thread

The transition from Akatherm HDPE to metal thread requires screw thread adaptors available in the Akatherm range.

The adaptors are available with inside and outside thread in HDPE connection diameters 40, 50 and 63 mm. The adaptors have a cylindrical thread dimensioned according to DIN-ISO 288-1 with threads in 1/2", 3/4", 1", 1 1/4", 1 1/2" and 2".

Refer to the product tables for a complete overview of article numbers and available combinations.

4.5.5 Transition plumbing fixture fittings

Connections from plumbing fixture drainage fittings are typically with other materials. Connections to Akatherm HDPE are possible using adaptor fittings with rubber nipple, available from the Akatherm HDPE range.



Illustration 4.4

Akatherm HDPE has a straight connection socket and a connection bend. Refer to the table below for the possible transitions available both straight and as a bend (32 mm not available for the bend).

Diameter (mm)	Connection range
32	1 1/4" and 1 1/2"
40	1 1/4" and 1 1/2"
50	1 1/4", 1 1/2" and 2"
56	1 1/4", 1 1/2" and 2"

Table 4.3

The socket and bend do not contain a rubber ring. The rubber ring can be ordered separately.

4.5.6 Transition to other materials

Pipe connection with non-standard diameters can be connected to Akatherm HDPE using the Akatherm contraction sockets.



Illustration 4.5

The contraction sockets have a variable connection diameter which shrinks and forms to the inserted pipe by applying heat. The connection is made watertight with a rubber ring and are available according to the table below

Diameter (mm)	Connection diameter d _x (mm)	Akatherm Code
40	41-44	550401
40	57-64	550402
50	57-64	550503
50	67-74	550504
56	62-69	555601
63	62-69	550601
63	75-79	550603
75	80-84	550701
75	90-94	550702
90	94-98	550902
110	102-111	551102
110	110-120	551103
110	115-136	551104
125	120-140	551201
125	135-155	551202
160	155-165	551602
160	160-180	551604
200	185-207	552001
250	236-260	552501

Table 4.4

4.6 Condensation

Condensation occurs when the water vapour carried in the air is deposited on a 'colder' surface. Air at a given temperature can contain only a certain amount of water vapour. If the air temperature drops when in contact with the colder pipe system, the excess amount of water vapour will then condense.

The temperature of the air at which air is saturated with water vapour is called the 'dew point'. Condensation occurs when pipework has a temperature under the dew point of the surrounding air. Condensation depends on a number of factors:

- Room temperature
- Relative humidity of the air
- Temperature of the pipe surface

Akatherm HDPE has a relatively good thermal coefficient and no condensation will occur during short periods of rain. To know exactly when and how to insulate a h-x (Mollier) diagram and a detailed calculation has to be used.

Pipe systems which are likely to be insulated against condensation are installed in:

- Wall cavities
- Concealed ceilings
- Concrete
- Pipes in poorly conditioned industrial buildings
- Pipes in food and paper applications

Usually, there is no need to insulate pipes in a properly conditioned industrial building that has sufficient air circulation due to heaters and fans.

When using Akatherm HDPE for storm water drainage, the relatively cold rainwater can cause dew condensation quicker than in soil & waste applications.



When insulating the pipe system use diffusion-proof closed cell insulation material. Open cell insulation has to have an impermeable outer layer.

The entire pipe network must be insulated and an insulated pipe system must always be a closed circuit. Always ensure to:

- Close all openings, cuts and transitions with sealing material
- Encasing the bracket fully and seal the transition

4.7 Noise attenuation

Noise is all around us all the time. In modern urbanised life there are few places left to enjoy the comfort of silence. In many building constructions like multi-storey apartment blocks, hospitals or luxurious spas, the sound of the sanitary and drainage systems have become a significant source of noise. Modern standards require the noise to stay within acceptable limits for everyday use.

Every object in motion makes noise transmitting its vibrations to the surrounding air as pressure waves. There are two types of noise in soil & waste systems:

Air-borne noise

This is sound that travels through the air from its source. The source causes the air to vibrate. Air-borne noise can pass through structures and is reduced by using absorbent materials.

Structure-borne noise

This is sound that first occurs through a solid structure generated from a vibrating source or impact event. The vibrations pass through the structure and reach the human ear as air-borne noise at different locations within the building. The building structure acts as an acoustic bridge. Structure-borne noise is reduced by using soft material to acoustically uncouple the vibrating source or impact event.

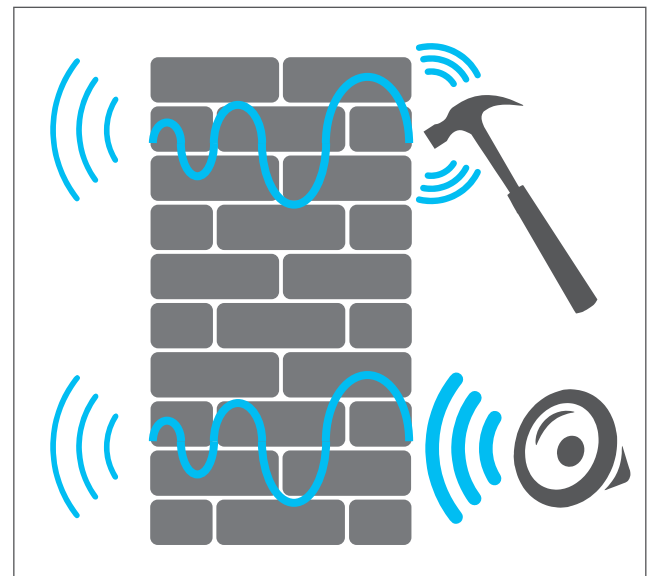


Illustration 4.6

The noise level resulting from internal sewers depends on factors as:

- type of (drain) pipe
- type of bracketing used
- insulation
- fall height
- drainage capacity and diameter

Acceptable noise level

The acceptable noise level that a human being can be exposed to while performing everyday activities and relaxing is described as 'the threshold noise level value'. According to the valid regulations, there are two categories of noise tests:

The table below presents several examples of the acceptable sound level in rooms designed for everyday stay.

Type of room	Acceptable average noise level	
	day	night
Rooms designed for mental activities that require intense concentration	30 dB	-
Rooms in 3-star or below 3-star hotels	40 dB	30 dB
Accommodation in residential buildings, boarding schools, children's homes, old people's homes, 4 and more star hotels	35 dB	25 dB
Rooms in intensive Medical Care Units	25 dB	25 dB
Patient's rooms in hospitals and sanatoriums except rooms in Intensive Care Units	30 dB	25 dB
Kitchens and sanitary rooms in flats	40 dB	40 dB

Table 4.5

Measures against noise

Design and construction measures can limit the noise levels in a drainage pipe system:

- Avoid drainage pipes installed close to habitable areas
- In non-residential construction drainage pipes installed close to storage rooms, toilets and pantries have the preference over offices and meeting rooms
- In no case should pipe work be installed directly in living areas
- A rubber lined bracket will prevent a noise bridge to the wall. A pipe system should never directly contact the building structure.
- Install the pipe system to a heavy wall (> 220 kg/m³)
- A heavy compartmenting wall will limit airborne noise
- Don't install the pipe system to the pre-wall but to the construction wall
- All wall and ceiling penetrations must be filled using an acoustic and moisture insulation
- A pipe system running through a concealed ceiling can be insulated at bends and branches
- Encasing the pipes in concrete at diameter of no more than 69 mm. A concrete cover of approximately 50 mm thick reduces the potential noise level by about 30 dB(A).
- Insulate the shaft wall in multi-storied residential buildings

A well designed and properly aerated pipe system will reduce the noise transmission levels:

- Use gradual bends for direction changes
- At the transition from downpipe to horizontal pipe use 2 x 45° bends with a 250 mm pipe section in between
- Design and dimension drainage pipes to have enough capacity for both the drainage water and the air
- Use a side connection to branch into a horizontal pipe section. If a top connection can't be avoided use a 45° branch.

4.8 Trace heating

Animal and vegetable-based oil and grease discharged by commercial kitchens are separated from the waste water by grease separators. Akatherm HDPE is very well suited to connect the discharge fixtures to the grease separator. When the pipe system has enough length, the grease can accumulate and lead to serious blockage of the pipe system. The use of trace heating and additional insulation may be required to reduce heat loss. The trace heating element should not exceed 45°C.

4.9 Embedding HDPE in concrete

The Akatherm HDPE system is suited to be embedded in concrete. Before pouring the concrete all welds need to be cooled down and it is preferable to check the pipe system for leakage. To prevent the pipes from floating upwards the systems needs to be properly bracketed to keep it in place.

Pressure and heat during pouring

When a pipe system is vertically installed into concrete the liquid concrete will cause outer pressure, possibly exceeding the maximum ring stiffness depending on the height of the installation.

To increase the maximum installation height the pipe can be filled with water (and closed) to compensate for the outer pressure. Refer to the table below for the maximum allowed height depending also on the wall thickness of the pipes and fittings (at 30°C).

Diameter (mm)	Wall thickness (mm)	Allowed height (m)	
		Empty	Filled with water
40	3,0	26,0	45,0
50	3,0	14,0	24,0
56	3,0	7,0	12,0
63	3,0	7,0	12,0
75	3,0	3,8	6,5
90	3,5	3,8	6,5
110	4,2	3,8	6,5
125	4,8	3,8	6,5
160	6,2	3,8	6,5
200	6,2	2,0	3,5
250	7,7	2,0	3,5
315	9,7	2,0	3,5
200	7,7	3,8	6,5
250	9,6	3,8	6,5
315	12,1	3,8	6,5

Table 4.6



Quick drying concrete will undergo an exothermic reaction which releases heat during its process. The heat will soften the HDPE pipe and influence the maximum allowed pressure. Adequate protection must be provided to the Akatherm HDPE system like filling the system with water.

Expansion and contraction compensation

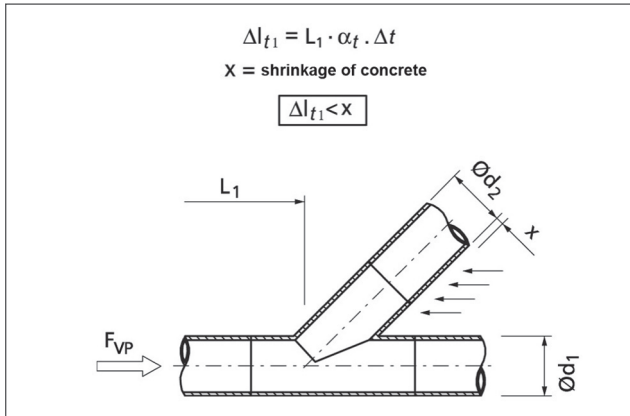


Illustration 4.7 HDPE expansion forces in concrete

Because HDPE and hardened concrete do not adhere, the pipe system embedded in concrete can move freely when expanding under influence of temperature changes. All fittings installed in the pipe system act as an anchor point and are subdued to the expansion force. The concrete acts as a rigid system and the expansion and possible deformation of the fittings therefore has to be counteracted like in any HDPE installation.

When the length change of the HDPE is smaller than the shrinkage of the concrete no special precautions have to be taken however this is very rarely the case.

All 45° and 88,5° branches are subdued to the expansion force (FVP) which can be counteracted by installing an electrofusion coupler. The electrofusion coupler acts as an anchor point preventing the additional load to be transferred to the branch (see illustration 4.8).

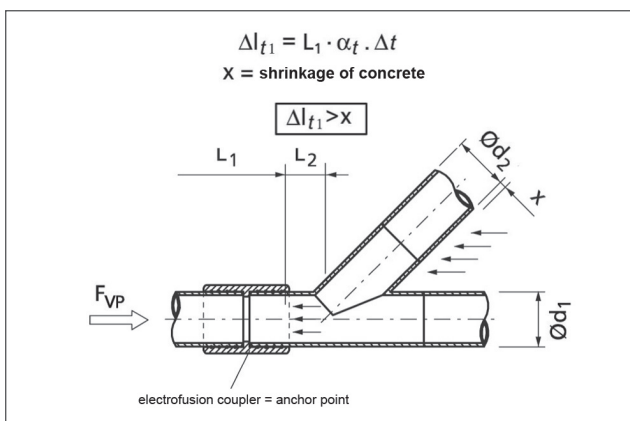


Illustration 4.8 Anchor point with an electrofusion coupler

As an alternative (snap) expansion sockets can be used. The (snap) expansion sockets act as an anchor point on one side and absorb the expansion on the other side of the socket. The snap-expansion socket can accommodate the expansion and contraction of a 5 m pipe (see illustration 4.9).

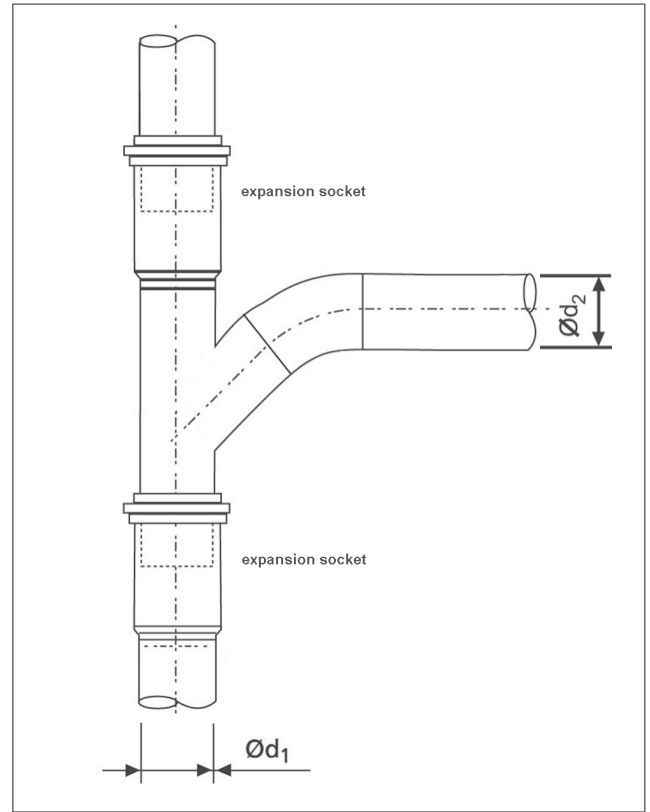


Illustration 4.9 Anchor point with (snap) expansion sockets

When the length of the branch is more than 2 m special precautions have to be taken as well. A fitting installed in a ceiling penetration acts as an anchor point as well. In case branches are used in a ceiling it is recommended to use an electrofusion coupler.

4.10 Installation underground

Due to specific properties such as flexibility and resistance to cold temperature (freezing), HDPE pipe systems are ideal for use in underground pipe lines. Buried pipes are exposed to various loads. The stability of Akatherm HDPE makes it possible to bury the pipes at substantial depth. The suitability depends on such factors as depth, groundwater level, density of the soil and traffic load.

Soil and traffic loads

The load capacity of underground plastic pipes is based on changes in the pipe and movement of the ground. The soil load causes the top of the pipe to deflect downward. The sides of pipe are correspondingly pressed outward against the surrounding soil. The reaction pressure, the lateral force exercised on the pipe, prevents a larger cross-sectional deformation (support function). The construction of the trench, the type of bedding used and the backfilling of the trench are, to a large extent, decisive factors determining the load capacity of an underground plastic pipe. The load needs to be evenly distributed over the entire pipe line. For this reason, the trench must be created in such a manner that bends in a longitudinal direction and loads at specific points are avoided. It is assumed that the increased pressure resulting from traffic loads caused by road or rail traffic are surface loads evenly distributed over the pipe sectional plane.

Groundwater

Underground pipes can be subject to external overpressure, especially in areas with high groundwater levels. In addition, a pipe enclosed in concrete is exposed to external pressure, though just for a short period. Underground pipe systems subject to additional external pressure must be tested for the ability to withstand dinting. The effective load due to external pressure will agree with the related hydrostatic pressure on the pipe axis.

For special circumstances contact our Technical Support department.

5 Highrise drainage design

Emporis Standard ESN 18727 defines highrise buildings as multi-story structures between 35-100 meters tall or a building of unknown height from 12-39 floors. Skyscrapers are at least 100 meters tall.

A highrise building drainage system interconnects many separate households, floor levels and offices spaces within a single drainage system at highly elevated flow rates. Properly managing these flow rates creates exponentially bigger challenges compared to low and medium rise buildings.



Illustration 5.1

The Akatherm HDPE Single Stack Solution with stack-aerators increases performance compared to a traditional secondary ventilated system and saves valuable building space.

5.1 Why use the Akatherm HDPE stack-aerator

The Akatherm HDPE stack-aerator saves valuable building installation space and construction costs with increased performance and comfort.

Performance benefits

- It reduces the pneumatic and hydraulic pressure
- Reduces stack dimension with increased capacity compared to a secondary ventilated system
- Saves valuable building space that becomes commercially available

Cost benefits

- Simplified design of highrise drainage stack
- One stack-aerator offers 6 branch connections
- Saves material and installation time
- A low weight HDPE solution with welded joints for minimal maintenance
- No separate ventilation pipes reduces core drilling and fire safety solutions

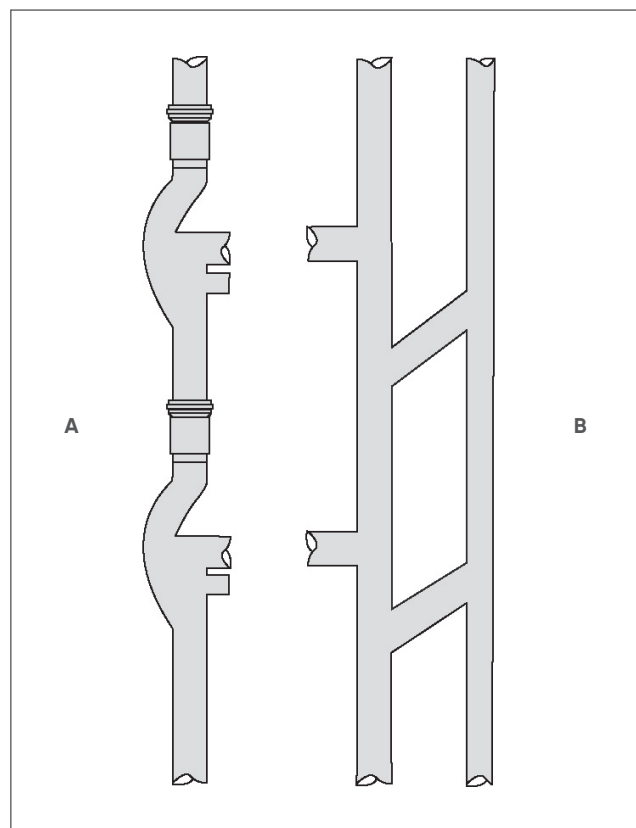


Illustration 5.2

Akatherm system with Akatherm HDPE stack-aerator (A)

- Single stack system
- Suited for highrise buildings
- Reduced stack dimension
- Multiple connections per branch
- Reduced velocity

Traditional stack with vent pipe (B)

- Two stacks
- Medium rise buildings
- Bigger diameter stack
- Multiple branches required
- High speed

5.2 How does the stack-aerator work

A drainage system is composed of pipes and fittings that are suited for the transport of both discharge water and air. It furthermore secures the water seal in the traps protecting the living environment against unwanted sewer gases and bacteria.

The capacity of a highrise drainage system is determined by the flow rate of the connected appliances, their simultaneous discharge pattern and the drainage design in the building.

To prevent trap seal breach the positive and negative transient pressures that exist in a highrise drainage system have to be limited.



Illustration 5.3

The unique shape of the Akatherm HDPE stack-aerator fitting reduces the speed of the falling waste water and smoothly converges the horizontal entry flow with the flow higher floors.

This maintains the core of air inside the stack and keeps the positive and negative pressures within the required limits to prevent trap seal breach, without the requirement of an additional vent pipe.

The vent opening between the offset chamber and the entry chamber keeps the horizontal pipe ventilated.

5.3 Akatherm HDPE stack-aerator design

The Akatherm HDPE Single Stack Solution works easily by using one Stack -aerator on each floor level. An additional ventilation pipe is not necessary. Always observe the following elements:

1. Use one stack-aerator on every floor level instead of a regular T-branch fitting.
2. The stack should be completed in one diameter, never reduced or increased in size.
3. A pressure relief line installed at the base of the stack to absorb positive pressures.
4. A vent pipe through the roof of the same diameter as the down pipe.
5. A relief vent where the stack is offset over a distance greater than 45°.

Stack-aerator in the down pipe

The Akatherm HDPE stack-aerator must be installed on each storey with a waste water connection and when the distance between two stack-aerators is larger than 6 m. A double offset should not be used and will reduce the flow capacity (see illustration 5.4).

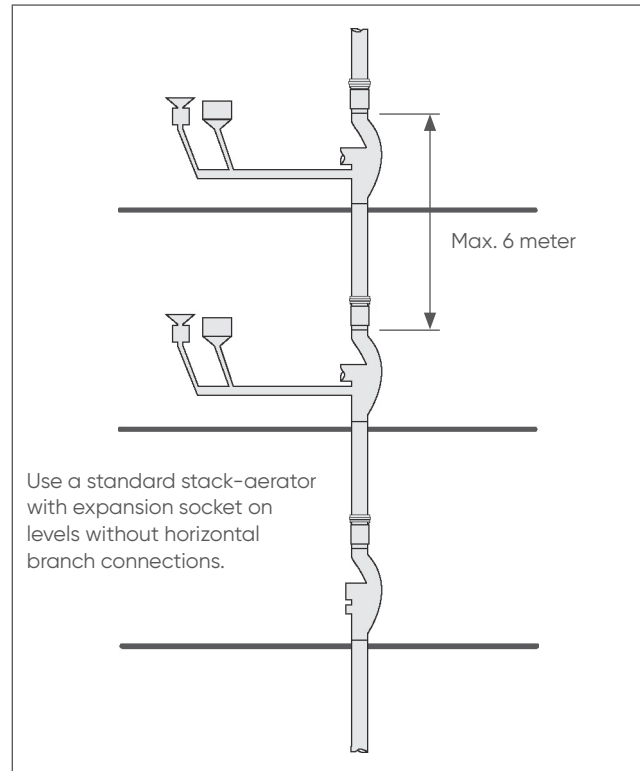


Illustration 5.4

Zone division

If the building design requires more than one down pipe or the maximum capacity of a single down pipe will be exceeded, the storeys must then be divided into zones, each draining into different stacks.

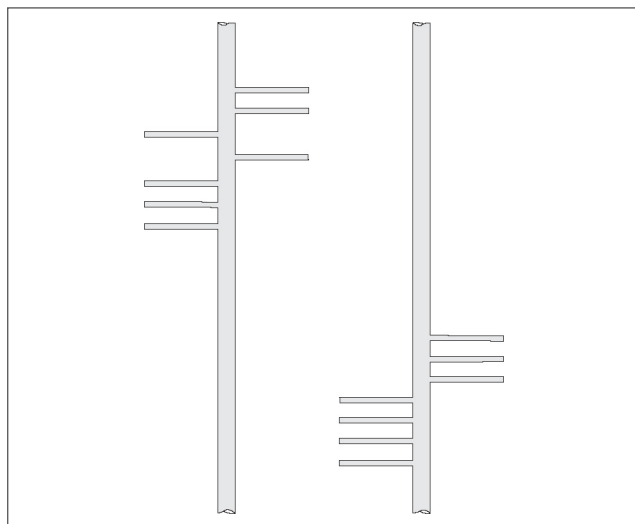


Illustration 5.5

Deflecting the stack

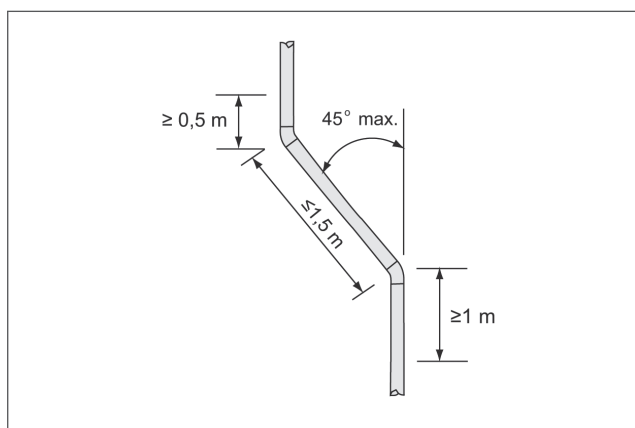


Illustration 5.6

A down pipe with stack-aerators can be deflected without use of an equalisation pipe if the transition is constructed as shown in illustration 5.6.

The angle of the offset must be 45° or less and the length of the offset pipe shorter than 1,5 m. No horizontal branch can be installed closer than 0,5 m above the offset and 1,0 beneath it.

If the axis of the down pipe with stack-aerators can't be deflected in accordance with the illustration 5.6, the offset must be equipped with an equalisation line, to be designed in accordance with illustration 5.7.

If the axis of the stack-aerator down pipe can't be deflected in accordance with the illustration 5.6, the offset must be equipped with an equalisation line, to be designed in accordance with illustration 5.7.

If collectors have to be connected at this point, these connections can be made on the equalisation pipe, which is also called a diverter. There are also joint-free zones on the diverter pipe as indicated in illustration 5.7. The equalisation or diverter pipe must have the same diameter as the down pipe.

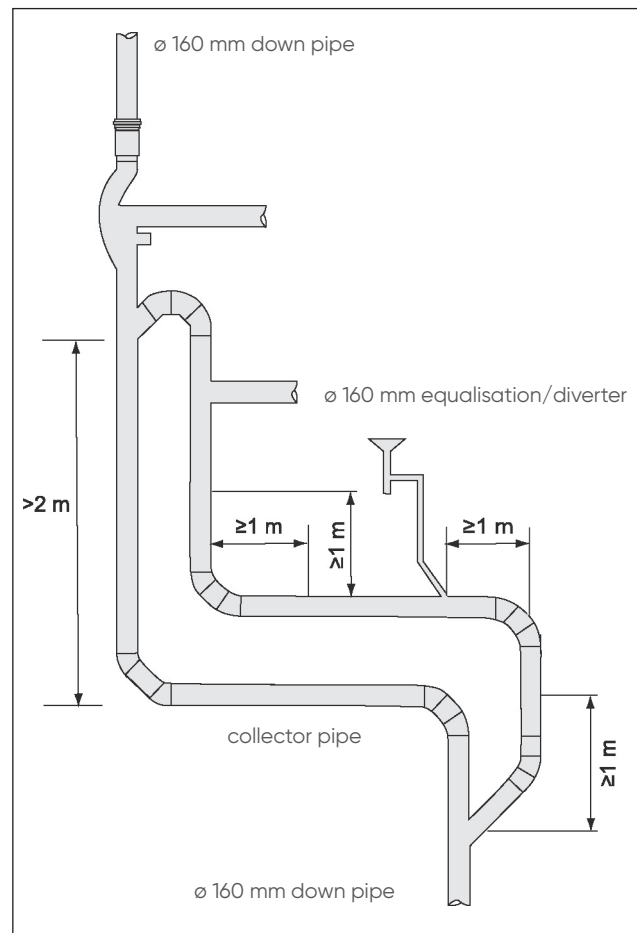


Illustration 5.7

Horizontal branch connections

Unvented connections

Unvented branch connections have a maximum length of 4 m at minimum gradient of 1,0% (1:100) with no more than three 90° bends and a maximum drop of 1,0 m. The branch connection must be sized in accordance to national standards and guidelines.

Vented branch connections

Vented Branch connections have a maximum length of 10 m at minimum gradient of 0,5% without bend limitation and a maximum drop of 3,0 m. The branch can be vented with pressure-relief vents connected at 45° or air admittance valves.

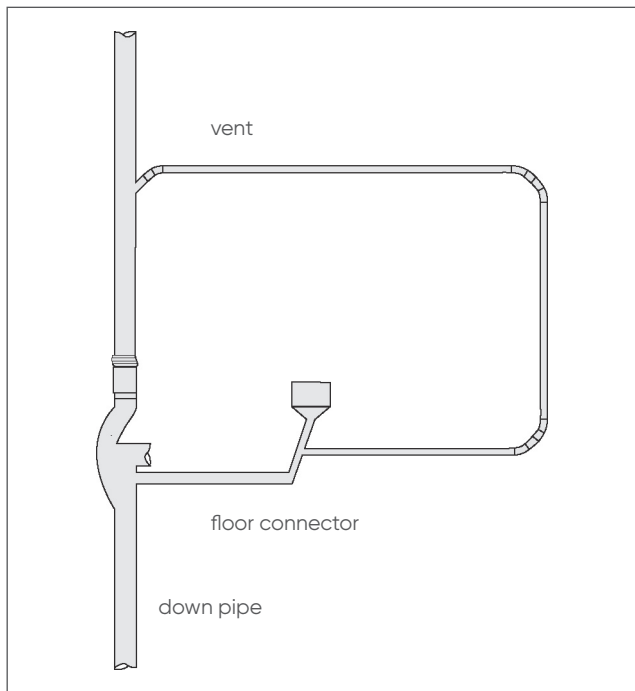


Illustration 5.8

Details about maximum total and per-storey drainage flows that may be handled by a stack-aerator down pipe can be found in paragraph 1.1.7 'System calculation'.

! All toilets must be connected to the stack-aerator using a 110 mm pipe. Directly opposing connections on the stack-aerator are not permitted.

Base of the stack

At the base of the stack a pressure relief line must be installed to absorb pressures. The ground level fixtures can be attached to the pressure relief line outside the joint-free zones. The design has to follow illustration 5.9.

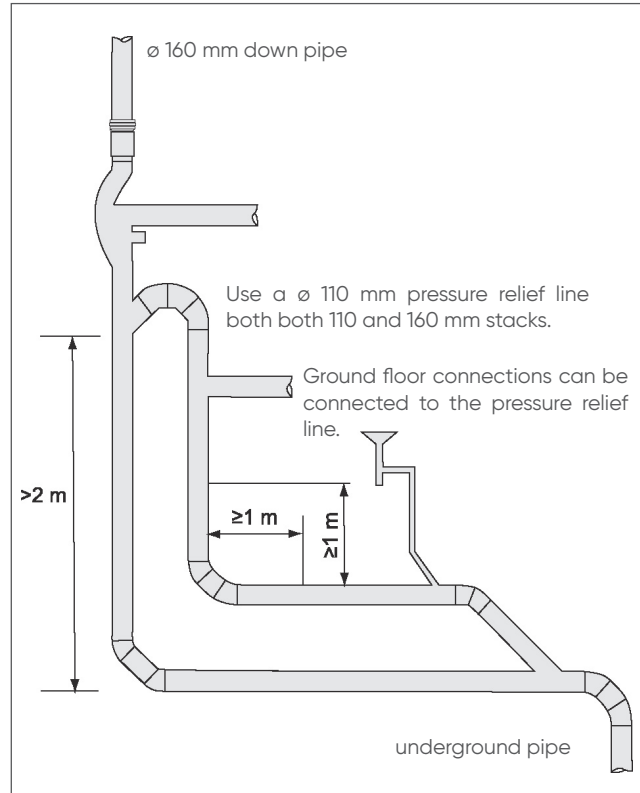


Illustration 5.9 End of the stack-aerator down pipe

Venting the stack-aerator down pipe through the roof

The diameter of the down pipe must remain the same without reduction until roof level is cleared. Exceptions to this rule involve the construction of multiple down pipes with a combined pressure-relief pipe. The pressure-relief pipes may be joined together beyond a point 1 m above the highest joint. For the Akatherm system, this is only permitted if the internal surface area of the combined pressure-relief line is equal to or larger than the sum of the internal surface areas of the individual pressure-relief lines.

The maximum number of combined down pipes is 3, as long as the combined pressure-relief pipe has a diameter as specified in table 5.1. Illustration 5.10 provides an example of 4 down pipes ø 110 mm with combined vent pipes.

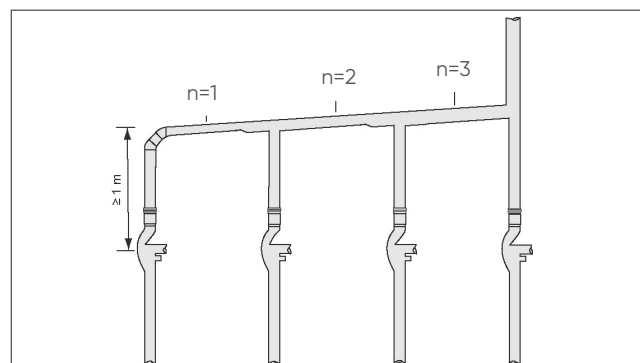


Illustration 5.10

Down pipe (n)	Minimum ø of combined pressure-relief pipe	
	Stack-aerator 110 mm	Stack-aerator 160 mm
1	110	160
2	160	250
3	200	315

Table 5.1

The position of the opening for the roof duct on the roof must be designed in accordance with national standards and guidelines, so that moisture and waste material is not allowed to enter.

Wind-shear effects can influence the pressure in the upper most section of the system. The roof penetrations should be placed as far away from the roofs edge or be protected against the wind-shear to avoid breach of traps.

From down pipe to underground pipe

One or more down pipes may be connected to an underground pipe provided that the capacity of the underground pipe is great enough. The maximum capacity of an underground pipe is described in EN 12056-2, and depends on the diameter and incline. The total drainage flow is the simultaneous flow from all connected drain fixtures. The relevant calculation for an underground pipe will be performed in paragraph 1.1.7.

5.4 Stack-aerator bracketing and pipe connections

Connections to the stack-aerator have to be butt-welded. It is strongly recommended that connections to the stack-aerator are prefabricated prior to site delivery.

Horizontal connections are best made using either Akatherm plug-in sockets or snap sockets. The snap socket offers the same convenience of the plug-in socket with a pull-tight connection, with the addition of a 'groove ring' to be applied by the plumbing contractor if required.

The stack-aerator must be fixed in place vertically to prevent any mechanical stress on the horizontal drainage pipes caused by thermal expansion and contraction of the vertical pipe system. An expansion socket on top of the stack-aerator is required to compensate for the expansion and contraction of the vertical pipe system.

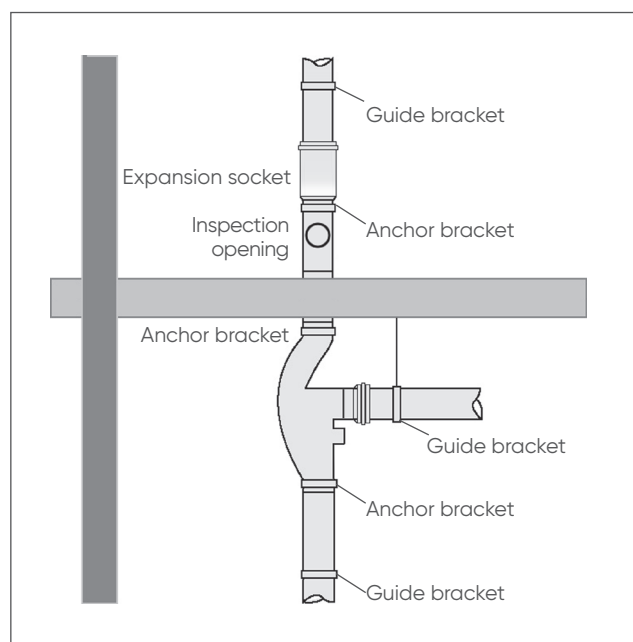


Illustration 5.11

In an underslab installation requiring penetration through a fire collar, a nominal section of pipe must be butt-welded onto the top of the stack-aerator. Take care to allow an electrofusion joint of the inspection opening and expansion socket combination above the slab.

Place anchor brackets at the expansion socket and the bottom of the stack-aerator. A slide bracket is placed at 2/3 of the pipe.

5.5 Duct size

The minimal duct size that is needed for a stack-aerator system can be found in table 5.2. The stack-aerator possibilities 1 and 3 are not to be used simultaneously to prevent opposing cross-flow (see illustration 5.12).

Some national standard do allow opposite connection of equally design toilet flow with a height drop in the horizontal pipe design.

	Duct size		
	only aerator 2	aerator 1 or 3	aerator 2 and (3 or 1)
110 A	300 mm	350 mm	350 mm
B	400 mm	350 mm	400 mm
160 A	270 mm	320 mm	320 mm
B	400 mm	350 mm	400 mm

Table 5.2

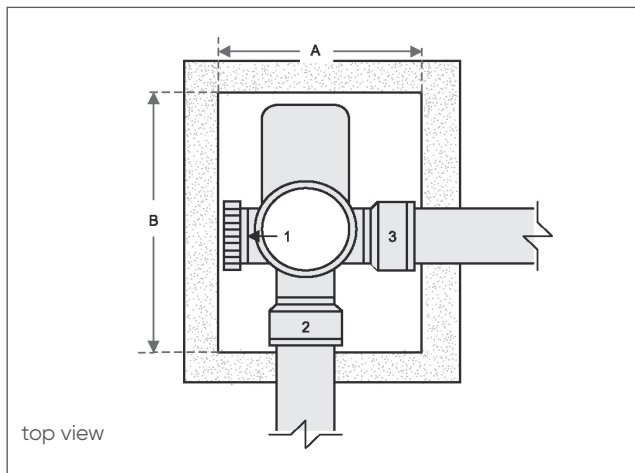


Illustration 5.12

5.6 Stack-aerator system calculation

The basic calculation for a stack-aerator involves determining the number of required down pipes and their diameter(s). For this purpose, the (composite) drainage flow for the collector pipes on the storeys must be compared to the maximum permissible capacity of the down pipe into which the stack-aerator is incorporated.

Basic drainage unit Q_i

The basic drainage unit (Q_i) of each drain fixture that can be connected to a collector pipe is expressed in l/s and one Q equals 1 l/s. Table 5.3 indicates a few devices with the basic drain values according to the standard.

Drain fixture	Q_i (l/s)
Sink, bidet	0,50
Washing machine, urinal	0,75
Bathtub, 70 mm floor drain	1,00
7 l toilet	2,00

Table 5.3 Q_i according to EN 12056

Simultaneity coefficient

Not every drain fixture will be used at the same time and, therefore, the simultaneity coefficient p exists to take this factor into account. This coefficient will differ for each type of building (see table 5.4).

Type of building	p
Residential and similar	0,50
Detention, health care and lodging	0,70
Office, education and retail	0,70
Other uses	0,70
Sport and meeting	1,00

Table 5.4 Simultaneity coefficient

The simultaneity coefficient is employed in equation 5.1 to combine the drainage from all drain fixtures into a comparable drainage flow.

$$Q_a = p \cdot \sqrt{\sum_{i=1}^n Q_i}$$

Equation 5.1 Combined drainage equation (l/s)

Q_a = Combined simultaneous drainage (l/s)

p = Simultaneity coefficient as indicated in table 1.5 ((l/s)^{0.5})

n = Number of drain fixtures (-)

Q_i = Basic drainage unit for drain fixture i as stated in table 1.4 (l/s)

In this equation, the element $\sum_{i=1}^n Q_i$ is the combined simultaneous drainage (every drain fixture being used simultaneously).

Akatherm HDPE stack-aerator capacity

This combined simultaneous drainage (Q_a) must be handled by one or more down pipes. Every down pipe incorporating the aerator has a maximum capacity based on diameter. Table 5.5 provides a summary of this.

Stack-aerator type	110 mm	160 mm
Design diameter standard (DN)	100 mm	150 mm
Maximum simultaneous drainage capacity	7,6 l/s	13,5 l/s
Max. capacity basic drainage units (Qi)*	231 l/s	729 l/s

Table 5.5 Stack-aerator capacity

* The last row in table 5.5 shows the permitted number of basic drainage units for the down pipe. The number is calculated by re-writing equation 5.1 and by inserting the maximum capacity of the stack-aerator from table 5.5 as Q_a .

A residential building ($p = 0,5$) with a single stack-aerator 110 mm down pipe can have drain fixtures with a total capacity of 231 l/s connected (see equation 5.2 for this calculation).

$$\sum_{i=1}^n Q_i = \left(\frac{Q_a}{p} \right)^2 = \left(\frac{7,6}{0,5} \right)^2$$

Equation 5.2 Re-written combined drainage equation (l/s)

This amounts to 462 bathroom sinks (basic drainage unit $Q_i = 0,5$ l/s) or 231 bathtubs (basic drainage unit $Q_i = 1,0$ l/s).

Conditions affecting stack-aerator capacity

Table 5.5 describes conditions concerning the maximum drainage flow of the collectors that may be connected to a stack-aerator down pipe in detail.

Max. capacity of one stack-aerator down pipe (l/s)	110 mm			160 mm		
	(l/s)	Q_i	Toilets	(l/s)	Q_i	Toilets
Total drainage from all floors	7,6	231	-	13,5	729	-
Toilet drainage from all floors	4,7	85	42	8,2	268	132
Total drainage from one floor	4,5	81	-	4,5	81	-
Toilet drainage from one floor	2,0	16	8	2,0	16	8

Table 5.6 Connection conditions

Example calculation

Calculation for a residential building with 50 floors and 4 apartments on each storey. Each apartment has drain fixtures with basic drainage units (Q_i), which you can find in table 5.7.

Drain fixture Q_i	110 mm
Kitchen	1,0
Bathroom	2,5
Toilet (6 l)	2,0
Total per apartment	5,5
Total per floor	22,0
Total for building	1100

Table 5.7

In this building, the $\sum_{i=1}^n Q_i$ is 1100 l/s and the simultaneity coefficient 0,5. The total flow Q_a is therefore:

$$Q_a = 0,5 \cdot \sqrt{1100} = 16,58 \text{ l/s.}$$

Equation 5.3

The maximum capacity for a 110 mm stack-aerator down pipe is 7,6 l/s. 3 x 110 mm stack-aerator down pipes are required or 2 x 160 mm stack-aerator down pipes having a maximum capacity of 13,5 l/s, if the conditions of the standard are to be met.

Underground pipe calculations

Usually, several down pipes are incorporated in a highrise building, and this combination connected to an underground pipe. The diameter of the underground pipe can be calculated in accordance with the following example.

Illustration 5.13 illustrates a situation in which the 2 down pipes in the above calculation are connected to a single underground pipe with a 1,0% gradient.

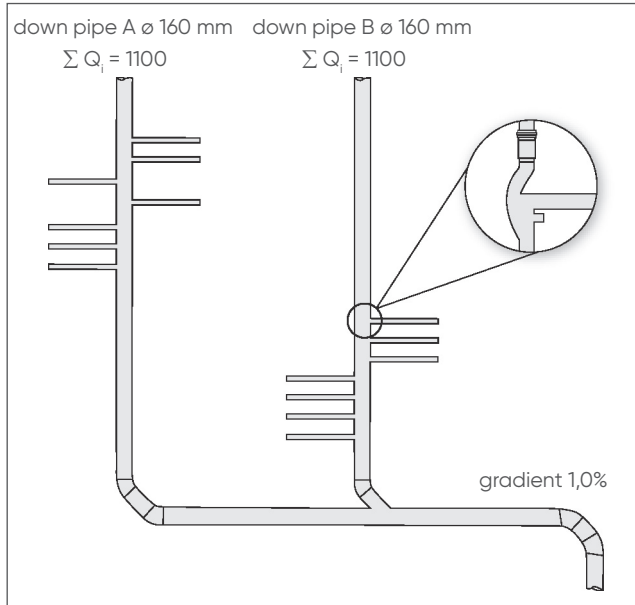


Illustration 5.13

The total capacity can be calculated by inserting the flow from all the drain fixtures into the simultaneity calculation.

$$Q_a \ 0,5 \cdot \sqrt{2200} = 23,45 \text{ l/s.}$$

Equation 5.4

The table below is a part of a table in EN 12056-2. It indicates the maximum flow per diameter and incline, based on 50% pipe filling.

Pipe ø	1:100 1,0%	1:67 1,5%	1:50 2,0%	1:40 2,5%	1:33 3,0%	1:20 5,0%
110	2,50	3,10	3,50	4,00	4,40	5,60
125	4,10	5,00	5,70	6,40	7,10	9,10
160	7,70	9,4	10,9	12,2	13,3	17,2
200	14,2	17,4	20,1	22,5	24,7	31,9
250	26,9	32,9	38,1	42,6	46,7	60,3
315	48,3	59,2	68,4	76,6	83,9	108,4

Table 5.8

The horizontal collector pipe taking the load of 11,7 l/s from stack A should continue horizontal in dimension 200 mm when installed at 1,0% gradient.

When stack B enters the horizontal collector pipe the size needs to be increased to 250 mm at 1,0 gradient to allow for the combined flow of 23,45 l/s.

6 Passive fire protection

Inside building there are two types of fire protection systems: Active fire protection and passive fire protection. Both systems should actively work together in the event of a fire.

Active fire protection

Active fire protection is a group of systems that require action in the event of a fire. This action can be manual, like a fire extinguisher, or automatic like a sprinkler system. When fire and/or smoke is detected these systems put out or, slow the growth of the fire until firefighters arrive.

Passive fire protection

Passive fire protection is a group of systems that compartmentalize a building through the use of fire-resistance rated walls and floors, keeping the fire from spreading quickly and providing time to escape for people in the building.

This chapter on fire protection in relation to Akatherm HDPE will address passive fire protection.

6.1 Fire compartmentation

Passive fire protection via compartmentation is important for life safety and property protection by dividing a building into smaller blocks. Vertical fire resistant walls and horizontal fire resistant floors aim to limit the fire spread and gain time. Compartmentation plays an important role in a building when the active system of the fire area is no longer able to control the fire.

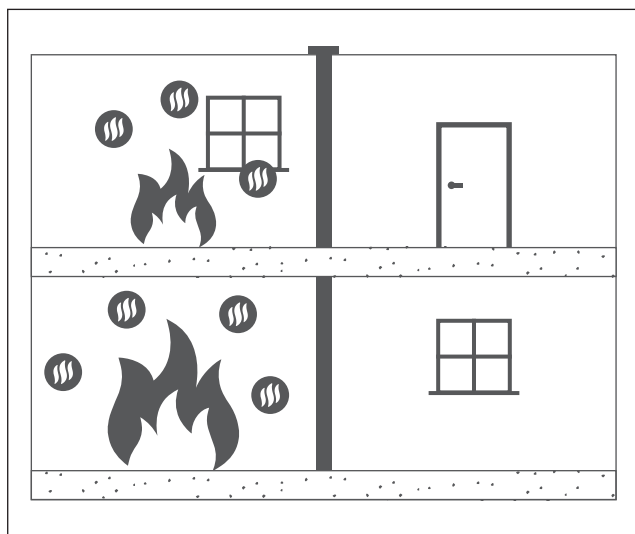


Illustration 6.1 Fire compartmentation

6.1.1 The four stages of fire development

Fire in a building evolves in four stages

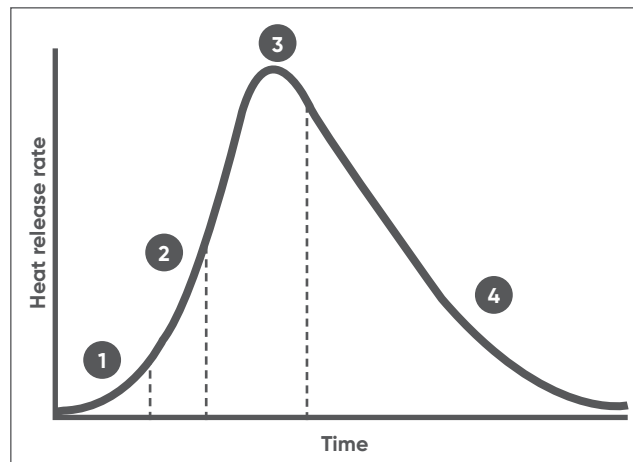


Illustration 6.2

1. Incipient stage

The incipient stage begins when heat, oxygen and a fuel source combine and have a chemical reaction resulting in fire. This is also known as "ignition" and is usually represented by a very small fire which often goes out on its own. Recognizing a fire in this stage provides the best chance at suppression or escape.

2. Growth stage

The growth stage is where the structures fire load and oxygen are used as fuel for the fire. There are numerous factors affecting the growth stage including where the fire started, what combustibles are near it and ceiling height. It is during this shortest of four stages when a deadly "flashover" can occur; potentially trapping, injuring or killing firefighters.



Flashover: the sudden complete involvement of a room in flames caused by thermal radiation feedback. Thermal radiation feedback will cause all combustible materials in the room to reach their ignition temperature.

3. Fully developed stage

When the growth stage has reached its max and all combustible materials have been ignited, a fire is considered fully developed. This is the hottest phase of a fire and the most dangerous for anybody trapped within.

4. Decay stage

Usually the longest stage of a fire, the decay stage is characterized by a significant decrease in oxygen or fuel, putting an end to the fire. Two common dangers during this stage are first - the existence of non-flaming combustibles, which can potentially start a new fire if not fully extinguished. Second, there is the danger of a "backdraft" (a smoke explosion) when oxygen is reintroduced to a volatile confined space.

6.1.2 Compartmentation during growth stage

A fire out of control occurs when the fire is at the flashover stage where everything that is combustible in a room is inevitably lost and one can only try to save the neighboring rooms or buildings.

Burnable hot gases are concentrated below the ceiling and are heated up due to the fire in the room. When this mixture of gases is hot enough, the flashover happens and a "wave" of fire rolls along the ceiling. A flashover does not occur in every fire compartment. The fuel must have sufficient heat energy to develop flashover conditions and the fire must have sufficient oxygen.

6.2 Fire behaviour of Akatherm HDPE

The behaviour of Akatherm HDPE in a fire, corresponds to material class B2 (normally inflammable) in accordance with DIN 4102, Part 1.

Standard	Classification
DIN 4102	B2
EN13501	E

Table 6.1

European standard EN 13501-1

This standard defines a class system for material behaviour at fire for building products and building constructions. The fire behaviour of the end product as applied needs to be described by its contribution to the development and spread of fire and smoke in an area or environment. All building products can be exposed to fire developing in an area that can grow (develop) and eventually flashover. This scenario contains three phases according to the development of a fire:

- Phase 1: flammability
- Phase 2: smoke generation
- Phase 3: flaming drops/parts

Fire classification

Phase 1: flammability

Class	Fire tests	Flashover	Contribution	Practice
F	Not tested, or does not comply to class E	Not classified	Not determined	Extremely flammable
E	EN-ISO 11925-2 (15 sec-Fs<150 mm-20 sec)	Flashover 100 kW <2 min	Very high contribution	Very flammable
D	EN 13823, Figra <750 W/s EN-ISO 11925-2 (30 sec-Fs<150 mm- 60 sec)	Flashover 100 kW >2 min	High contribution	Good flammable
C	EN 13823, Figra <120 W/s + Thr <15 MJ EN-ISO 11925-2 (30 sec-Fs<150 mm-60 sec)	Flashover 100 kW >10 min	Great contribution	Flammable
B	EN 13823, Figra <120 W/s + Thr <7,5 MJ EN-ISO 11925-2 (30 sec-Fs<150 mm-60 sec)	No flashover	Very limited contribution	Very difficult flammable
A2	EN ISO 1182 of EN-ISO 1716 plus EN 13823, Figra <120 W/s + Thr <7,5 MJ	No flashover	Hardly contribution	Practically not flammable
A1	EN ISO 1182 = Not flammable EN-ISO 1716 = Calorific value	No flashover	No contribution	Not flammable

Table 6.2

Fire safety level of buildings

The level of fire safety of a building is not equal in every European country. Each member state may determine in its regulations which products may be used and which fire class is found suitable.

German industry standard DIN 4102

In the past the official fire rating has been ruled according to DIN 4102 (still valid today).

Materials are tested for the degree of flammability and combustibility. DIN 4102 include for testing of passive fire protection systems, as well as some of its constituent materials. The following are the categories in order of degree of combustibility as well as flammability:

Rating	Degree of flammability
A1	100% non-combustible
A2	~98% non-combustible
B1	Difficult to ignite
B2	Normal combustibility
B3	Easily ignited

Table 6.3

6.3 Fire collar protection

The fire behavior of Akatherm HDPE is rated as normally inflammable, class B2 according to DIN 4102. When Akatherm HDPE passes through fire-rated building elements, it is mandatory to install fire protection collars that will not reduce the fire-rating of these building elements and prevent a flashover. The Akatherm HDPE system can be installed with Promat fire collars as an effective passive fire safety solution.

Certification

Promat fire collars are tested with Akatherm HDPE according to EN1366-3:2009 and hold a fire resistance classification certificate according to EN13501-2:2016.

Measuring passive fire stopping

Passive fire stopping by means of fire collars is measured in terms of integrity and insulation. Stability or structural adequacy is not recorded for service penetrations like pipes, except when those which are required to be load bearing. Integrity failure occurs when cracks, holes or openings occurs through which flames or hot gases can pass.

Insulation failure occurs when the temperature on the unexposed surface of the pipe system exceed a set temperature (~180°C). To prevent failure in interlinked concealed cavities, where pipe systems generally run, it is vital to ensure compartmentation by sealing any and all gaps, including gaps left for structural movement and gaps left due to poor workmanship.

EU standard EN1366-3:2009 is accepted for fire testing in many parts of the world. For more information related to fire safety testing regulation in conformity with international standards please contact your Aliaxis export office.

! Applicable national regulations, standards, codes and building practice on fire protection must be observed.

6.3.1 Wall penetrations with Akatherm HDPE

Penetrations of fire rated walls require two fire collars on both sides of wall. The origin of the fire is unknown and can come from both sides.

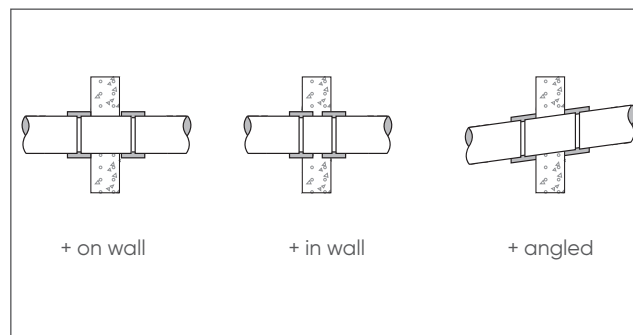


Illustration 6.3

Akatherm HDPE is tested in a variety of ceiling constructions, please refer to the fire resistance rating chapter.

6.3.2 Ceiling penetrations with Akatherm HDPE

Penetrations of fire rated ceilings require one fire collar installed on the bottom of the ceiling. The heat of the fire and the flashover come only from below.

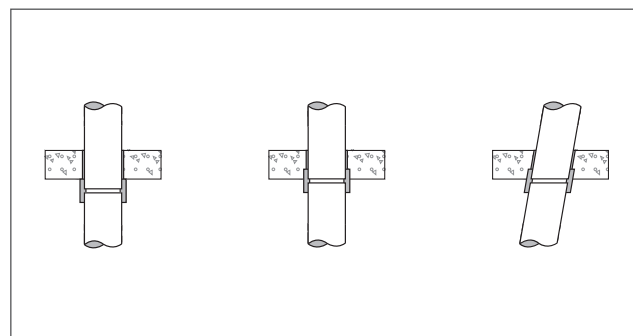


Illustration 6.4

Akatherm HDPE is tested in a variety of ceiling constructions, please refer to the fire resistance rating chapter.

6.4 Promat fire resistance rating for HDPE

Promat fire collars are tested with Akatherm HDPE according to EN1366-3:2009 and hold a fire resistance classification certificate according to EN13501-2:2016.

Wall penetrations of Akatherm HDPE pipes

		Akatherm pipe outer diameter (mm)																	
		40	50	56	63	75	90	110	125	160	200	250	315						
Type	Thickness	Specification	Promat fire collar	Penetration angle	Installation	Load bearing/Integrity/Insulation													
Concrete wall	> 100 mm	> 450 kg/m ³	Promastop-FC3	90°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-		
			Promastop-FC6	90°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-
			Promastop-FC6	45°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-	-	-
	> 150 mm	> 450 kg/m ³	Promastop-FC3	90°	In wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-	
			Promastop-FC6	90°	In wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-
			Promastop-FC6	90°	On wall	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-/240/240	-	-	-
Multiboard (wood) wall	> 140 mm		Promastop-FC3	90°	On wall	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-	
			Promastop-FC6	90°	On wall	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-
Sandwich panel wall	> 80 mm		Promastop-FC3	90°	On wall	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-	
			Promastop-FC6	90°	On wall	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-
Light partition wall	> 100 mm		Promastop-FC3	90°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-		
			Promastop-FC6	90°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-	
			Promastop-FC6	45°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-	-	
Shaft wall	> 2 x 15 mm		Promastop-FC6	90°	On wall	-/60/60	-/60/60	-/60/60	-/60/60	-/60/60	-/60/60	-/60/60	-/60/60	-/60/60	-	-	-		
	> 2 x 20 mm		Promastop-FC6	90°	On wall	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-		
	> 2 x 25 mm		Promastop-FC6	90°	On wall	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-		

Table 6.4

Ceiling penetrations of Akatherm HDPE pipes

		Akatherm pipe outer diameter (mm)																
		40	50	56	63	75	90	110	125	160	200	250	315					
Type	Thickness	Specification	Promat fire collar	Penetration angle	Installation	Load bearing/Integrity/Insulation												
Concrete ceiling	> 150 mm	> 650 kg/m ³	Promastop-FC3	90°	On ceiling	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-	
			Promastop-FC6	90°	On ceiling	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-
			Promastop-FC6	45°	On ceiling	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-/120/120	-	-	-
Suspended ceiling	> 40 mm	2 layers	Promastop-FC3	90°	On ceiling	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-	-	-	-	-	
			Promastop-FC6	90°	On ceiling	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-/90/90	-	-

Table 6.5

6.5 Plastics and fire safety

Although most metal pipes are classified as non-combustible, and plastic pipes as combustible, one needs to have a closer look at which drain, waste and vent (DWV) pipe material may be advantageous for life safety in a building fire.

It is important to note that in most fire safety codes, the objectives are not on prevention of fire, but rather on the spread of fire. In other words, construction practices are specified with regard to fire safety that if a fire should break out for some reason, that the building construction practices should be such that this fire is compartmentalized to remain in the compartment of origin, thus allowing sufficient time for fire suppression activities to occur such as fire sprinklers or fire department response.

It is generally conceded that most combustible pipes will be consumed fairly quickly in a fire but does that create a large fire safety risk for the remainder of the building? The answer is no.

The reason it does not is through very effective fire stopping. Fire stopping is the process of applying tested materials and systems to the underside of floors or on both sides of walls whereby the penetration for the pipe will not allow passage of heat or flame to adjacent compartments. It can be argued that fire stopping devices such as collars actually work more effectively with combustible pipe than they would for metal pipe. This is because these devices tend to sever off a combustible pipe very early in a fire as the intumescent material rapidly expands and fills the hole left by the consumed pipe. The end result is a collar fastened to the floor or wall surface that contains a large amount of charred material which is resistant to the passage of flame or significant heat. They are effectively like a lump of coal protecting the hole during the fire and will typically offer sufficient protection.

Fire stopping metal pipe is also somewhat common but works much differently. Since the metal pipe will not be consumed during the fire, the focus of fire stopping is simply to seal off the annular space between the pipe's outside diameter and the hole interior. Mineral wool and firestop caulking can achieve this but there are two concerns with these systems.

One is that the mineral wool plus caulking will not prevent a high level of heat transfer from one compartment to the next through the very conductive metal pipe. Temperature increases on the unexposed side of a pipe penetration can easily exceed 180°C with uninsulated metal pipe. Having this hot stove pipe effect can actually inadvertently ignite combustible materials on the unexposed side of a fire and thus allow continuity of the fire beyond the separation.

Secondly, the most common manner of joining cast iron pipes today is through the use of a rubber, steel mesh sleeved mechanical joint couplings. During a fire, the rubber component of these couplings can be consumed which will potentially create openings in a cast iron stack (vertical pipe) and thus allow fire to enter the pipe interior and breach the separation by spreading to the unexposed side.

7 Fixing system and thermal movement

The Akatherm HDPE pipe system expands and contracts under influence of temperature changes. The pipe system therefore has to be installed to allow for compensation of these changes.

7.1 Choice of pipe installation methods

The choice of the pipe fixing system is essential to correctly install the pipe system. Depending on the temperature of the medium, the ambient temperature and the building constraints multiple options exist:

1. Free moving guide bracket system with axial movement correction by means of:
 - Snap expansion sockets
 - Deflection legs
 - Deflection leg with expansion socket
2. Rigid anchor point bracket system
3. Embedding HDPE in concrete
4. Underground installation of HDPE

7.2 Bracket assembly methods

7.2.1 Guide bracket

The guide bracket is used to support the pipe and to prevent the pipe from buckling sideways in a rigid installation. The pipe can freely move in the bracket.

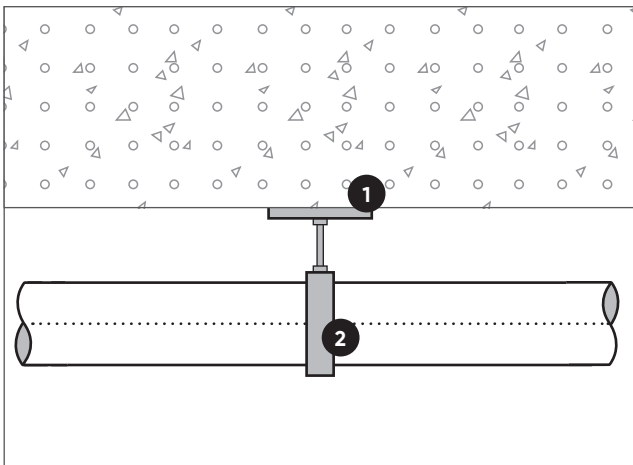


Illustration 7.1 Guide bracket

1. mounting plate for guide bracket code 7094xx
2. guide bracket code 70xx10/70xx80

7.2.2 Anchor point bracket

This method of bracketing is used for rigid installation. The expansion forces are transferred to the building structure. Within the Akatherm product range there are two options:

Anchor bracket with 2 electrofusion couplers

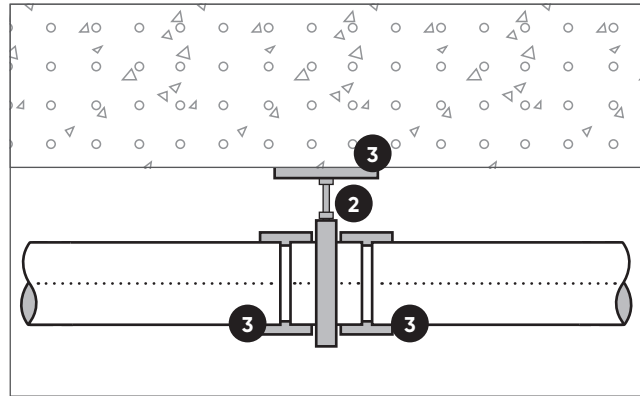


Illustration 7.2 Anchor bracket with electrofusion couplers

1. electrofusion coupler code 41xx95
2. anchor bracket code 70xxxx
3. mounting plate for anchor bracket code 7094xx

Anchor bracket with expansion socket

This method of installation is used for flexible installation where the expansion force is not transferred to the building structure. Only the force caused by the internal resistance of the expansion socket is transferred.

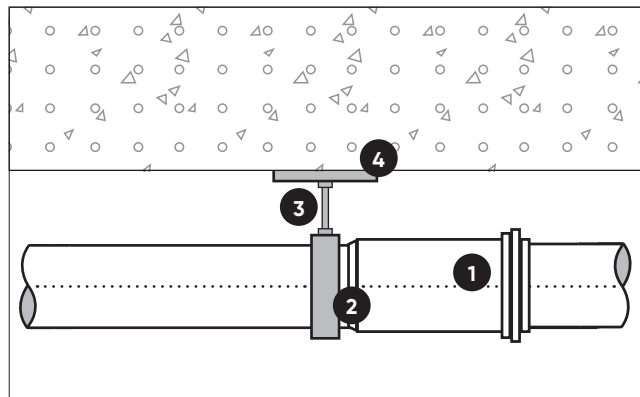


Illustration 7.3

1. expansion socket code 40xx20/42xx20
2. clamp liner code 70xx15
3. anchor bracket code 70xxxx
4. mounting plate for anchor bracket code 7094xx



In all previously mentioned setups the anchor bracket must be fixed to the building in such a way that it can resist the forces caused by the expansion or contraction of the pipe. Movement of the pipe bracket has to be limited to a minimum.



Do not use guide brackets (70xx10/70xx80) in an anchor bracket configuration. Anchor brackets are designed so that they can cope with the forces transmitted due to expansion and contraction of the piping system.

7.3 Guide bracket system with expansion sockets

7.3.1 Expansion and contraction calculation

The axial movement is caused by the linear expansion of the pipe. The total expansion Δl triggered by the temperature difference can be calculated using equation 7.1. A visual representation of expansion at specific temperature differences can be found in graphic drawing 7.1.

$$\Delta l_t = L_{\text{buis}} \cdot \alpha_t \cdot t_{\text{max}}$$

Equation 7.1 Length change caused by temperature difference

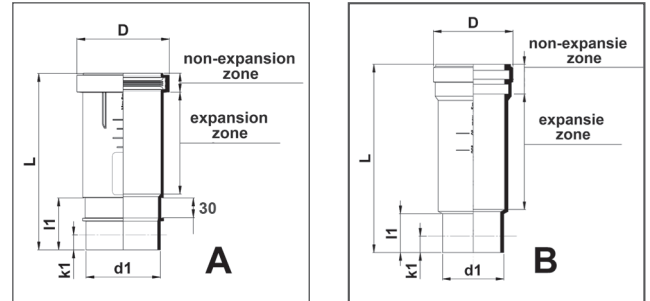
Δl_t = length change (mm)

L_{pipe} = total length of pipe (m)

α_t = linear expansion coefficient (mm / m²K)

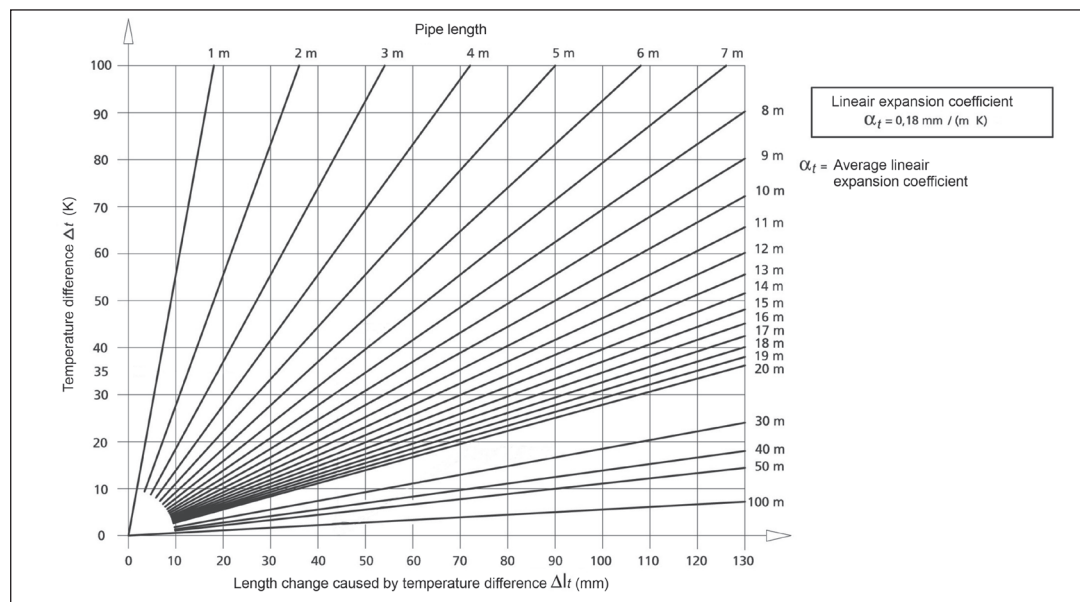
t_{max} = temperature difference in °C

The maximum length change which can be accommodated by the expansion sockets can be found in table 7.1



(mm)	Code	D (mm)	L (mm)	Non- expansion zone (mm)	Expansion zone (mm)	l ₁ (mm)	k ₁ (mm)	Type
40	400420	56	172	25	109	35	-	B
50	400520	65	172	25	109	35	-	B
56	405620	72	172	25	109	35	-	B
63	400620	80	155	25	114	15	-	B
75	420720	98	255	32	148	72	30	A
90	420920	114	255	32	148	72	30	A
110	421120	135	260	35	145	76	35	A
125	421220	152	260	38	142	76	35	A
160	421620	186	266	41	148	76	35	A
200	402020	240	300	45	200	55	-	B
250	402520	298	325	55	205	62	-	B
315	403120	372	355	55	225	68	-	B

Table 7.1 Length change with expansion sockets



Graphic drawing 7.1 Length change caused by temperature difference

The number of expansion sockets necessary can be calculated using equation 7.1.

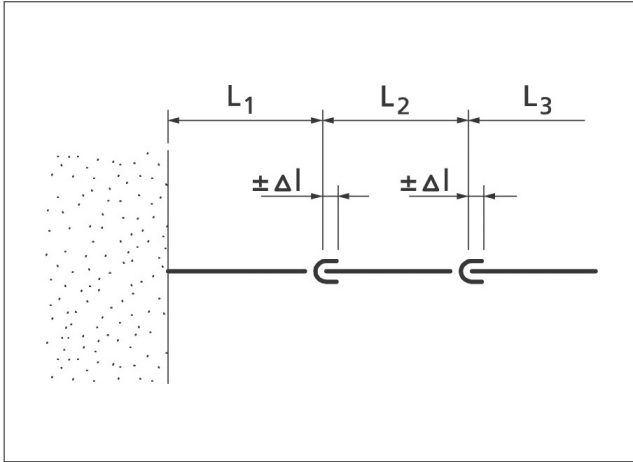


Illustration 7.4 Pipe section with expansion sockets

Example:

Length pipe section ($L_1+L_2+L_3$): 18 m
 Installation temperature: 5°C - 278K
 Temperature medium: +15°C / +75°C - 288K/348K
 Temperature difference: 75-5 = 70°C - 343K
 Total expansion: 18 m x 0,18 mm/mK . 70K = 227 mm
 Expansion length per expansion socket d110 = 141mm

In a pipe section consisting of 100 mm pipe this results in $227/141 = \sim 1.6 = 2$ expansion sockets. Therefore, based upon the calculation only 2 expansion sockets are needed.

With short term temperature differences, for example the emptying of a bathtub, a reduction factor of 0,5 can be applied to the temperature difference. In the example this would result in $0,5 \times 227/141 = \sim 0,8 = 1$ expansion socket.

7.3.2 Horizontal installation

The bracket directly in front of the expansion socket has a shorter bracket distance (L_A^*). This enables a better guidance into the expansion socket (see illustration 7.6). The bracketing distances for this application can be found in table 7.2. The maximum distance between 2 expansion sockets is 5 m.

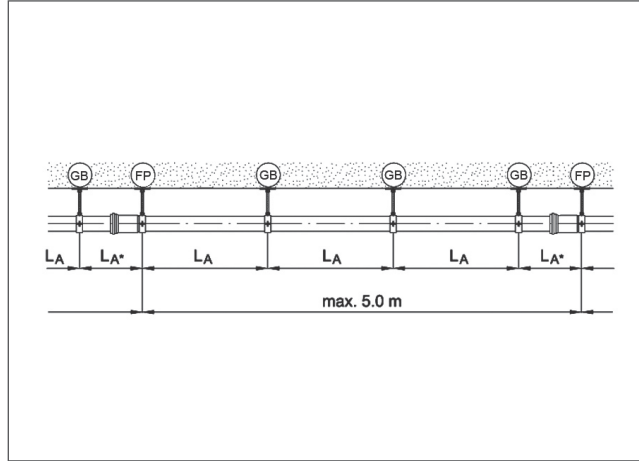


Illustration 7.5 Horizontal installation with expansion sockets without support trays

GB = guide bracket
 FP = anchor point
 L_A = bracket distance
 L_A^* = bracket distance before expansion socket

d_i	L_A (m)	L_A^* (m)
50	0,8	0,4
56	0,8	0,4
63	0,8	0,4
75	0,8	0,4
90	0,9	0,5
110	1,1	0,6
125	1,3	0,7
160	1,6	0,8
200	2,0	1,0
250	2,0	1,0
315	2,0	1,0
315	2,0	1,0

Table 7.2 Bracket distances horizontal installation with expansion sockets without support trays

7.3.3 Horizontal installation with support tray

In this kind of installation the pipe is extra supported by support trays. The distance between the brackets can be larger than without support trays. The support trays are installed on to the pipe with straps. For distances see table 7.3.

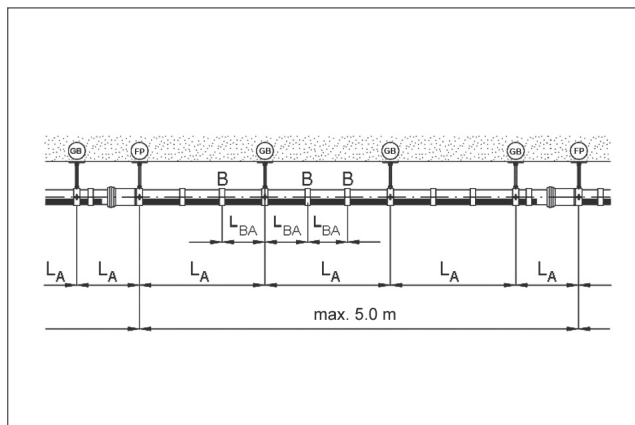


Illustration 7.6 Bracket distances horizontal installation with expansion sockets without support trays

- GB = guide bracket
- FP = anchor point
- B = tray band
- L_A = bracket distance
- L_A* = bracket distance before expansion socket
- L_{BA} = spacing for straps

d _i	L _A (m)	L _A * (m)	L _{BA} (m)
50	1,0	0,5	0,5
56	1,0	0,5	0,5
63	1,0	0,5	0,5
75	1,2	0,6	0,5
90	1,4	0,7	0,5
110	1,7	0,9	0,5
125	1,9	1,0	0,5
160	2,4	1,2	0,5
200	3,0	1,5	0,5
250	3,0	1,5	0,5
315	3,0	1,5	0,5

Table 7.3 Bracket distances horizontal installation with expansion sockets and support trays

7.3.4 Vertical installation

The bracketing distance for vertical installation is in general 1,5 times the distance of the horizontal bracketing. There is no separate bracket distance for immediately in front of the expansion socket because there is no sagging of the pipe and the insertion is always in line.

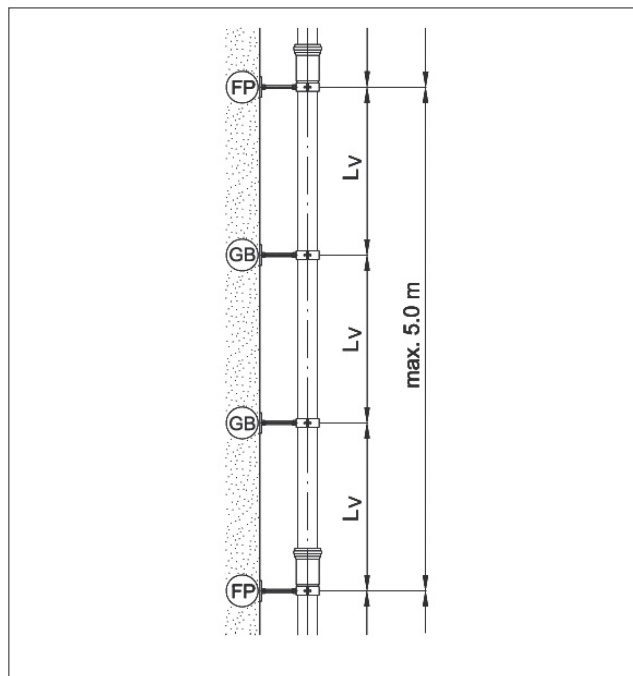


Illustration 7.7 Vertical installation

- GB = guide bracket
- FP = anchor point
- L_V = bracket distance

d _i	L _V (m)
50	1,0
56	1,0
63	1,0
75	1,2
90	1,4
110	1,7
125	1,9
160	2,4
200	3,0
250	3,0
315	3,0

Table 7.4 Bracket distances vertical installation from wall to wall

In the table 7.5 the diameters of the connecting pipe are listed per pipe dimension and the distance from the wall/floor. The threaded rod diameter as given in the table has to be respected to prevent pipe movement.

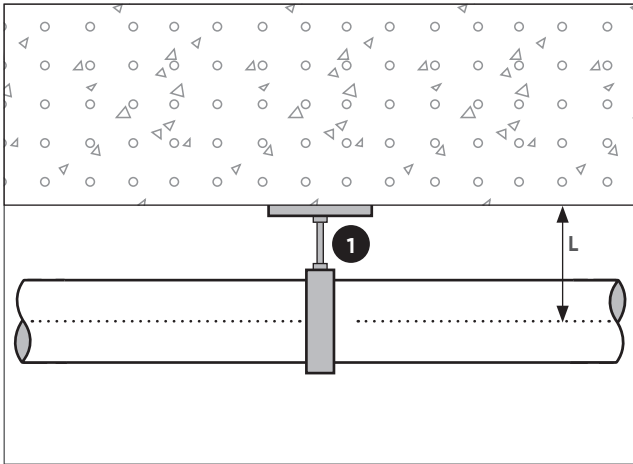


Illustration 7.8

1. diameter of the connecting rod

! In all cases, brackets have to be connected to the pipe in accordance with the installation instructions. Movement of the bracket itself, opposed to the longitudinal movement of the pipe system is to be minimized.

		Bracketing using expansion sockets - diameter of the connecting rod																								
Pipe diameter (mm)		40		50		56		63		75		90		110		125		160		200		250		315		
		Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	
Distance to wall/floor L (mm)	100	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"							
	200	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	1"	1"	1"	1"	1"	1 1/4"	
	300	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	3/4"	1/2"	3/4"	1/2"	1"	1"	1"	1 1/4"	1"	2"	
	400	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	M10	1/2"	3/4"	1/2"	3/4"	1/2"	3/4"	1/2"	1"	1"	1 1/4"	1"	1 1/4"	1"	2"
	500	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/4"	1/2"	3/4"	1/2"	3/4"	1/2"	1"	1/2"	1"	1"	1 1/4"	1"	1 1/4"	1"	2"	
	600	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/4"	1/2"	3/4"	1/2"	3/4"	1/2"	1"	1/2"	1 1/4"	1"	1 1/4"	1"	2"	1"	2"	

Table 7.5

Guide = guide bracket
 Fixed = expansion socket

7.4 Guide bracket system with deflection leg

7.4.1 Deflection leg calculation

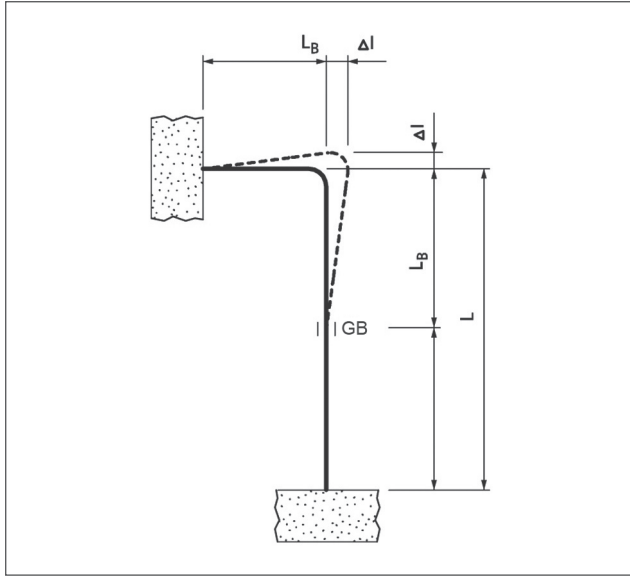


Illustration 79 Installation with deflection leg

- L_B = length deflection leg
- L = pipe length
- GB = guide bracket
- Δl = length change

For calculating the length of the deflection leg, the equation 7.2 can be used.

$$L_B = 10 \times \sqrt{\Delta l \times d_{1,2}}$$

Equation 7.2 Computing the length of deflection leg

- L_B = Length of deflection leg (mm)
- d_1 = Diameter pipe (mm)
- Δl = Length change caused by expansion (mm)

First the length change Δl has to be determined at a temperature difference Δt_{max} (see paragraph 7.3.1).

Remark:

If the calculated deflection leg is shorter than the available length there will be no extra load on the pipe system.

! If this is not the case, an additional expansion socket needs to be installed (see paragraph 7.4.2).

Fixing system

Check: Allowed $L_A \leq L_{B1} + L_{B2}$

Equation 7.3

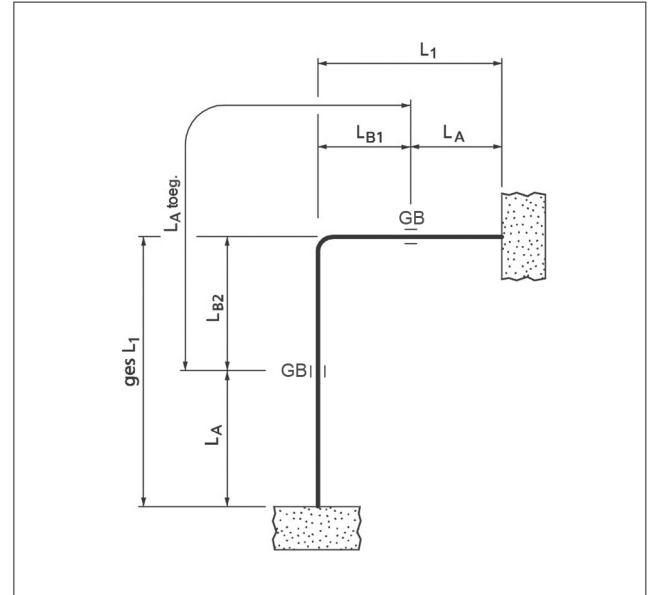


Illustration 710 Check fixing system

- L_1 = pipe length
- L_A = bracket distance
- L_{B1}/L_{B2} = length deflection leg
- ges L_1 = total length L_1
- $L_{A, toeg.}$ = allowed bracket distance
- GB = guide bracket

When the distance between both guide brackets is larger than the allowed bracket distance L_A , the deflection leg needs additional support to prevent sagging. This extra bracket should not hinder the working of the deflection leg. This can be done by a pendulum bracket. Bracket distance L_A can be found in table 7.6.

d_1	L_A (m)
50	0,8
56	0,8
63	0,8
75	0,8
90	0,9
110	1,1
125	1,3
160	1,6
200	2,0
250	2,0
315	2,0

Table 7.6 Bracket distances horizontal installation with anchor brackets

Anchor bracket with double-flange bushing

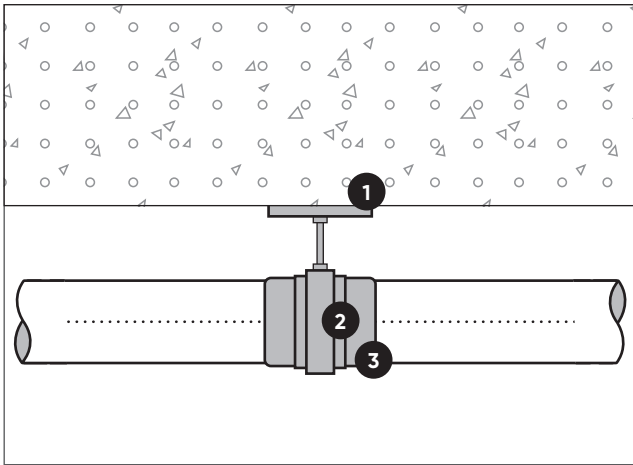


Illustration 7.11

- 1. mounting plate for anchor bracket code 7094xx
- 2. anchor bracket code 70xxxx
- 3. double-flange bushing code 43xx15

Anchor bracket with expansion socket

This method of installation is used for flexible installation where the expansion force is not transferred to the building structure. Only the force caused by the internal resistance of the expansion socket is transferred.

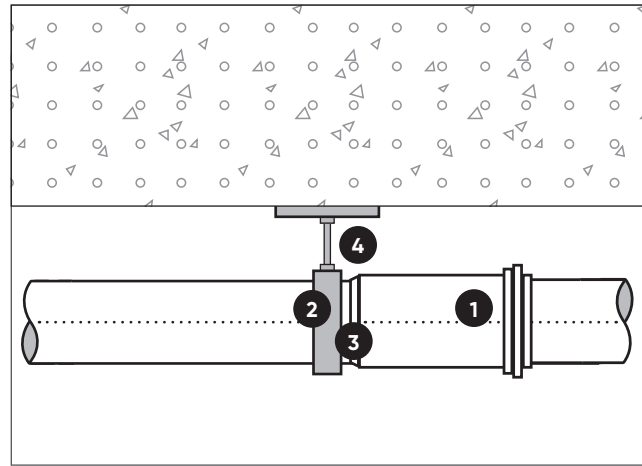


Illustration 7.12

- 1. expansion socket code 40xx20/42xx20
- 2. clamp liner code 70xx15
- 3. anchor bracket code 70xxxx
- 4. mounting plate for anchor bracket code 7094xx

! In all previously mentioned mentioned setups the anchor bracket must be fixed to the building in such a way that it can resist the forces caused by the expansion or contraction of the pipe. Movement of the pipe bracket has to be limited to a minimum.

! Do not use guide brackets (70xx10/70xx80) in an anchor bracket configuration. Anchor brackets are designed so that they can cope with the forces transmitted due to expansion and contraction of the piping system.

		Bracket system using expansion legs - diameter of the connecting rod																							
Pipe diameter (mm)		40		50		56		63		75		90		110		125		160		200		250		315	
		Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed	Guide	Fixed
Distance to wall/floor L (mm)	100	M10	¾"	M10	1"	M10	1"	M10	1"	M10	1 ¼"	M10	1 ¼"	M10	1 ½"	M10	2"								
	200	M10	1 ¼"	M10	1 ½"	M10	1 ½"	M10	1 ½"	M10	1 ½"	M10	2"	M10		M10				1"		1"			1"
	300	M10	1 ¼"	M10	2"	M10	2"	M10	2"	M10	2"	M10		M10		½"		½"		1"		1"			1"
	400	M10	1 ½"	M10	2"	M10	2"	M10	2"	M10	2"	M10		½"		½"		½"		1"		1"			1"
	500	½"	2"	½"	2"	½"	2"	½"		½"		½"		½"		½"		½"		1"		1"			1"
	600	½"	2"	½"	2"	½"		½"		½"		½"		½"		½"		½"		1"		1"			1"

Table 7.7

Guide = guide bracket
Fixed = expansion socket

7.4.2 Deflection leg calculation with expansion socket

When possible a combination of a deflection leg with expansion sockets is recommended. It uses the advantages of both systems and saves expansion sockets. In illustration 7.14 you will find an example.

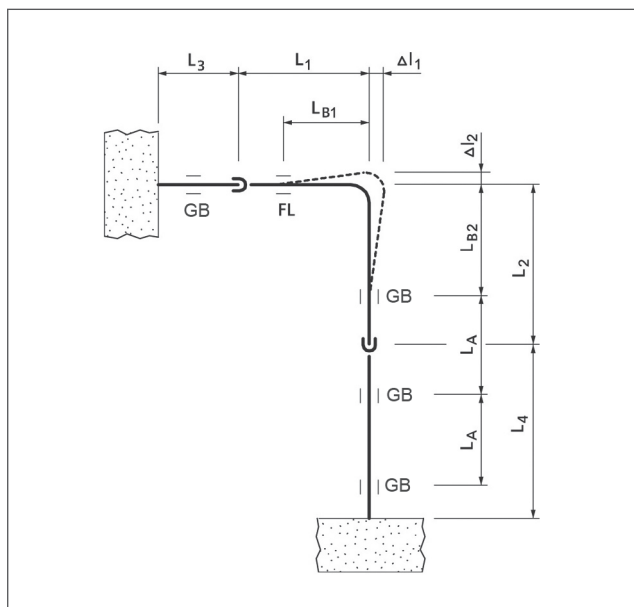


Illustration 7.13 Installation with deflection leg and expansion sockets

- $L_1/L_2/L_3/L_4$ = pipe length
- L_A = bracket distance
- L_{B1}/L_{B2} = length deflection leg
- $\Delta l_1/\Delta l_2$ = length change
- GB = guide bracket
- FL = guide bracket

Operating temperature: +15°C/+75°C

Pipe lengths $L_1 - L_4 \leq 5$ m

The expansion sockets take up the expansion of pipe sections L_3 and L_4 . Several guide brackets have to be installed. The deflection leg L_{B1} and L_{B2} compensates the length change of L_1 and L_2 from pipe section L_1 and L_2 . When the expansion is more than can be compensated in one expansion socket a number of expansion sockets with anchor brackets need to be used. Guide bracket FL prevents lateral kinks.

7.5 Anchor point bracket system

7.5.1 Bracket distance at different temperatures

The bracket distances for Akatherm HDPE depend on the working temperature and the weight of the pipe including the medium. When the pipe is fully filled, other bracket distances are applicable (see table 7.8).

7.5.2 Horizontal installation

! Because the pipe generates different forces with different dimensions, the anchor brackets have to be placed at dimension changes, branches and on the beginning and end of a pipe section.

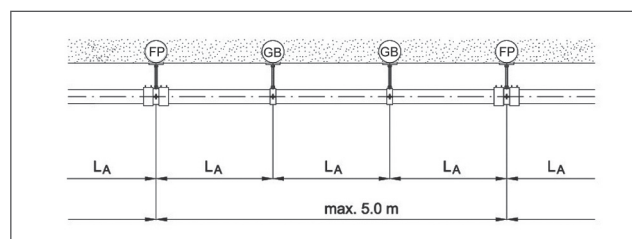


Illustration 7.14 Horizontal installation with anchor points

- GB = guide bracket
- FP = anchor point
- L_A = bracket distance

d_i	L_A (m)
50	0,8
56	0,8
63	0,8
75	0,8
90	0,9
110	1,1
125	1,3
160	1,6
200	2,0
250	2,0
315	2,0

Table 7.8 Bracket distances horizontal installation with anchor brackets

7.5.3 Horizontal installation with anchor points and support trays

! Because the pipe generates different forces with different dimensions, the anchor brackets have to be placed at dimension changes, branches and on the beginning and end of a pipe section.

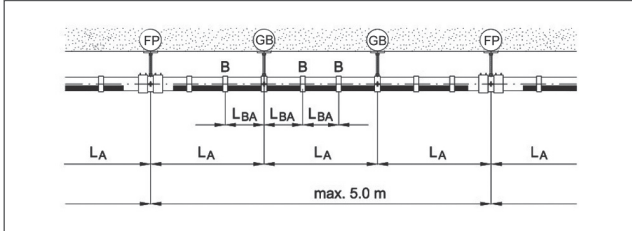


Illustration 7.15 Horizontal installation with anchor points and support trays

GB = guide bracket
 FP = anchor point
 L_A = bracket distance
 L_{BA} = spacing for straps

d_1	L_A (m)	L_{BA} (m)
50	1,0	0,5
56	1,0	0,5
63	1,0	0,5
75	1,2	0,5
90	1,4	0,5
110	1,7	0,5
125	1,9	0,5
160	2,4	0,5
200	3,0	0,5
250	3,0	0,5
315	3,0	0,5
315	3,0	0,5

Table 79 Bracket distances horizontal installation with anchor brackets and support trays

7.5.4 Vertical installation

The bracketing distance for vertical installation is in general 1,5 times the distance of the horizontal bracketing.

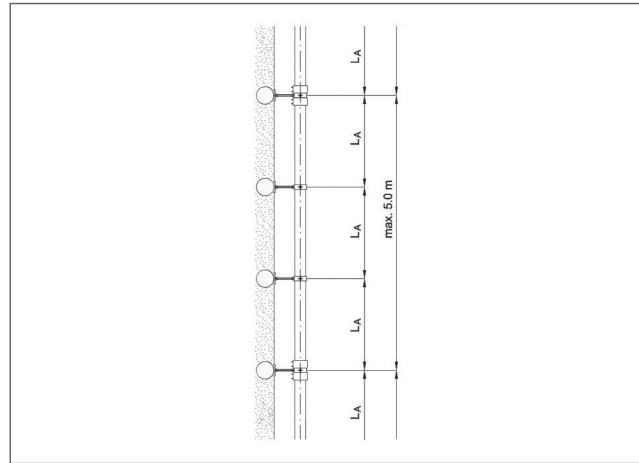


Illustration 7.16 Vertical installation with anchor points

GB = guide bracket
 FP = anchor point
 L_A = bracket distance

d_1	L_A (m)
50	1,0
56	1,0
63	1,0
75	1,2
90	1,4
110	1,7
125	1,9
160	2,4
200	3,0
250	3,0
315	3,0

Table 7.10 Bracket distances vertical installation with anchor brackets

7.5.5 Distance of the bracket to the wall or ceiling

In table 7.5 the diameters of the connecting pipe are listed per pipe dimension and distance from the wall/floor (see illustration 7.18).

! When the pipe is larger than 160 mm, a special construction is needed and has to be dimensioned.

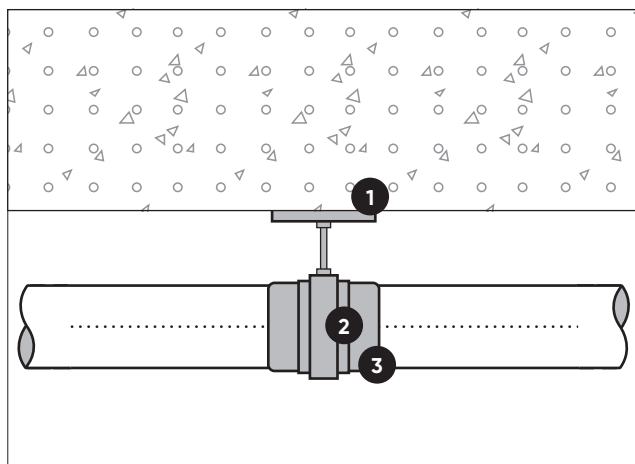


Illustration 7.17 1 = diameter of the connecting tube

1. Mounting plate for anchor bracket code 7094xx
2. Anchor bracket code 70xxx
3. Double-flange bushing code 43xx15

! In all previously mentioned mentioned setups the anchor bracket must be fixed to the building in such a way that it can resist the forces caused by the expansion or contraction of the pipe. Movement of the pipe bracket has to be limited to a minimum.

! Do not use guide brackets (70xx10/70xx80) in an anchor bracket configuration. Anchor brackets are designed so that they can cope with the forces transmitted due to expansion and contraction of the piping system.

7.6 Embedding HDPE in concrete

7.6.1 installation guidelines before pouring concrete

High-density polyethylene (HDPE) is well suited to be embedded in concrete. Depending on the installation circumstances and material used, certain installation practices are to be applied.

Several precautions have to be taken for the pipe system to withstand the forces resulting from expansion and shrinkage of the concrete:

- Outer pressure on the piping system due to the liquid concrete being poured may cause the pipe system to be deformed. To prevent this ensure that the pipe system is completely filled with water.
- When quick-drying concrete is used, the exothermic reaction (a chemical reaction that is accompanied by the release of heat) may cause the maximum allowed temperature of HDPE to be exceeded. This may degrade the material and lower the threshold for the maximum allowed negative pressure. In this case, ensuring the pipe system is filled with water and thus creating an incompressible closed system is critical.
- The pipe system has to be secured against movement before pouring the concrete.

7.6.2 Expansion and contraction compensation

Because HDPE and hardened concrete do not adhere, the pipe system embedded in concrete can move freely when expanding under influence of temperature changes. All fittings installed in the pipe system act as an anchor point and are subjected to expansion forces. The concrete acts as a rigid system and the expansion and possible deformation of the fittings has to be counteracted like in any HDPE installation.

Embedding HDPE in concrete

All 45° and 88,5° branches are subjected to expansion forces which can be counteracted by installing an electrofusion coupler (see illustration 7.18).

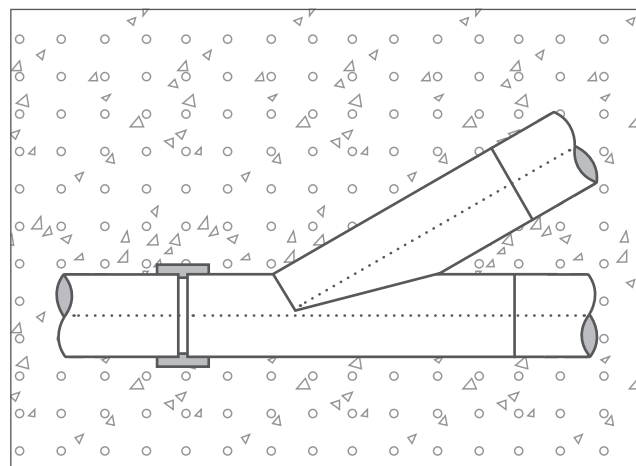


Illustration 7.18 Anchor point with an electrofusion coupler

If contraction of pipe has to be compensated (snap) expansion sockets can be used. The (snap) expansion sockets act as an anchor point on one side and absorb the expansion on the other side of the socket. The snap-expansion socket can accommodate the expansion and contraction of a 5 meter pipe.

! When rubber ring connections are used assure that the rubber ring cannot be contaminated with concrete mix water. To do so use plastic film or insulating tape.

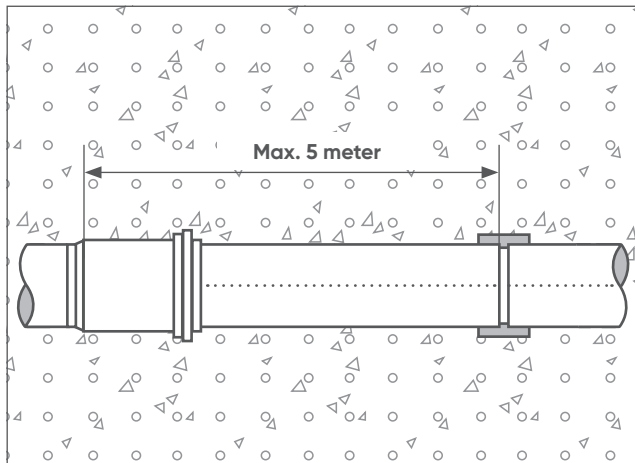


Illustration 7.19 Expansion socket in concrete

Embedding insulated HDPE in concrete

In case HDPE is embedded into concrete using thermal or acoustic insulation the system needs to be protected from expansion forces and slippage inside the concrete and insulation material. In order to do this the following configuration has to be considered:

1. Pipe (with insulation material)
2. Electrofusion socket
3. Pipe bracket
4. Threaded rod (1/2")

The pipe and electrofusion socket are to be insulated first. After insulating the pipe bracket is to be placed and fastened in between the electrofusion sockets. The threaded rod can be used to increase the anchoring.

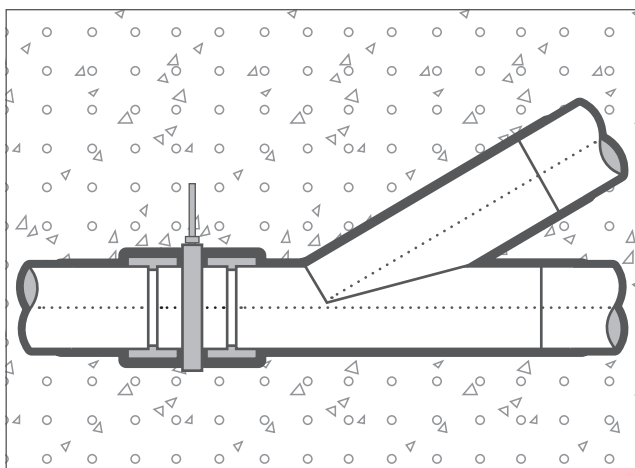


Illustration 7.20 Insulated HDPE in concrete

7.7 Underground installation of HDPE

The properties of Akatherm HDPE make the system ideal for use in underground pipelines:

- Akatherm HDPE is a fully closed pipe system. When the installation instructions are properly applied (chemical) soil and waste has no way of entering the environment.
- The system is suitable to be installed in a wide temperature range. It is possible to install Akatherm HDPE in cold climates (-40°C).
- The flexibility of the pipe system makes it especially suitable for underground installations in which small ground movements may take place.

The stability of the Akatherm HDPE pipe system allows it to withstand pressures exposed to the pipe system when laid at substantial depth. Various factors such as depth, groundwater level, trench width, embedding, the density of the soil and traffic load have to be considered.

7.7.1 Loads

The load capacity of underground plastic pipes is determined by a combination of factors. The vertical load by the soil directly above the pipe causes the pipe to be compressed in turn this will cause the sides of the pipe to be pressed outward against the surrounding soil. The resulting pressure, the axial compression exercised on the pipe by the surrounding soil prevents a larger deformation of the pipe. The construction of the trench, the type of bedding used and the backfilling of the trench are, to a large extent, decisive factors determining the total support function of the trench and thus, the maximum load capacity of the underground plastic pipe.

! Bends in the pipe system may cause soil load to be concentrated in specific points. When designing the system ensure that the load is evenly divided over the entire length of pipe.

! Traffic loads may cause increased pressure on the piping system. Ensure that loads are evenly distributed.

! Underground pipes can be subject to external overpressure, especially in areas with high groundwater levels.

Pipe systems subject to additional external pressure must be tested for the ability to withstand denting.

7.7.2 Construction and installation of underground pipe systems

To assure that soil and traffic loads are evenly distributed it is important to take care of proper construction of the pipe trench. To do so a trench base, pipe embedding layer and protective layer have to be created.

! It is the responsibility of the purchaser, specifier or installer to install the pipe system taking into account particular requirements and any relevant national regulations and installation practices or codes.

! Akatherm HDPE has been designed according to EN1519 which limits underground use of pipes and fittings.

Trench base (bedding) - zone 1

The state and form of the trench base must match the mechanical properties of the HDPE pipe.

The existing or newly constructed support layer must consist of stone-free sand that has been slightly compressed using a suitable piece of equipment. The pipe must be laid in such a way that a stable surface with at least a 90° arc of enclosure is created in order to prevent sagging or intermittent loads.

The trench in which the pipe is laid must be sufficiently wide in order to keep the final soil pressure as low as possible. The space between pipe and trench wall must be at least $\varnothing + 20$ mm.

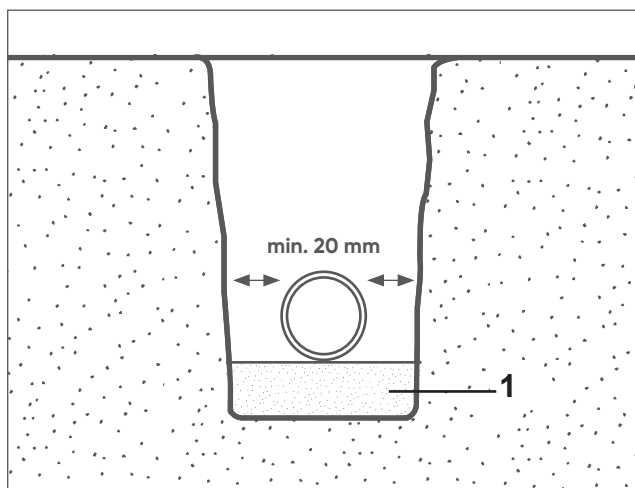


Illustration 7.21

The height of zone 1 depends on the soil conditions and the nominal pipe width, the heights for Akatherm HDPE are provided in table 7.20.

d	Normal soil	Rocky or thick soil
75	108 mm	158 mm
90	109 mm	159 mm
110	111 mm	161 mm
125	113 mm	163 mm
160	116 mm	166 mm
200	120 mm	170 mm
250	125 mm	175 mm
315	132 mm	182 mm

Table 7.11 Zone 1 height

Embedding of the pipe (consolidation) - zone 2

The fill for the pipe system embedding must consist of stone-free sand or similar material: the fill must ensure optimal compacting of the ground. The embedding is, to a large extent, a decisive factor in distributing the soil pressure and load, as well as providing lateral soil pressure on the pipe with the resulting pipe support effect.

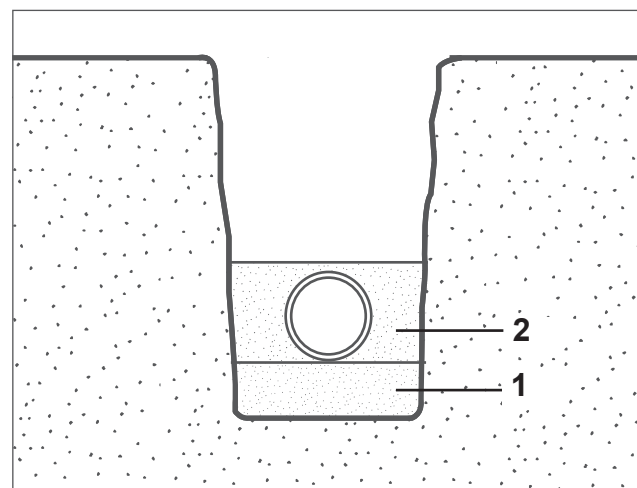


Illustration 7.22

The height of zone 2 must extend to at least 150 mm above the pipe. This must also be at least 100 mm above any pipe fittings.

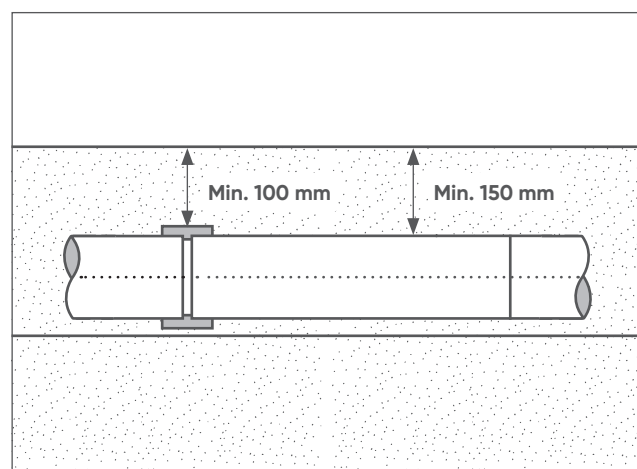


Illustration 7.23

Filling of trench (protective layer) - zone 3

The trench is backfilled in layers and compacted with care. Types of soil and materials which may cause dents are not permissible to be used to backfill the trench (e.g. ash, waste, stones). The protective layer consists of the following 2 sublayers:

- Protective layer (P): Consists of a layer of minimally 300 mm made of the same material as zone 2. The material must be stone-free sand or similar material. It is not allowed to use heavy compacting equipment on this layer
- Ground layer (G): Layer to fill the rest of the trench of at least 500 mm. Small stones are allowable. Depending on local regulations this layer may be compacted using heavy compacting equipment.

! It is important to immediately press the sand and fill the trench after laying the pipe. Not doing so may uncover the pipe.

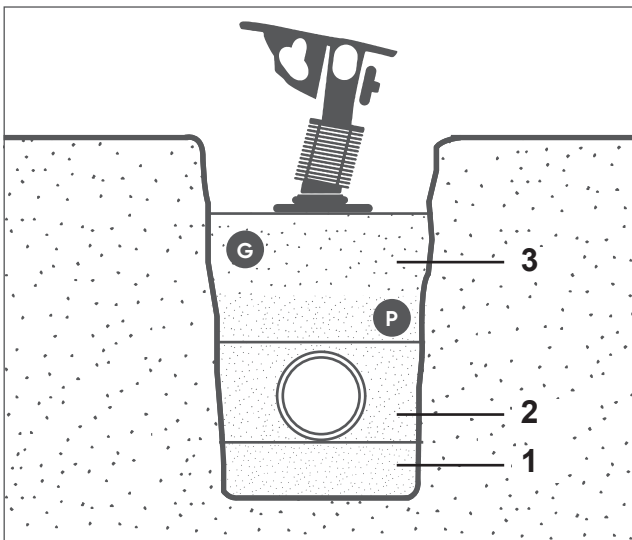


Illustration 7.24

Due to risk of the waste water freezing, the pipes must be laid at a frost-free depth.

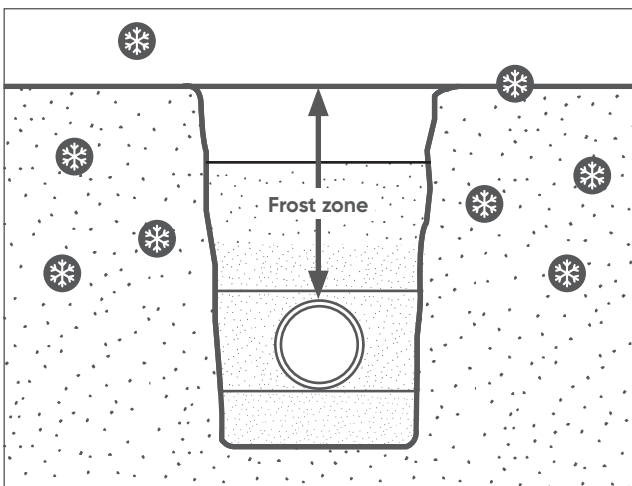


Illustration 7.25

! For determining the depth of the frost zone consult local regulations.

8 Joining methods

8.1 Joint methods

Akatherm HDPE is suitable for High Density Polyethylene, a material made with welded joints. Secure and durable connections lasting 50 to 100 years. Welded joints are made without the need for glue or rubber ring joints and are actually stronger than the surrounding piece of pipe or fitting. HDPE welded joints are both pull tight and leak proof, once tested there is very little risk of future failure because of the flexibility, impact resistance and overall toughness of the material.

Besides welded joints Akatherm HDPE pipes and fittings can be joined by different methods, depending on the applications. Joints are divided in welded/mechanical and pull-tight/not pull-tight. Pull tight joints can't come apart under influence of external forces.

To be opened (dismountable)

Joining methods which can be disconnected after assembly. These joining methods are ideal for pipe sections which need to be cleaned, calibrated, inspected or dismantled on a regular basis.

Not to be opened (fixed)

Joining methods which cannot be disconnected after assembly. These are permanent joints in which the joints can remain closed for their lifetime.

Tension-resistant (pull tight: PT)

This are connections which withstand tensional forces. This is ideal when thermal movement is expected or gravity pulls on the connection.

Non-tension-resistant (not pull tight: NPT)

This are connections which cannot withstand tensional forces. This joint is used when the pipe system is designed to accommodate movement without risk that the joint is pulled apart.

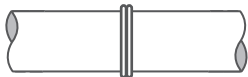
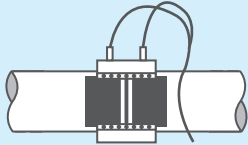


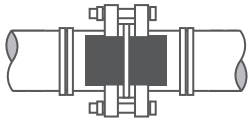



Joining technique	Product	Welded/mechanical	Pull-tight	Dismountable
Butt-weld joint		Welded	Yes	No
Electrofusion		Welded	Yes	No
Snap socket		Mechanical	Yes	No
Screw coupler		Mechanical	Yes	Yes
Flange		Mechanical	Yes	Yes
Plug-in socket		Mechanical	No	Yes
Expansion socket		Mechanical	No	Yes
Contraction joint		Mechanical	No	No

Table 8.1

8.2 Butt-weld joint

Butt-welding is an economical and reliable way of joining without using additional components requiring only butt-welding equipment.

All Akatherm products can be welded using this joining method (DVS 2207-1). Fittings can be shortened by up to the k-dimension when indicated in the catalogue, still allowing butt-welding. This joining method is very suitable for prefabrication and producing special fittings.

Preparations

Before starting the welding process it is important to establish a work space where the jointing can be done consistently:

- The temperature of the welding plate needs to be between 200°C and 220°C. In general it is advisable to consider welding with higher temperatures in this temperature range when welding pipes and fittings with small wall-thickness. Pipes and fittings with a relative higher surface area need to be heated more slowly
- Ensure that the welding plate has reached the correct temperature and is thoroughly heated. In order to do so allow for a 10 minute heating period after the correct temperature is measured initially
- Before welding clean the heating element with paper and a pre approved cleaning solution (ensuring 100% evaporation). Ensure that the heating surface is undamaged
- Establish a work space where the jointing can be done without being affected by major weather conditions. The use of wind shields is advised to keep the weld plate at a constant temperature
- The functionality of the butt welding equipment needs to be checked regularly. Especially on those machines which are used at the building site.

Welding process

In general butt-welds are made using an Akatherm butt-welding machine. Only diameters up to 75 mm can be welded by hand. For diameters at 90 mm and above the welding pressure is too big to make a good weld by hand. The welding process consists of the following steps:

- Preheat: Push the pipe/fittings against the heating plate until the required welding bead has been formed (refer to appendix B)
- Heating up: Hold the pipe/fittings against the heating plate with no pressure (for time see appendix B)
- Change over, welding and cooling: When the spigots are thoroughly heated both parts need to be joined as quick as possible using a gently buildup of pressure. Moving the parts during or after cool down is not permitted. Keep the parts jointed together under pressure as long as the welding bead is still plasticized. Ensure that the joint is allowed to cool down without any additional load.

Using a butt-welding machine gives a better result under all circumstances.

Machining the surface

Both sides should be machined until they run parallel. When machining is finished, open the carriages (the plastic shavings must be continuous and uniform in both sides to weld).

Verify the alignment between the machined surfaces. remove the plastic shaving. Do not touch and keep machined surfaces clean.



Without removing the oxygen layer a weld cannot be guaranteed. The oxidation layer will form again within one hour.

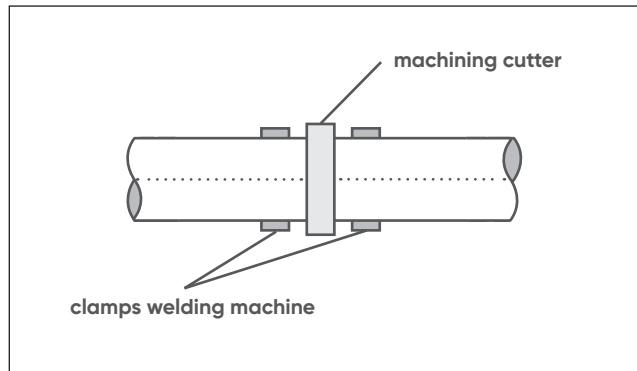


Illustration 8.1 Machining the surface

Preheating under pressure

During heating, the two spigot ends must be placed under low pressure to the heating element (0,2N/mm²). Through contact with the heating element a welding bead will form. The size of the bead is a good indication that the appropriate pressure and time is used. The correct welding bead height and preheating pressure is provided in appendix B.

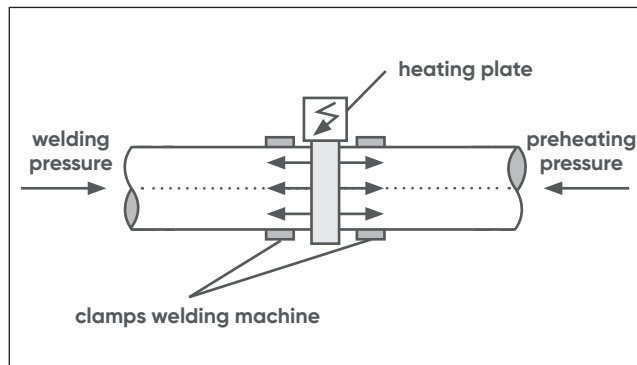


Illustration 8.2 Preheating under pressure

Heating with less pressure

HDPE is a good insulator, therefore at this stage it is necessary that the correct heating depth of the pipe ends is obtained. Only a small amount of pressure 0,01 N/mm² is required to maintain the contact of the ends with the heating element. The heat will gradually spread through the pipe/fitting end. The size of the bead will increase a little. The time and pressure needed for this phase can be found in appendix B.

Change over

Remove the heating element from the jointing areas and immediately join the two end together. Do not push the ends abruptly onto each other. The removal of the heating element needs to be done quickly to prevent the ends from cooling down. The maximum allowed change over times can be found in appendix B.

Welding and cooling

After the jointing areas have made contact they should be joined with a gradual increase in pressure up to the specified value. The build-up of pressure should be done linear and not differ more than 0,01 N/mm². When the buildup occurs too fast the plastic material will be pushed away. Contrary, when the buildup is too slow the material cools down before a homogenous weld is formed. In both cases the quality of the weld is questionable. Keep the specified welding pressure at a constant level during the complete cooling period. There must not be any load or strain at the joint.

! It is not allowed to artificially cool the joint!

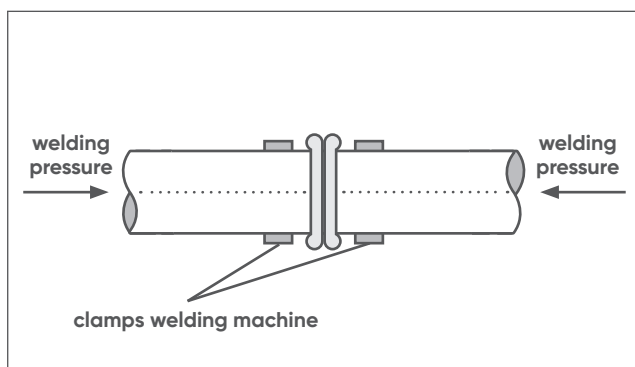


Illustration 8.3

The welded components can be removed from the machine when 50% of the cooling period has elapsed providing the following criteria are met:

- Prefabrication in workplace conditions.
- No load and strain placed on the joint.
- No additional load and strain when the fitting is removed from the clamping equipment.

! The weld may only be subjected to full operational load after the cooling time provided in appendix B has elapsed.

Welding by hand

The welding process when welding by hand is in general the same as the welding process by using a machine. The following steps are to be considered

- 1. Preheating:** Push the pipe/fitting against the heating plate until the required welding bead has formed (for height of the welding bead see appendix B - welding parameters).
- 2. Heating up:** Push the pipe/fitting against the heating plate until the required welding bead has formed (for height of the welding bead see appendix B).
- 3. Change over:** As the spigots are thoroughly heated up both parts need to be joined. It is important to minimize the change over time as much as possible. (the maximum allowed change over time is given in appendix B).
- 4. Welding:** The jointing has to be carried out accurately. Moving the parts during and after jointing is not possible. (the height of the welding bead is given in appendix B).
- 5. Cooling:** Keep the parts jointed together under pressure as long as the welding bead is still plasticized. The joint needs to cool down without any additional load. The use of a support structure is recommended when jointing long pipe parts.

! The use of a butt-welding machine is highly preferable and will give better and more consistent results.

Evaluating the butt-weld joint

For evaluation of the butt weld on the job site visual inspection methods can be used. Additional testing can be done using both destructive and non-destructive evaluation methods. For these evaluation methods special equipment may be necessary. For a first visual evaluation consider the following factors:

Shape of the welding bead

The shape of the welding bead is an indication for proper operation of the welding process. Both welding beads should have the same shape and size. The width of the welding bead should be approximately 0,5x the height. The height of the welding bead is provided in appendix B. In illustration 8.4 a good weld is shown with a uniform welding bead.

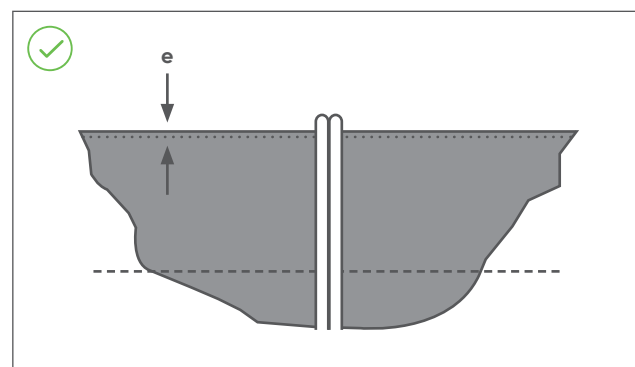


Illustration 8.4 Butt-weld with even welding beads (acceptable)

Differences between the beads can be caused by the difference in HDPE material used in the welded components. Despite the differences in welding bead the butt-weld can be of sufficient strength. In illustration 8.5 a cross-section of a regular, round fusion bead is shown. When differences in welding bead are observed the collar X value is greater than 0.

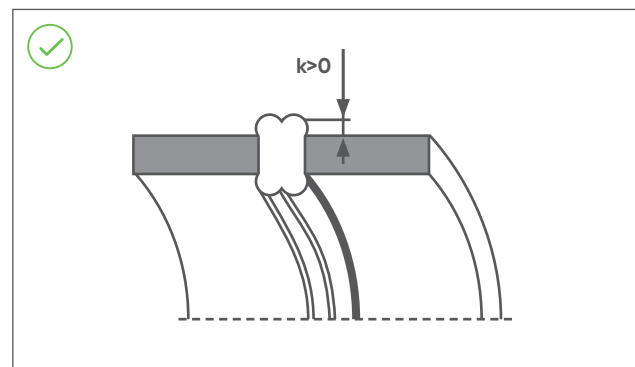


Illustration 8.5 Cross section of a good butt-weld

Alignment

Misalignment between fittings and pipe can occur for several reasons. Oval pipe ends or irregular pipe necking can cause an incorrect fit. If this sagging is less than 10% of the wall thickness the weld can still be classified as acceptable (see illustration 8.6).

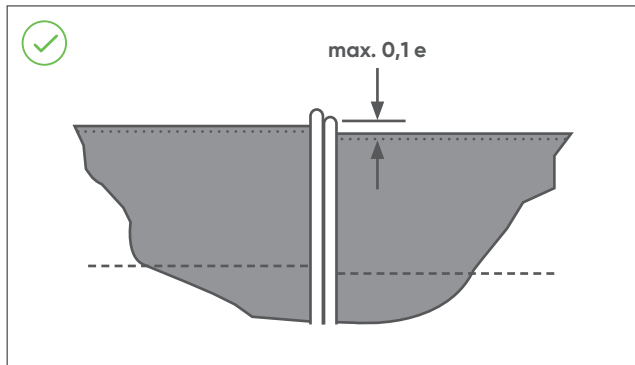


Illustration 8.6 Butt-weld with mis-alignment of pipe (acceptable)

Welding bead size

Illustration 8.7 shows a joint with beads that are too big. The uniformity indicates a good joint preparation. However, heat supply and/or jointing pressure seems to be too high. A purely visual assessment would still classify the weld as acceptable.

- ! Consider illustration 8.5. When the collar value X is greater than 0 the weld can be classified as acceptable regardless of the welding bead shape.

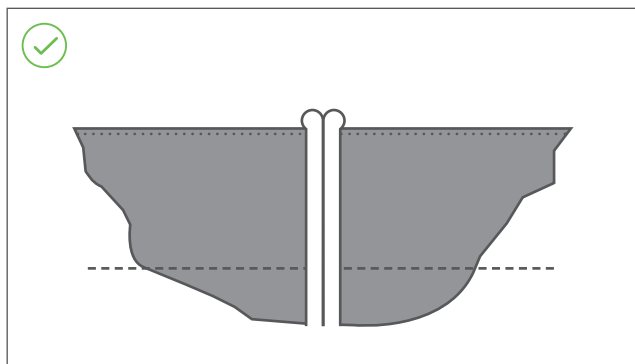


Illustration 8.7 Butt-weld with big welding beads (acceptable)

When there is either insufficient heating up or not enough welding pressure there are hardly any beads. In cases like this thick walled pipes often form shrinking cavities. The weld must be classified as non acceptable

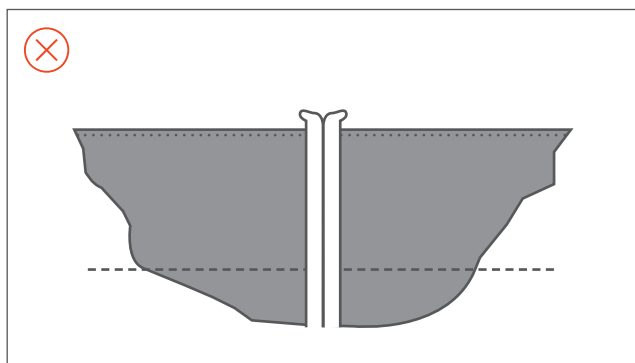


Illustration 8.8 Butt-weld with hardly beads (onacceptable)

8.3 Electrofusion joint

Electrofusion is a rapid and simple way of permanent jointing. Using the electrofusion coupler and equipment, pipe, fittings and prefabricated pipe section can be efficiently assembled.

- ! All Akatherm products can be welded by electrofusion unless specifically stated in the product table.

- ! It is highly recommended to make use of Akatherm electrofusion equipment as compatibility with other welding machines cannot be guaranteed.

Preparations

The following guidelines are to be respected when welding using the electrofusion process:

- Establish a work space where welding can be done without being effect by major weather conditions. The operating temperature of electrofusion control boxes is $-10^{\circ}\text{C}/+40^{\circ}\text{C}$. Welding above or below these temperatures may not be possible.
- Check if the equipment functions properly. Welding equipment used on site has to undergo regular maintenance. It is necessary to recalibrate the electrofusion control boxes at least every 2 years.
- The resistance wire in the electrofusion coupler lies at the surface for optimal heat exchange. The resistance wires need to be fully covered by the inserted pipe or fitting.

The resistance wires are positioned in the fusion zone. On both sides of the fusion zones, a cold zone prevents the molten HDPE from outpouring thereby containing the fusion process. During the fusion process the pipe/fitting expands and touches the inner coupler wall. The electrofusion joint is made with the pressure expanding HDPE and the heat from the resistance wires.

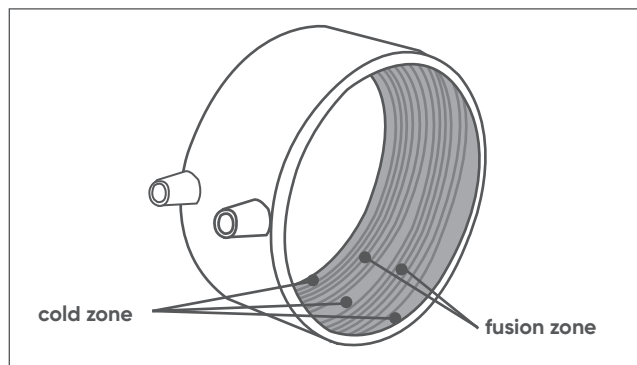


Illustration 8.9

Welding process

In order to make a good electrofusion connection, it is important that the following steps are carried out carefully.

Cut pipe square

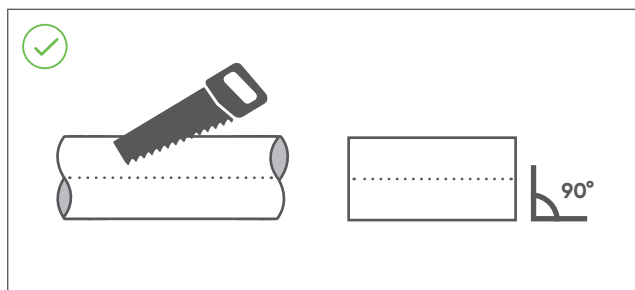


Illustration 8.10

The pipe ends must be cut square to ensure that the resistance wire in the coupler is completely covered by the pipe or fitting

! After cutting the pipe ensure that burrs are removed.

Mark surface for scraping

Mark insertion depth to ensure that across the full welding zone the oxidized layer will be removed.

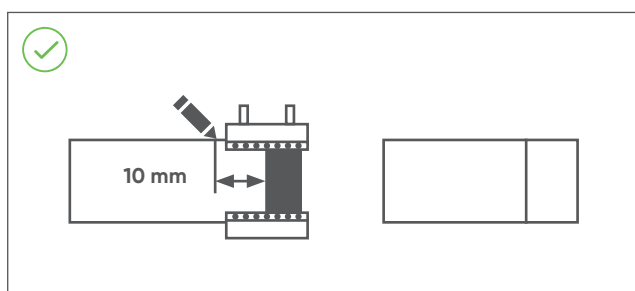


Illustration 8.11

Scrape pipe and mark insertion depth

The full outer surface of the pipe that will be covered by the coupler must be scraped. Scraping depth must be approximately 0,2 mm deep to remove any surface 'oxidation'. The insertion depth should be marked again to safeguard full insertion.

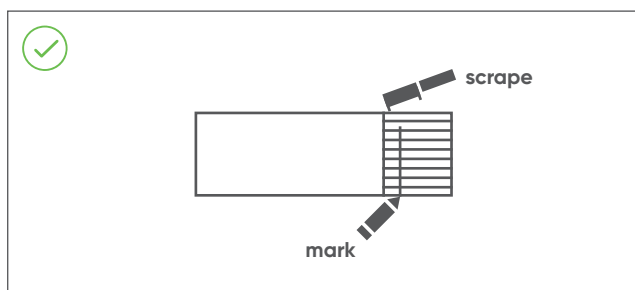


Illustration 8.12

! Without removing the oxidation layer a weld cannot be guaranteed. The oxidation layer will form again within one hour. The electrofusion needs to be made right after scraping the ends.

Clean electrofusion coupler

Before assembling the pipes into the coupler ensure that all to be welded surfaces are clean and dry.

! Before welding clean the electrofusion coupler and the to be welded spigot ends with paper and a pre approved cleaning solution (ensuring 100% evaporation). Do not touch the inside of the electrofusion coupler or outside of the spigot ends after cleaning!

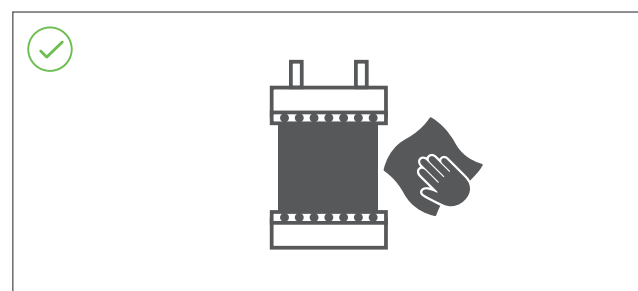


Illustration 8.13

Insert pipe/fitting

! Insert pipe/fitting until marked line.

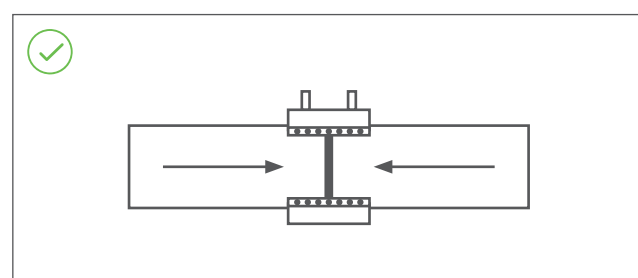


Illustration 8.14

Ensure that the pipe is pushed into the coupler as straight as possible up to the marked insertion depth. This will ensure that all the wires are covered with HDPE during the fusion cycle. Misalignment will cause extra load on the fusion zone causing additional HDPE to melt resulting in the outpouring of HDPE or wire movement.

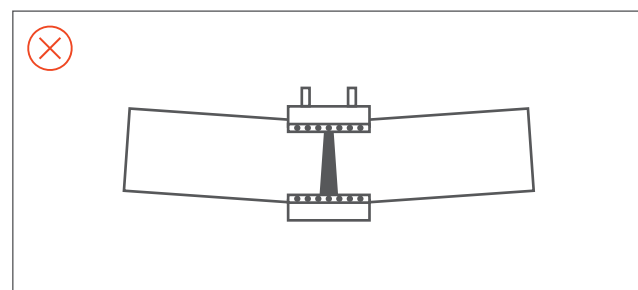


Illustration 8.15

The movement of the pipe can cause melted HDPE to flow out of the joint. This can result in wire movement and possibly a short circuit and thus a bad weld or fire hazard.

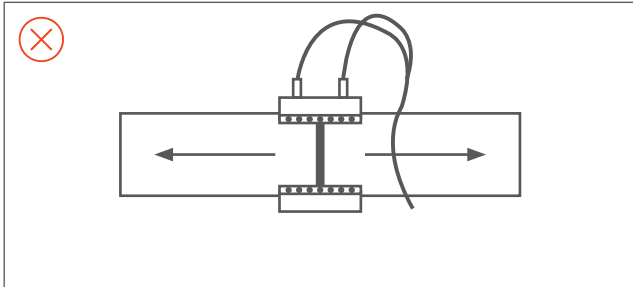


Illustration 8.16

When an electrofusion coupler is used as a repair coupler the center stop is to be removed. This may result in the coupler sliding down when placed vertically. Ensure that the coupler cannot move. Movement may result in short circuit and thus a bad weld or fire hazard.

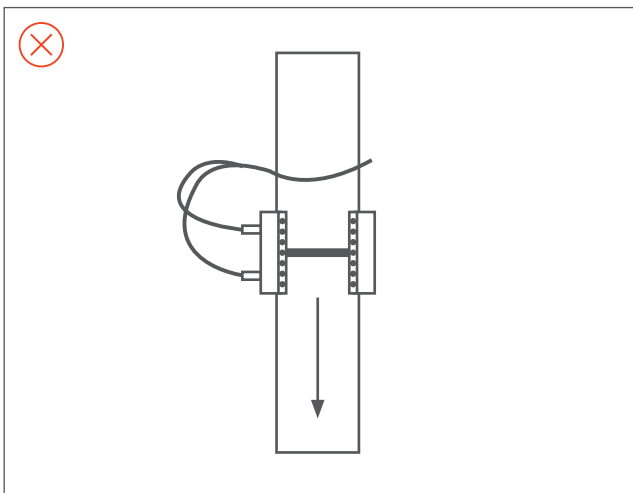


Illustration 8.17

An additional load on the vertical pipe will transfer extra HDPE material to the fusion zone. This will cause movement of the wires and possibly a short circuit and thus a bad weld or fire hazard.

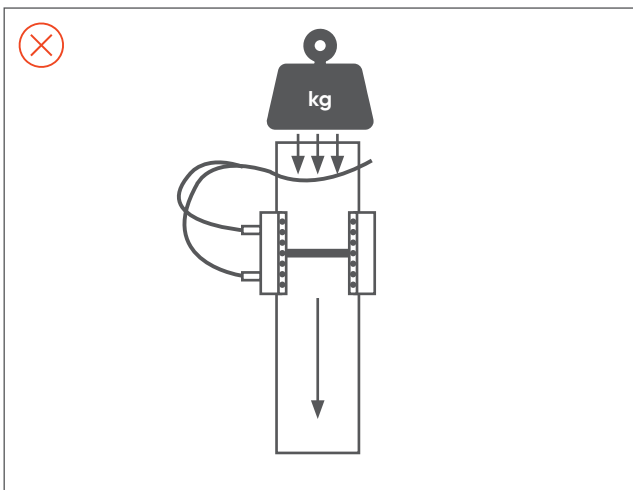


Illustration 8.18

Welding electrofusion coupler and cooling down

After connecting the cables of the control box the fusion process can be commenced by pushing the start button. Both the CB315 and CB160 control boxes adapt the welding time to the ambient temperature. When it is colder than 20°C the welding time is extended and when the ambient temperature exceeds 20°C the welding time is shortened. Welding below an ambient temperature of -10°C is not recommended.

Ambient temperature °C	40-160 mm	200 - 315 mm
-10	97 s	482 s
-5	95 s	469 s
0	92 s	455 s
5	90 s	442 s
10	87 s	428 s
15	84 s	415 s
20	82 s	401 s
25	79 s	388 s
30	77 s	374 s
35	74 s	361 s
40	72 s	347 s
45	69 s	334 s
50	66 s	320 s

Table 8.2 welding time

Cooling times for the 40-160 range are 20 minutes, whilst a cooling time of 30 minutes has to be respected for the 200-315 range products. The cooling period can be reduced by 50% when there is no additional load or strain during cooling (in workshop setting)



Never weld a coupler twice.

During the fusion cycle the right amount of energy is put into the fusion zones. A second fusion cycle would put so much energy into the joint causing the HDPE to melt extensively. This will cause movement of the wires and possibly a short circuit. In the extreme case it may even cause fire.

Assessing an electrofusion weld

Compared to a butt-weld, it is harder to judge a good electrofusion weld. The welding indicators on the electrofusion coupler provide only an indication if the weld has actually been executed. However, they do not guarantee the integrity of the joint. The amount of movement of the pop-out depends on several factors including the size tolerances of the components and any ovality of the pipe or fitting.

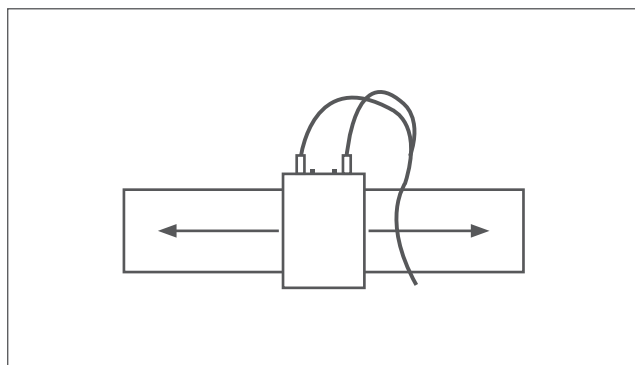


Illustration 8.19

A joint can be marked o.k. when the welding indicators are protruded, all welding preparations such as marking insertion depth, scraping, making sure that there was no additional load during welding and cooling have been executed successfully. If a significant quantity of melt flows out from the fitting after welding, there may be a misalignment of the components, the tolerances may be excessive or a second welding may have accidentally occurred. The integrity of such a joint is suspicious.

Please note that the fitting will become too hot to touch during the welding process. The temperature will continue to increase for some time after the fusion process has been completed.

Deformation

A too big deformation can cause problems during assembly and welding of the components. The maximum allowed deformation of pipe or fitting spigot is $0,02 \times d_1$. This results in a maximum difference between the largest and smallest diameter corresponding with table 8.3. The pipe or fitting spigot needs to be "rounded" using clamps when the deformation is larger.

diameter d_1 (mm)	$d_1 \text{ max} - d_1 \text{ min}$ (mm)
40	1,0
50	1,0
56	1,0
63	1,0
75	1,5
90	2,0
110	2,0
125	2,5
160	3,0
200	4,0
250	5,0
315	6,0

Table 8.3 Deformation pipe

8.4 Rubber ring joint

Plug in joint

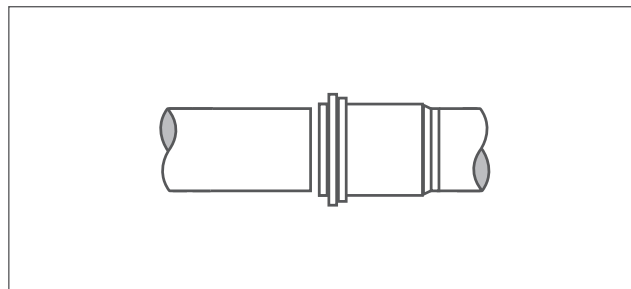


Illustration 8.20

A plug-in joint is an easy to make, detachable and not pull-tight jointing method. Additionally, expansion sockets allow for expansion compensation in the piping system using the same easy to make joint.

Snap joint

For making pull-tight rubber ring joint connections, snap sockets are available. These sockets are rubber ring joints with an additional snap ring which provides, in combination with a groove in the pipe, a pull-tight connection.

Jointing process

1. Cut pipe square and remove burr

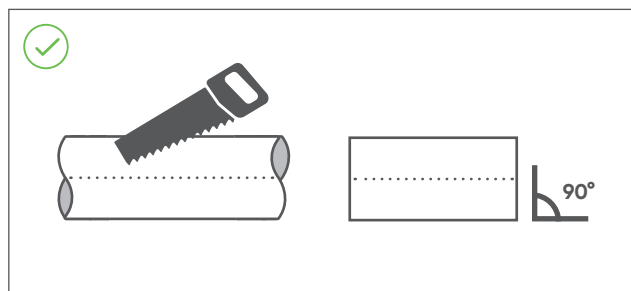


Illustration 8.21

2. Mark insertion depth

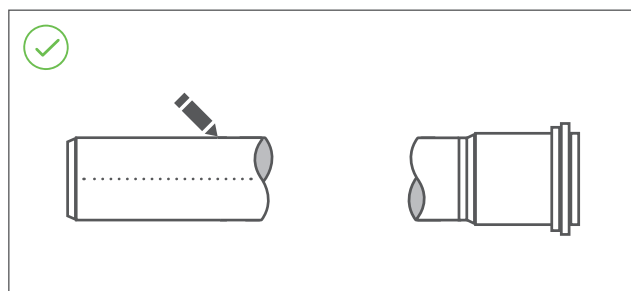


Illustration 8.22

Expansion socket

An expansion socket is used to accommodate the expansion and contraction of a pipe system.

The insertion depth is marked on the socket for both ambient temperatures of 0° and 20°C. For detailed information on insertion depth expansion and socket calculation see paragraph 7.3.1.

3. chamfer pipe end

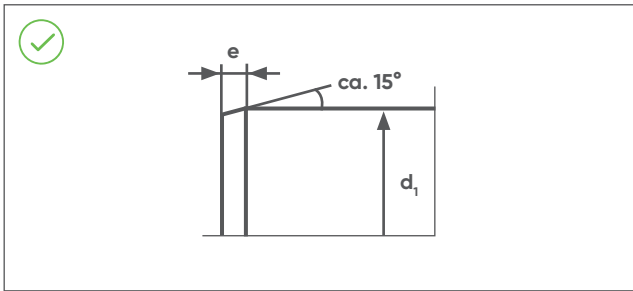


Illustration 8.23 Plug-in joint

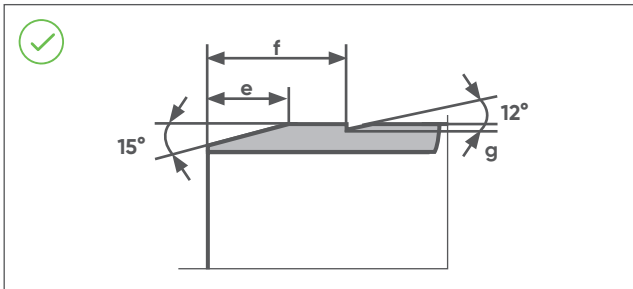


Illustration 8.24: Snap joint

The pipe-ends needs to be chamfered under an angle of 15°. A chamfering tool should be used to get an even cut and chamfer.

When using snap joints a groove needs to be cut under an angle of 12°. The correct dimension can be found in table 8.4. To get an even cut and chamfer it is recommended to use an Akatherm groove cutter.

! When no groove is made, the Akatherm snap sockets are detachable like a non pull-tight joint.

d ₁ (mm)	e	f	g
40	5	15	1
50	5	15	1
56	5	15	1
63	5	15	1
75	5	15	1
90	6	15	1
110	8	15	1
125	9	15	1
160	11	15	1
200	11	30	2
250	15	30	2
315	18	50	3

Table 8.4 Dimensions chamfer and groove

4. Make joint

Lubricate the pie end and insert the pipe up to the marked insertion dept. When jointing a snap joint a distinguished click can be heard when the snap ring is engaged to the groove.

8.5 Screw-threaded joint

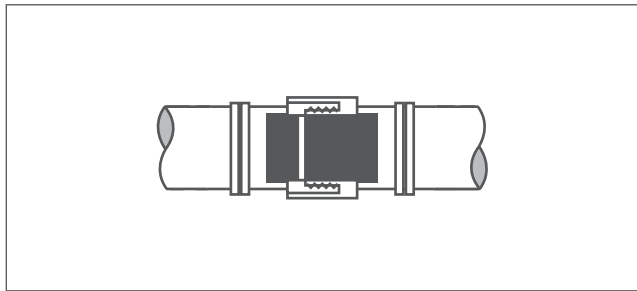


Illustration 8.25

The Akatherm screw threaded joint can be used in both pull-tight and not pull-tight joints.

Not pull-tight joints

In this case the pipe or fitting is inserted directly into the joint.

Joining process:

- **Cut pipe square and remove burr**
- **Disassemble screw threaded joint**
Orange protection cap is no longer needed.
- **Assemble joint and insert pipe**
Push the nut, washer and seal (in this order) over the pipe and insert the pipe end into the threaded piece completely. Tighten nut.
The washer prevents damage to the seal and delivers an even pressure onto the joint.

Pull-tight joints

In combination with the flange bushing a pull-tight joint can be made.

Joining process:

- **Cut pipe square and remove burr**
- **Disassemble screw threaded joint**
Orange protection cap and washer are no longer needed.
- **Assemble joint an insert pipe**
Push the nut over the pipe before butt-welding the flange bushing onto the pipe. After welding everything can be assembled.
The flange bushing prevents damage to the seal and delivers an even pressure onto the joint.

8.6 Flange joint

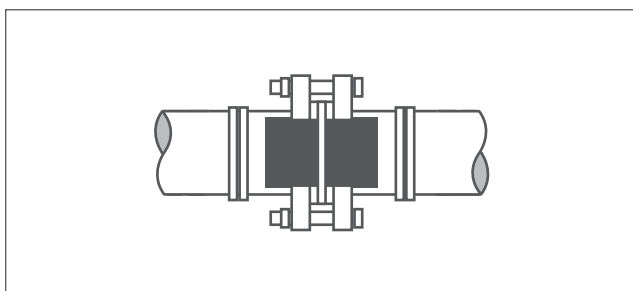


Illustration 8.26

The flanged joint is a detachable joint not that common in soil and waste systems. It is the ideal joining method to connect the system onto flanged equipment and to install valves. The joint can be made by the following steps:

- Mount backing ring over pipe or fitting
- Weld stub flange to fitting or pipe
- Apply seal
- Mount bolts, nuts and washers and tighten nuts crosswise with the bolt torque of table 8.5

d _i (mm)	Bolt torque (Nm)
40	20
50	30
56	35
63	35
75	40
90	40
110	40
125	40
160	60
200	70
250	80
315	100

Table 8.5 Bolt torque for non-pressure applications

8.7 Contraction sleeve joint

A simple transition to other materials than HDPE can be made using the contraction sleeve. The sleeve provides a not pull-tight connection and is installed as follows:

- Mark insertion depth on the connecting pipe.
- Connect contraction sleeve to HDPE pipe or fitting using electrofusion or butt-welding.
- Mount the O-ring in the middle of the insertion zone.
- Heat up the contraction sleeve evenly with a torch or an industrial heater. Diameters above 125 mm are best heated up using a second heat source.

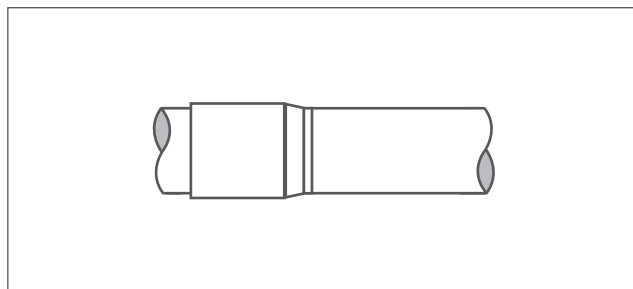


Illustration 8.27

8.8 Metal coupling

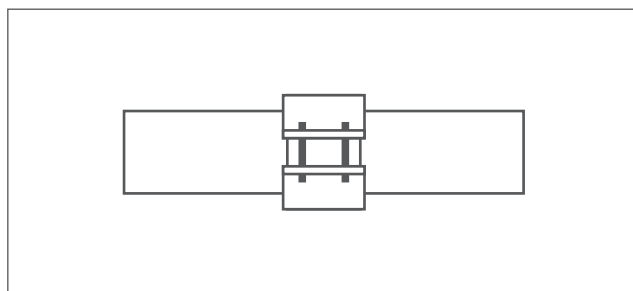


Illustration 8.28

For the transition to another material the standard metal coupler can also be used. Depending on the type, either a pull-tight or not pull-tight joint is possible. To prevent the HDPE pipe from deforming and to disengage from the coupler, a metal support ring should be inserted in the pipe or fitting. The coupling is installed as follows:

- Cut pipe square
- Insert metal support ring into pipe or fitting
- Push connecting pipe ends into coupling
- Tighten nuts with recommended torque

9 Prefabrication

9.1 Choosing to prefabricate

Prefabrication of pipe systems refers to the manufacturing of standardized and factory-made pipe sections in large quantities, which are then assembled during installation on the building site. The fittings and pipes are butt-welded together during prefabrication.

- Building pipe systems requires time; time to measure, make cuts, joints and to complete testing. Using a fabricated system cuts downtime on site considerably.
- Reliable butt-welded joints made in factory conditions.
- Drainage systems designed and made accurately minimizes offcuts and waste on site.

Of course, pipe system can be prefabricated from other materials. HDPE however, offers some distinct advantages making especially suitable for this manner of installation:

- Easy handling due to the light weight of HDPE. A related advantage is the lower transportation costs.
- Minimal risk of breakage and deformation during transport and handling because HDPE is flexible, impact-resistant and tough material. It will even survive rough treatment.
- Simple assembly using butt-welding or electrofusion, enabling firm and leak-free welded joints to be made.

The advantages of prefabrication are especially visible in situations when the pipe systems are identical and can be prefabricated in large batches. Large identical pipe systems are typically installed in hospitals and residential buildings.



Illustration 9.1 Prefabricated pipe sections



Illustration 9.2 Prefabricated pipe sections installed on site

Examples of installation in difficult conditions

The pipe sections are prefabricated in controlled conditions, after which installation on site can be performed using simple electrofusion joints. This allows for safer assembly of the pipe system especially under difficult conditions.



Illustration 9.3

9.2 Pipe and fittings

K-dimension

In some situations, it is necessary to shorten fittings. Fittings with the dimension "k" included in the product table can be maximally shortened by the given "k" dimension in order to still allow butt-welding using a standard butt-welding machine. The k-dimension of the relevant spigot of most fittings is listed in the product table. When welding must occur by hand, the entire spigot can be shortened (-5 mm for butt-welding, see the conditions in chapter 8.2). Welding with the aid of a butt-welding machine is always recommended.

Graduated arc

To facilitate the welding of fittings at angles, they are marked with a graduated arc. This consists of a long lines at 45° with intervening short lines at each 15°. The pipe is also marked with two continuous lines.

Protection plugs

A single fitting or pipe is easy to inspect visually for blockages prior to installation. This is not always possible when prefabricating pipe segments. To prevent blockages, it is recommended to leave the protection plugs in the fittings (included in delivery) and to close the pipe ends with the special protection plugs for pipe (code 40xx29)

Dimensions

Dimensions of the fittings have been standardized. For instance, eccentric adapters are all 80 mm long and injection moulded 45° branches of the same diameter all have the same standard lengths.

9.3 BIM and prefabrication

BIM is a process for integrating intelligent 3D models of every aspect of a design into a single model from which one can extract enormous amounts of data. Before starting the building process a virtual building is created ensuring that every single component of the project works.



BIM will change the way architects and builders work. By combining the advantages of Akatherm HDPE and the intelligent functions of BIM, pipe systems can be prefabricated. Ultimately saving time and ensuring reliable joints, made under factory conditions.

The smart files will help you to automatically pick the right products for all your direction changes, branches and other junctions. Change in diameter and reducers are placed automatically without the hassle to re-enter your library. Integrated push-fit insertion and butt-weld jointing losses create truly accurate pipe lengths. The Akatherm Revit content packages create 'as built' designs.

We are continuously updating our Revit family files. The content is available in a multitude of Revit versions. Our packages are available at the Akatherm website only, ensuring you will always be able to download the most up-to-date files. Please go to: <https://akathermhdpe.com/en/pageid/download-page>.

10 Product range

The following pages provide an overview of the Akatherm HDPE product range. This includes:

- Pipes
- Fittings
- Fixing technology
- Tools
- Spare parts

10.1 Dimensions

The dimensions of the pipes and fittings in the product tables are all in mm unless otherwise stated. The European standard EN12056 has been applied since 2001 and replaces local standards. EN12056 dimensions are based on the outside diameter, compared to wall thickness.

DN	e (S12,5)	Application
32	3	BD
40	3	BD
50	3	BD
56	3	BD
63	3	BD
75	3	BD
90	3,5	BD
110	4,2	BD
125	4,8	BD
160	6,2	BD
200	7,7	BD
250	9,6	BD
315	12,1	BD

Table 10.1

DN	e (type S16)	Application
200	6,2	B
250	7,7	B
315	9,7	B

Table 10.2

Scope application B = inside the building structure

Scope application BD = inside and buried outside the building structure

10.2 Pipes

Akatherm HDPE pipes are produced according to EN1519.

Akatherm HDPE pipes are suitable for applications in which the temperature of the pipe can get relatively high, or vary considerably.

Akatherm HDPE pipe has a standard length of 5 m and is produced to high quality standards with many international approvals.

10.3 Electrofusion

Aliaxis Nederland B.V. products can be welded by electrofusion unless stated otherwise in the product table. Electrofusion is the preferred method of on-site jointing.

10.4 Buttwelding and the k-dimension

All Aliaxis Nederland B.V. products can be welded using this jointing method. Fittings can be shortened by up to the k-dimension (when indicated in the catalogue), thus allowing buttwelding on a standard buttwelding machine.

Only identical materials can be welded.

10.5 Abbreviations

Abbreviation	
A	Cross section area flow
Code	Article number
D	External dimension fitting part
d₁, d₂ ...	External dimension fitting/pipe
DN	Nominal size
e	Wall thickness
k₁, k₂ ...	Maximum length for shortening fittings
L	Total length fitting
l₁, l₂ ...	Partial length of fitting
S	Pipe class according to ISO-S (SDR-1)/2
SDR	Ratio diameter/wall thickness d ₁ /e

Table 10.3

10.6 Handling and storage

Pipes

The high impact strength of Akatherm HDPE provides some protection against damage, but care should still be taken at all stages of handling, transportation and storage. Pipe must be transported by a suitable vehicle and properly loaded and unloaded. Whenever possible it should be moved by hand or mechanical lifting equipment. Pipes must not be dragged across the ground. The storage should be flat, level, and free from sharp objects.

Lengths

Pipe lengths stored individually should be stacked in a pyramid of not more than one metre high, with the bottom layer fully restrained by wedges. Where possible, the bottom layer of pipes should be laid on timber battens up to one metre apart. On site, pipes may be laid out individually. Where appropriate, protective barriers should be placed with adequate warning signs and lamps.

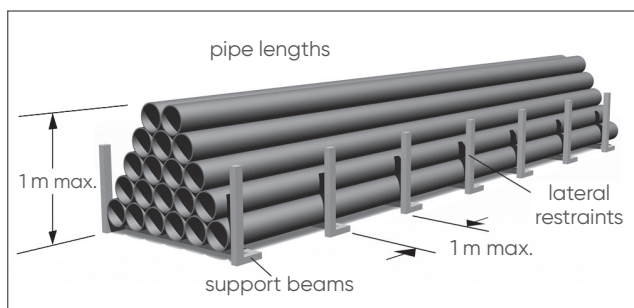


Image 10.1

Bundles

Bundled packs of pipe should be stored on clear, level ground with the battens supported from the outside by timber or concrete blocks. For safety, bundled packs should not be stacked more than 3 m high. Smaller pipes may be nested inside larger pipes. Side bracing should be provided to prevent stack collapse.

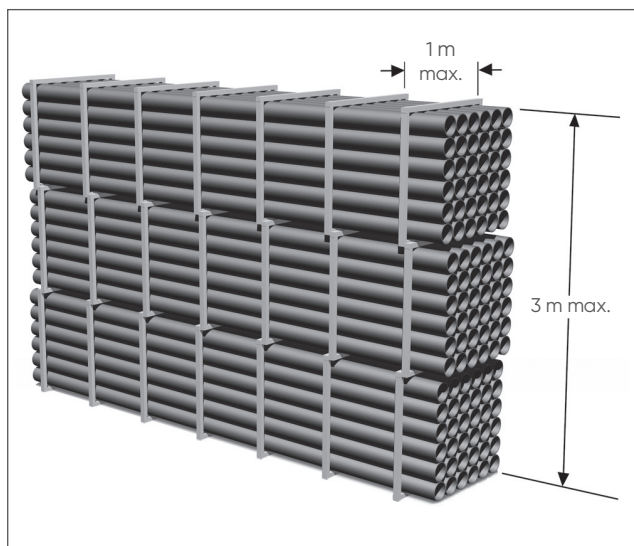


Image 10.2

Fittings

Fittings and electrofusion couplers need to be stored in a dry place. To prevent oxidation and contamination, it is recommended to leave fittings in their original packaging until required for use.

Tools

All tools - especially electrical - ones must be protected against moisture and dust, and should not be dropped.

Recycling residual waste

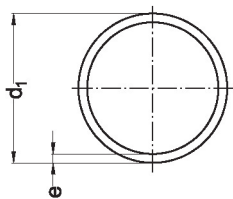
To comply with regulations, residual waste materials should be recycled:

- PE/electrofusion couplers: recycle/residual waste
- Carton boxes : recycled paper
- Plastic containers : residual waste
- Chips : residual waste
- Cleaning cloths : residual waste

Pipe

HDPE

Pipe length = 5 m



d_1	Code	S	SDR	e	A (cm ²)	kg/m
40	100400	12,5	26	3	9,1	0,36
50	100500	12,5	26	3	15,2	0,45
56	105600	12,5	26	3	19,6	0,51
63	100600	12,5	26	3	25,5	0,58
75	100700	12,5	26	3	37,4	0,7
90	100900	12,5	26	3,5	54,1	0,98
110	101100	12,5	26	4,2	80,7	1,43
125	101200	12,5	26	4,8	104,2	1,85
160	101600	12,5	26	6,2	171,1	3,04
200	102010	12,5	26	7,7	267,6	4,69
250	102510	12,5	26	9,6	418,4	7,3
315	103110	12,5	26	12,1	664,2	11,6
200	102000	16	33	6,2	276,4	3,84
250	102500	16	33	7,7	431,5	5,99
315	103100	16	33	9,7	685,4	9,45

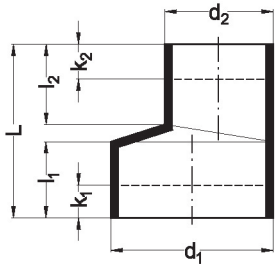
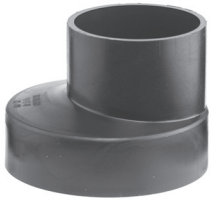
Drainage pipe d40-315 mm according to EN 1519 for application in buildings, d110-315 mm for buried pipe application according EN 12666.

S= pipe class.

A (cm²) = cross sectional area of flow.

Reducer eccentric

HDPE



d_1/d_2	Code	L	l_1	l_2	k_1	k_2
50/40	160504	80	35	37	20	20
56/40	165604	80	35	37	20	20
56/50	165605	80	35	37	20	20
63/40	160604	80	35	37	20	20
63/50	160605	80	35	37	20	20
63/56	160656	80	35	37	20	20
75/40	160704	80	35	30	20	20
75/50	160705	80	35	37	20	20
75/56	160756	80	35	37	20	20
75/63	160706	80	35	37	20	20
90/40	160904	80	30	33	20	20
90/50	160905	80	30	34	20	20
90/56	160956	80	30	36	20	20
90/63	160906	80	30	39	20	20
90/75	160907	80	30	44	20	20
110/40	161104	80	31	34	20	20
110/50	161105	80	31	34	20	20
110/56	161156	80	31	35	20	20
110/63	161106	80	31	34	20	20
110/75	161107	80	31	36	20	20
110/90	161109	80	31	41	20	20
125/56	161256	80	35	37	20	20
125/63	161206	80	35	37	20	20
125/75	161207	80	35	30	20	20
125/90	161209	80	35	32	20	20
125/110	161211	80	36	36	20	20
160/110	161611	80	28	36	20	20
160/125	161612	80	32	36	20	20

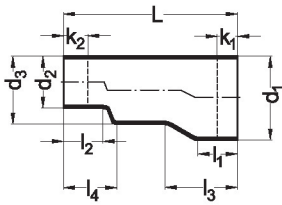
Reducer eccentric long

HDPE

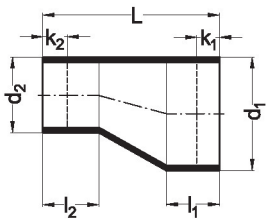


d_1/d_2	Code	Type	L	l_1	l_2	l_3	l_4	d_3	k_1	k_2
200/110	142011	A	335	95	36	165	55	160	75	20
200/125	142012	A	335	95	36	165	55	160	75	20
200/160	142016	B	260	95	95				75	75
250/200	142520	B	290	105	95				85	75
315/200	143120	A	580	115	95	235	190	250	95	75
315/250	143125	B	340	115	105				75	85

A

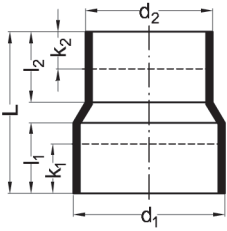


B



Reducer concentric

HDPE



d_1/d_2	Code		L	l_1	l_2	k_1	k_2
40/32	150403		80	30	30	15	15
50/32	150503		80	30	30	15	15
50/40	150504		80	30	30	15	15
56/40	155604		80	30	30	15	15
56/50	155605		80	30	30	15	15
63/40	150604		80	30	30	15	15
63/50	150605		80	30	30	15	15
63/56	150656		80	30	30	15	15
75/40	150704		80	30	30	15	15
75/50	150705		80	30	30	15	15
75/56	150756		80	30	30	15	15
75/63	150706		80	30	30	15	15
90/40	150904		80	30	30	15	15
90/50	150905		80	30	28	15	15
90/56	150956		80	30	30	15	15
90/63	150906		80	30	30	15	15
90/75	150907		80	30	28	15	15
110/40	151104		80	30	30	15	15
110/50	151105		80	30	30	15	15
110/56	151156		80	30	30	15	15
110/63	151106		80	30	30	15	15
110/75	151107		80	30	30	15	15
110/90	151109		80	30	30	15	15
125/75	151207		80	30	30	15	15
125/90	151209		80	30	30	15	15
125/110	151211		80	35	30	15	15
160/110	151611		80	35	30	15	15
160/125	151612		80	39	30	15	15
200/160	152016	1)	149	50	40	40	30
250/160	152516	1)	194	60	40	50	30
250/200	152520	1)	182	60	50	50	40
315/200	153120	1)	230	90	80	80	70
315/250	153125	1)	230	90	80	80	80

1) butt-weld only

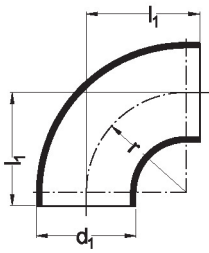
Bend 90°

HDPE



d_1	Code	l_1	r
160	111691	160	160
200	112091	205	200
250	112591	290	265
315	113191	340	300

Butt-weld only.



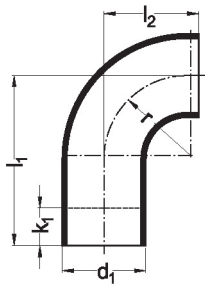
Bend 90° with long side

HDPE



d_1	Code	l_1	l_2	r	k_1
40	110492	93	43	40	45
50	110592	103	53	50	45
56	115692	120	59	56	55
63	110692	130	66	65	60
75	110792	140	78	75	60
90	110992	153	93	90	60
110	111196	270	100	100	170
125	111292	190	128	125	60

Electrofusable at one side.

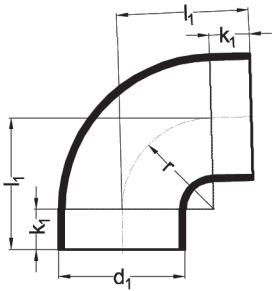


Bend 88,5° electrofusible

HDPE



d_1	Code	l_1	l_2	r	k_1
110	111198	116	116	80	25



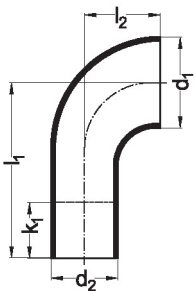
Bend reduced 90°

HDPE



d_1/d_2	Code	l_1	l_2	k_1
50/40	170504	90	40	40
63/50	170605	119	50	50

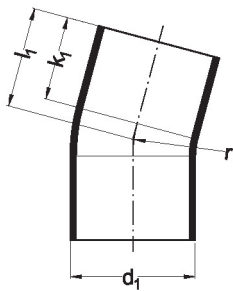
Electrofusible at one side.



Bend 15°

HDPE

fabricated version

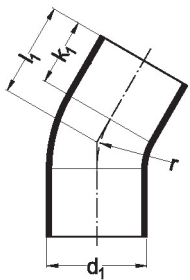


d_1	Code	l_1	r	k_1
110	181115	125	165	65
125	181215	150	188	45
160	181615	175	240	100
200	182015	200	300	125
250	182515	225	375	135
315	183115	250	473	175

Bend 30°

HDPE

fabricated version



d_1	Code	l_1	r	k_1
110	181130	125	165	60
125	181230	150	188	85
160	181630	175	240	100
200	182030	200	200	115
250	182530	225	255	125
315	183130	250	320	135

Bend 180°

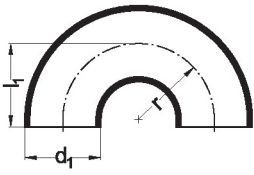
HDPE



d_1	Code	l_1	r
50	110599	55	50
56	115699	47	49
63	110699	60	64

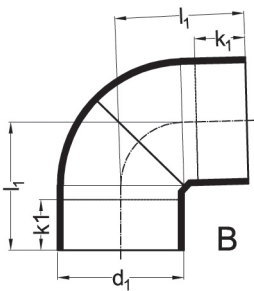
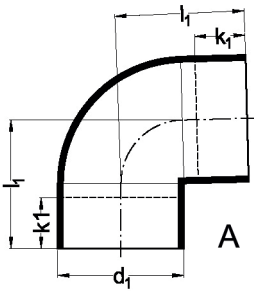
Butt-weld only.

Bends 180° are suitable for the fabrication of traps.



Elbow 88,5°

HDPE



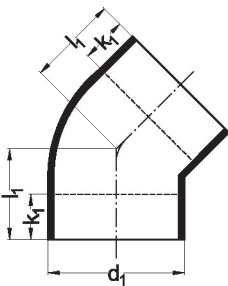
d_1	Code		Type	l_1	k_1
40	120488		A	55	25
50	120588		A	60	20
56	125688		A	65	20
63	120688		A	70	20
75	120788		A	75	20
90	120988		A	80	20
110	121188		A	95	25
125	121288		A	100	25
160	121688		A	120	25
200	122088	1)	B	290	60
250	122588	2)	8	350	60
315	123188	2)	B	360	60

1) fabricated

2) fabricated - wall thickness e according to S12,5

Elbow 45°

HDPE

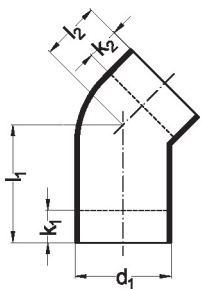


d_1	Code		l_1	k_1
40	120445		40	20
50	120545		45	20
56	125645		45	20
63	120645		50	20
75	120745		50	20
90	120945		55	20
110	121145		60	25
125	121245		65	25
160	121645		69	20
200	122045		173	60
250	122545	1)	182	60
315	123145	1)	195	60

1) wall thickness e according to S12,5

Elbow 45° with long side

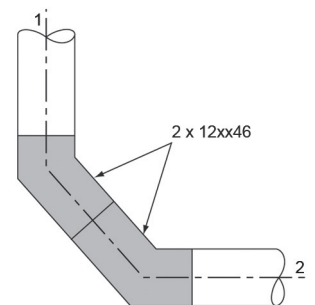
HDPE



d_1	Code		l_1	l_2	k_1	k_2
75	120746		145	50	120	25
90	120946		150	55	120	25
110	121146		147	60	120	25

Elbows 45° with long side are applied for making the transition from stack to building drain acc. to EN 12056 (see drawing).

- 1 stack
- 2 building drain



Elbow 90° with long side

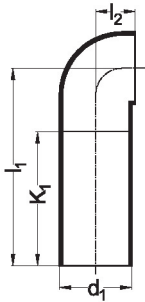
HDPE



d_1	Code	l_1	l_2	k_1
90	120993	270	50	175
110	121193	300	60	220

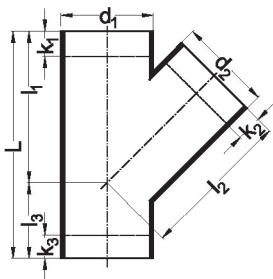
Electrofusable at one side.

Elbows 90° with long side are applied in combination with wall or floor lavatory sockets (Code 500951, 501171 and 50xx01).



Y-branch 45°

HDPE



d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
40/40	300404		135	90	45	30	30	25
50/40	300504		165	110	55	45	45	40
50/50	300505		165	110	55	20	20	35
56/40	305604		180	120	60	35	30	60
56/50	305605		180	120	60	30	30	40
56/56	305656		180	120	60	25	25	40
63/40	300604		195	130	65	40	45	45
63/50	300605		195	130	65	30	30	50
63/56	300656		195	130	65	25	25	45
63/63	300606		195	130	65	20	20	40
75/40	300704		210	140	70	60	50	65
75/50	300705		210	140	70	40	30	70
75/56	300756		210	140	70	35	25	55
75/63	300706		210	140	70	35	25	45
75/75	300707		210	140	70	25	25	40
90/40	300904		240	160	80	65	55	75
90/50	300905		240	160	80	50	40	80
90/56	300956		240	160	80	45	35	75
90/63	300906		240	160	80	40	30	70
90/75	300907		240	160	80	35	30	65
90/90	300909		240	160	80	20	20	50
110/40	301104		270	180	90	75	60	95
110/50	301105		270	180	90	55	50	95
110/56	301156		270	180	90	45	40	90
110/63	301106		270	180	90	40	35	85
110/75	301107		270	180	90	35	30	75
110/90	301109		270	180	90	30	25	65
110/110	301111		270	180	90	20	20	55
125/50	301205		300	200	100	115	60	75
125/56	301256		300	200	100	110	50	45
125/63	301206		300	200	100	60	45	105
125/75	301207		300	200	100	50	40	95
125/90	301209		300	200	100	35	30	30
125/110	301211		300	200	100	25	25	25
125/125	301212		300	200	100	20	20	20
160/50	301605	¹⁾	375	250	125	120	115	65
160/56	301656	¹⁾	375	250	125	120	115	65
160/63	301606	¹⁾	375	250	125	120	115	65
160/75	301607		375	250	125	120	115	65
160/90	301609		375	250	125	110	105	55
160/110	301611		375	250	125	50	40	45
160/125	301612		375	250	125	10	20	40
160/160	301616		375	250	125	10	15	25
200/50	302005	²⁾	540	360	180	95	15	175
200/56	302056	²⁾	540	360	180	95	15	175
200/63	302006	²⁾	540	360	180	95	15	175
200/75	302007	³⁾	540	360	180	95	160	175
200/90	302009	³⁾	540	360	180	80	150	165
200/110	302011	³⁾	540	360	180	65	140	150
200/125	302012	³⁾	540	360	180	55	130	140
200/160	302016	³⁾	540	360	180	35	85	115

¹⁾ fabricated²⁾ fabricated from branch 200/75 mm with concentric reducer³⁾ wall thickness e according to S12,5

-- to be continued --

Y-branch 45° - continuation -

d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
200/200	302020	3)	555	375	180	0	0	95
250/75	302507	1)	660	440	220	170	205	235
250/90	302509	1)	660	440	220	160	195	225
250/110	302511	1)	660	440	220	150	185	215
250/125	302512	1)	660	440	220	140	175	205
250/160	302516	1)	660	440	220	120	130	180
250/200	302520	1)	660	440	220	90	50	150
250/250	302525	1)	900	600	300	160	160	250
315/75	303107		840	560	280	255	280	325
315/90	303109	1)	840	560	280	245	270	315
315/110	303111	1)	840	560	280	235	260	305
315/125	303112	1)	840	560	280	220	250	290
315/160	303116	1)	840	560	280	200	205	270
315/200	303120	1)	840	560	280	175	125	240
315/250	303125	1)	840	560	280	140	130	205
315/315	303131	1)	950	610	340	170	170	280

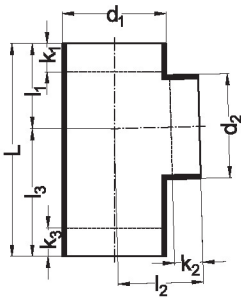
1) fabricated

2) fabricated from branch 200/75 mm with concentric reducer

3) wall thickness e according to S12,5

Branch 88,5°

HDPE



d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
40/40	200404		130	55	75	25	25	45
50/40	200504		150	60	90	30	25	60
50/50	200505		150	60	90	25	25	55
56/50	205605		175	70	105	35	30	70
56/56	205656		175	70	105	30	30	65
63/40	200604		175	70	105	30	30	70
63/50	200605		175	70	105	35	30	70
63/56	200656		175	70	105	30	30	65
63/63	200606		175	70	105	30	30	60
75/40	200704		175	70	105	40	25	75
75/50	200705		175	70	105	35	25	70
75/56	200756		175	70	105	30	25	65
75/63	200706		175	70	105	25	25	60
75/75	200707		175	70	105	25	25	55
90/40	200904		200	80	120	45	25	85
90/50	200905		200	80	120	45	25	85
90/56	200956		200	80	120	40	25	85
90/63	200906		200	80	120	35	25	80
90/75	200907		200	80	120	30	25	75
90/90	200909		200	80	120	25	25	70
110/40	201104		225	90	135	60	25	100
110/50	201105		225	90	135	50	25	95
110/56	201156		225	90	135	45	25	90
110/63	201106		225	90	135	40	25	90
110/75	201107		225	90	135	35	25	85
110/90	201109		225	90	135	30	25	75
110/110	201111		225	90	135	20	20	65
125/50	201205	1)	250	100	150	60	25	110
125/56	201256	1)	250	100	150	55	25	105
125/63	201206	1)	250	100	150	50	25	105
125/75	201207		250	100	150	45	25	100
125/90	201209		250	100	150	40	25	90
125/110	201211		250	100	150	30	20	80
125/125	201212		250	100	150	20	20	70
160/50	201605	1)	350	140	210	75	30	145
160/56	201656	1)	350	140	210	75	30	145
160/63	201606	1)	350	140	210	65	30	140
160/75	201607	1)	350	140	210	80	45	150
160/90	201609	1)	350	140	210	55	30	125
160/110	201611		350	140	210	60	45	135
160/160	201616		350	140	210	30	35	105
200/75	202007	1)	360	180	180	90	60	90
200/90	202009	1)	360	180	180	80	60	80
200/110	202011	1)	360	180	180	70	60	70
200/125	202012	1)	360	180	180	65	60	65
200/160	202016	1)	360	180	180	45	60	45
200/200	202020	1)	360	180	180	25	60	25
250/110	202511	1)	440	220	220	110	70	110
250/125	202512	1)	440	220	220	105	70	105
250/160	202516	1)	440	220	220	85	70	85
250/200	202520	1)	480	240	240	65	40	65
250/250	202525	1)	480	240	240	40	40	40
315/110	203111	1)	560	280	280	170	90	170

1) fabricated

-- to be continued --

Branch 88,5° - continuation -

d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
315/125	203112	1)	560	280	280	165	90	165
315/160	203116	1)	560	280	280	145	90	145
315/200	203120	1)	560	280	280	120	65	120
315/250	203125	1)	560	280	280	95	65	95
315/315	203131	1)	560	280	280	70	65	70

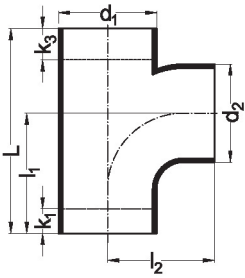
1) fabricated

Branch swept entry 88,5°

HDPE



d_1/d_2	Code		L	l_1	l_2	k_1	k_3
110/110	251111		225	135	130	30	30

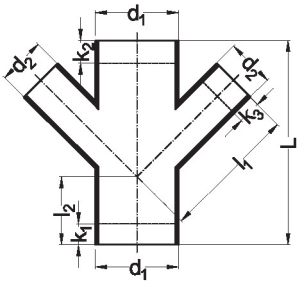


Double branch 45°

HDPE



d_1/d_2	Code	L	l_1	l_2	k_1	k_2	k_3
110/110	361111	270	180	100	65	20	20

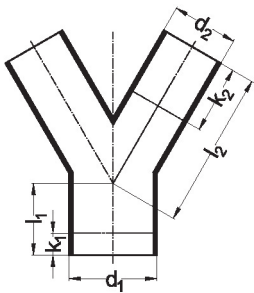


Y-piece 60°

HDPE



d_1/d_2	Code	l_1	l_2	k_1	k_2
110/110	371111	90	102	-	-



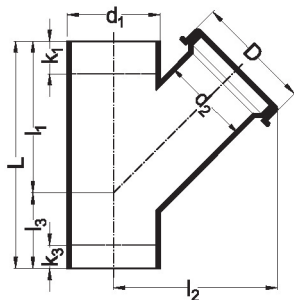
Clean out branch 45°

HDPE



d_1/d_2	Code	D	L	l_1	l_2	l_3	k_1	k_3
110/110	331100	140	270	180	195	90	20	55
125/110	331200	140	300	200	200	100	25	25
160/110	331600	140	375	250	220	125	45	45

Clean out branches 45° can be applied in horizontal and vertical pipes.



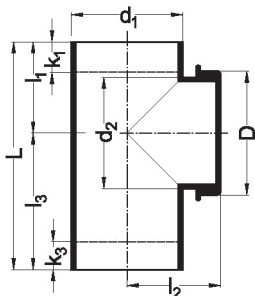
Clean out branch 90°

HDPE



d_1/d_2	Code	D	L	l_1	l_2	l_3	k_1	k_3
40/40	230400	64	130	55	80	75	25	45
50/50	230500	72	150	60	72	90	25	55
56/56	235600	83	175	70	100	105	30	65
63/63	230600	87	175	70	100	105	30	60
75/75	230700	91	175	70	100	105	25	55
90/90	230900	118	200	80	100	120	25	70
110/110	231120	127	225	90	105	135	20	65
125/110	231200	140	250	100	123	150	20	80
160/110	231620	134	350	140	120	210	60	135
200/110	232000	140	360	180	160	180	90	90
250/110	232500	140	440	220	185	220	110	110
315/110	233100	140	560	280	220	280	170	170

Clean out branches 90° can be applied in horizontal and vertical pipes.



Double ball branch 88,5° - 90°

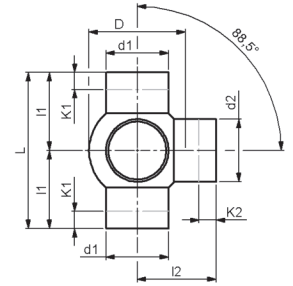
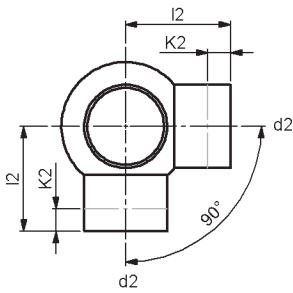
HDPE

fabricated - 90°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	241114	275	135	140	170	30	15
110/56	241115	275	135	140	170	30	15
110/63	241116	275	135	140	170	30	15
110/75	241117	275	135	140	170	30	15
110/90	241119	275	135	140	170	30	15
110/110	241101	275	135	140	170	30	30
125/110	241201	260	130	125	190	30	40

Double ball branches can be applied in soil and waste stacks.



Double ball branch 88,5° - 135°

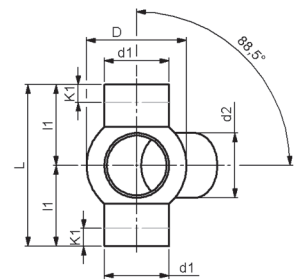
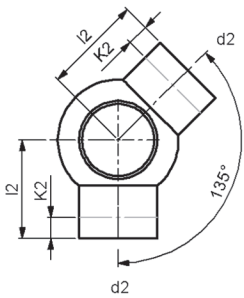
HDPE

fabricated - 135°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	241124	275	135	140	170	30	15
110/56	241125	275	135	140	170	30	15
110/75	241127	275	135	140	170	30	15
110/110	241102	275	135	140	170	30	30
125/110	241202	260	130	125	190	30	40

Double ball branches can be applied in soil and waste stacks.



Double ball branch 88,5° - 180°

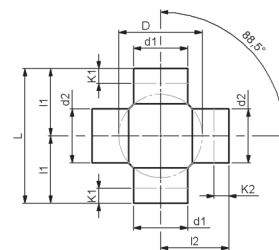
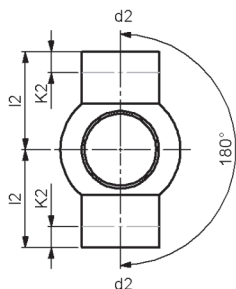
HDPE

fabricated - 180°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	241134	275	135	140	170	30	15
110/56	241135	275	135	140	170	30	15
110/63	241136	275	135	140	170	30	15
110/75	241137	275	135	140	170	30	15
110/90	241139	275	135	140	170	30	15
110/110	241103	275	135	140	170	30	30
125/110	241203	260	130	125	190	30	40

Double ball branches can be applied in soil and waste stacks.



Triple ball branch 88,5° - 90°

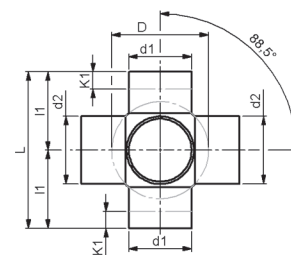
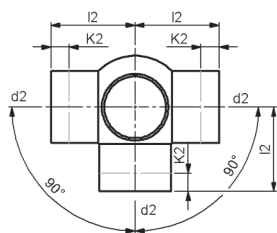
HDPE

fabricated - 90°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	341114	275	135	140	170	30	15
110/56	341115	275	135	140	170	30	15
110/63	341116	275	135	140	170	30	15
110/75	341117	275	135	140	170	30	15
110/90	341119	275	135	140	170	30	15
110/110	341101	275	135	140	170	30	30
125/110	341201	260	130	125	190	30	40

Triple ball branches can be applied in soil and waste stacks.



Triple ball branch 88,5° - 135°

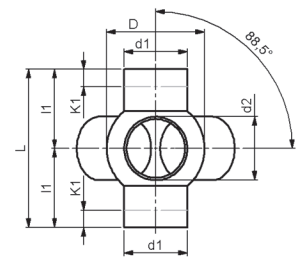
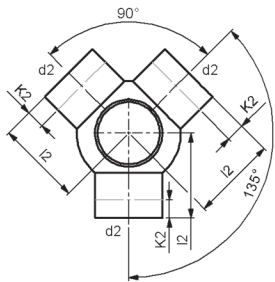
HDPE

fabricated - 135°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/56	341125	275	135	140	170	30	15
110/63	341126	275	135	140	170	30	15
110/75	341127	275	135	140	170	30	15
110/90	341129	275	135	140	170	30	15
110/110	341102	275	135	140	170	30	30

Triple ball branches can be applied in soil and waste stacks.



Fourfold ball branch 88,5° - 90°

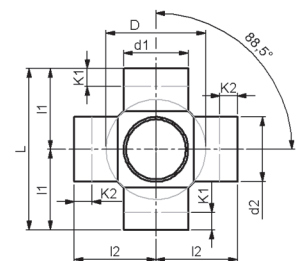
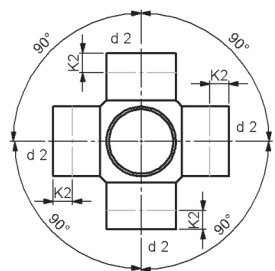
HDPE

fabricated - 90°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/110	441101	275	135	140	170	30	30
125/110	441201	260	130	125	190	30	40

Fourfold ball branches can be applied in soil and waste stacks.



Stack-aerator

HDPE



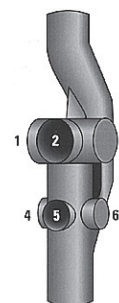
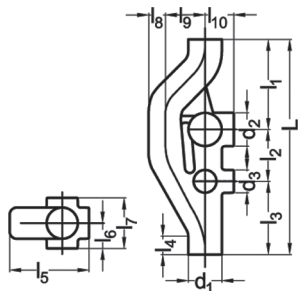
d ₁ /d ₂	Code	d ₃	L	l ₁	l ₂	l ₃	l ₄	l ₅	l ₆	l ₇	l ₈	l ₉	l ₁₀
110/110	601117	75	705	295	170	240	60	279	89	178	55	130	94
160/110	601617	75	750	330	170	250	60	339	114	228	80	140	119

1) 1/2/3 = max. Ø 110 mm - 4/5/6 = max. Ø 75 mm - butt-weld only

The stack-aerator is delivered with closed caps. After removing the caps, the required horizontal branches can be butt-welded directly to the stack-aerator.

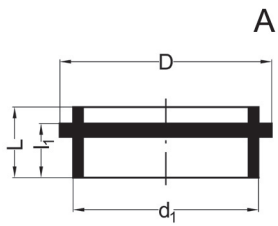
The horizontal branches can also be connected using plug-in sockets butt-welded to the stack-aerator. Plug-in sockets allow for easy assembly on-site and enable a transition from 110 mm dBlue for acoustic horizontal drainage or a standard uPVC 110 mm branch. Using snap-sockets a pull-tight connection can be created.

An expansion socket on every level is mandatory to absorb any pipe expansion and have a tension-free stack-aerator. Inspection openings should be installed according to local regulation, we advise one on every level.

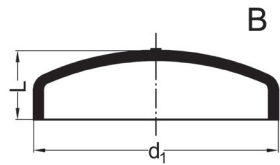


End cap

HDPE



A



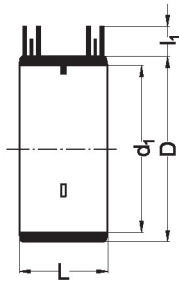
B

d_1	Code	Type	L	D	l_1
40	670407	A	15	46	11
50	670507	A	16	57	12
56	675607	A	16	64	12
63	670607	A	18	71	14
75	670707	A	21	85	16
90	670907	A	19	100	19
110	671107	A	19	120	19
125	671209	B	35		
160	671609	B	45		
200	672009	B	55		
250	672509	B	30		
315	673109	B	30		

Butt-weld only

Electrofusion coupler

HDPE

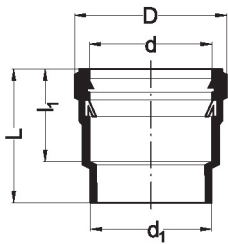


d_1	Code	D	L	I_1	System
40	410495	52	54	16	5A/80s
50	410595	62	54	16	5A/80s
56	415695	68	54	16	5A/80s
63	410695	75	54	16	5A/80s
75	410795	87	54	16	5A/80s
90	410995	102	56	16	5A/80s
110	411195	123	60	16	5A/80s
125	411295	137	66	16	5A/80s
160	411695	172	66	14	5A/80s
200	412065	233	175	21	220V/420s
250	412565	283	175	22	220V/420s
315	413165	349	175	22	220V/420s

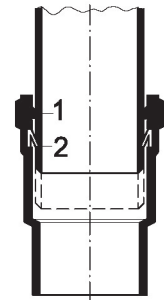
The electrofusion couplers are delivered with centre stops. These stops can easily be removed with a knife or screwdriver (200, 250, 315), so that the coupler can be used as a slide-coupler. Before welding, cut pipe ends squarely with a pipe cutting tool, remove the oxide film with a scraper and mark the insertion depth. The couplers can easily be welded with our Akatherm control box and other suitable control boxes.

Snap socket

with protection plug
SBR seal



d_1	Code	D	d	L	l_1
40	400410	55	41	73	55
50	400510	65	51	77	55
63	400610	78	64	90	70
75	400710	90	76	90	70
90	400910	110	91	90	70
110	401110	130	111	90	70
125	401210	150	126	94	70
160	401610	190	162	134	105
200	402010	230	202	155	125



1 sealing ring
2 snap ring

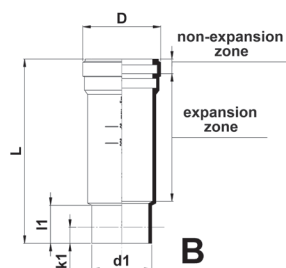
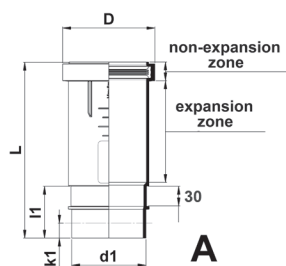
The snap socket can be used as a plug-in connection and a pull tight connection. The snap ring (besides the rubber sealing ring) provides the possibility to make a pull tight connection between pipe and snap socket, provided that a groove is cut into the pipe with a groove cutter (see chapter Tools). The pipe end should be pushed into the snap socket entirely.

Butt-weld only

Expansion socket with anchor point

with protection plug
SBR seal

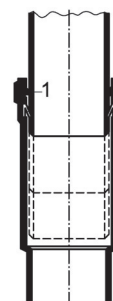
HDPE



d ₁	Code		Type	D	L	Non-expansion zone	Expansion zone	l ₁	k ₁
40	400420		B	56	172	25	109	35	-
50	400520		B	65	172	25	109	35	-
56	405620		B	72	172	25	109	35	-
63	400620	¹⁾	B	80	155	25	114	15	-
75	420720		A	98	255	32	148	72	30
90	420920		A	114	255	32	148	72	30
110	421120		A	135	260	35	145	76	35
125	421220		A	152	260	38	142	76	35
160	421620		A	186	266	41	148	76	35
200	402020	²⁾	B	240	300	45	200	55	-
250	402520	²⁾	B	298	325	55	205	62	-
315	403120	²⁾	B	372	355	55	225	68	-

¹⁾ butt-weld only

²⁾ without protection plug - butt-weld only



1 sealing ring

The expansion sockets can absorb length changes of pipes with a max. length of 6 m. A temperature difference of 10°C will result in expansion or contraction of 8 mm. The insertion depths at ambient temperature of 0°C and 20°C are indicated on the sockets.

Expansion sockets d75-160 mm have an intergrated anchor point, that is able to incorporate extension of the 5 meter down pipe

Snap socket

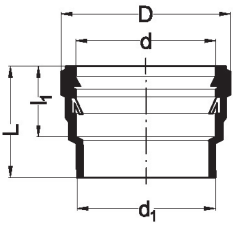
with protection plug
SBR seal



d_1	Code	D	d	L	l_1
110	401140	130	111	55	45

Butt-weld only

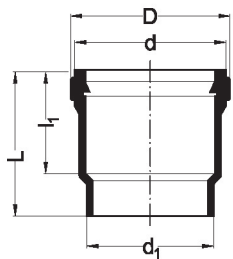
Short snap sockets can be used as a plug-in and a tight-fit connection. They are applied at places where thermally caused length changes are not allowed (for instance imbedded stacks).

**Plug-in socket**

with protection plug
SBR seal



d_1	Code	D	d	L	l_1
40	420450	53	41	93	54
50	420550	67	51	89	54
56	425650	72	57	89	54
63	420650	84	64	104	69
75	420750	96	76	109	69
90	420950	110	91	109	69
110	421150	128	119	101	60
125	421250	150	126	114	70
160	421650	190	162	151	105



Screw coupler short

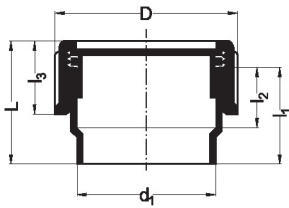
complete with threaded piece, nut, pressure ring and sealing ring
EPDM seal

HDPE



d ₁	Code	D	L	I ₁	I ₂	I ₃
40	430430	66	71	56	32	33
50	430530	76	71	56	32	33
56	435630	82	71	56	32	35
63	430630	89	76	61	37	42
75	430730	103	81	65	37	44
90	430930	122	92	75	45	48
110	431130	148	97	80	49	62

Butt-weld only



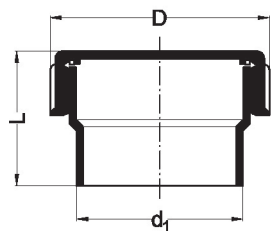
Inspection screw lock long

EPDM seal

HDPE



d ₁	Code	D	L
40	660440	66	85
50	660540	76	85
56	665640	82	85
63	660640	89	90
75	660740	103	91
90	660940	122	102
110	661140	148	107

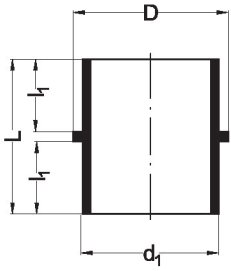


Flange bushing for screw coupler

HDPE



d_1	Code	D	L	l_1
40	430405	45	58	27
50	430505	56	66	31
56	435605	63	64	30
63	430605	69	73	34
75	430705	84	81	38
90	430905	99	101	48
110	431105	119	112	53



Inspection screw lock short

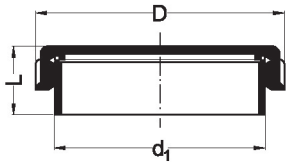
HDPE

EPDM seal



d_1	Code	D	L
75	660700	91	48
110	661120	133	53

Butt-weld only



Waste connector

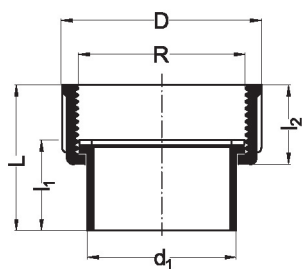
with nut and seal
SBR seal

HDPE



d ₁	Code	R	L	I ₁	I ₂	D
32	980381	1 ¼"	35	21	21	54
40	980482	1 ½"	38	25	21	59
50	980583	2"	44	30	21	72

Butt-weld only



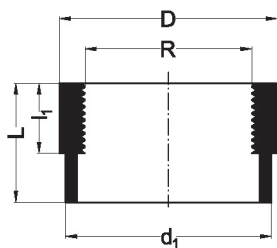
Female thread adaptor short

HDPE

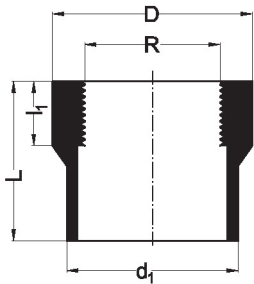


d ₁	Code	R	L	I ₁	D
40	910479	¾"	38	30	40
40	910480	1"	38	30	45
40	910481	1 ¼"	38	30	55
50	910580	1"	38	30	50
50	910581	1 ¼"	38	30	55
50	910582	1 ½"	38	30	63
63	910682	1 ½"	38	30	63
63	910683	2"	38	30	75

Butt-weld only

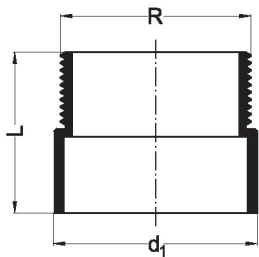
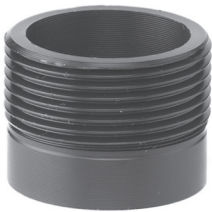


Female thread adaptor long



d ₁	Code	R	L	l ₁	D
40	920478	1/2"	55	30	40
40	920479	3/4"	70	30	40
40	920480	1"	70	30	45
40	920481	1 1/4"	70	30	55
50	920578	1/2"	60	30	50
50	920580	1"	70	30	50
50	920581	1 1/4"	70	30	55
50	920582	1 1/2"	70	30	63
50	920583	2"	70	30	75
56	925683	2"	70	30	75
63	920683	2"	70	30	75
75	920784	2 1/2"	70	30	90

Male thread adaptor short

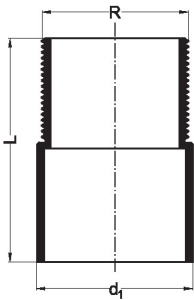


d ₁	Code	R	L
40	960478	1/2"	30
40	960479	3/4"	30
40	960480	1"	30
40	960481	1 1/4"	30
50	960580	1"	35
50	960581	1 1/4"	35
50	960582	1 1/2"	35
63	960682	1 1/2"	40
63	960683	2"	40

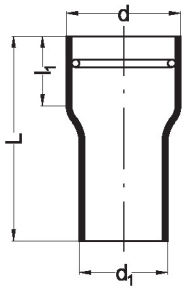
Butt-weld only

Male thread adaptor long

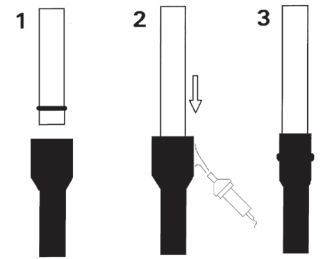
HDPE



d ₁	Code	R	L
40	970478	1/2"	60
40	970479	3/4"	60
40	970480	1"	60
40	970481	1 1/4"	60
50	970580	1"	65
50	970581	1 1/4"	65
50	970582	1 1/2"	65
56	975683	2"	65
63	970682	1 1/2"	70
63	970683	2"	70
75	970784	2 1/2"	70

Contraction socketwith O-ring
NBR

d_1/d	Code	L	l_1	d_x
40/50	550401	210	65	41-44
50/80	550504	210	60	67-74
56/75	555601	210	70	62-69
63/75	550601	210	70	62-69
63/85	550603	210	70	75-79
75/90	550701	210	75	80-84
90/110	550902	210	75	94-98
110/125	551102	210	100	102-111
110/135	551103	210	100	110-120
125/155	551201	210	85	120-140
125/170	551202	210	85	135-155
160/180	551602	220	90	155-165
160/195	551604	220	90	160-180
200/225	552001	300	150	185-207

 d_x = connecting range

Contraction sockets are applied for jointing PE to concrete, clayware, copper, stainless steel etc. (see drawing).

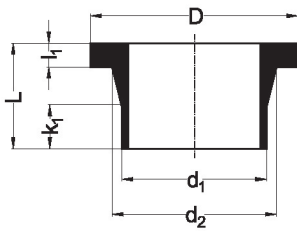
1 Slip the seal over the pipe end.

2 Then slide the retraction socket over the pipe end with seal and heat it with for instance hot air.

3 The socket will shrink and fit over the pipe end.

Stub flange

HDPE

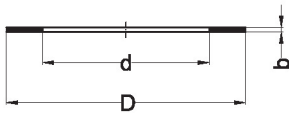
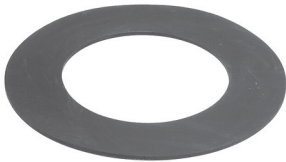


d_1	Code		d_2	D	L	l_1	k_1
40	470402	¹⁾	50	78	50	10	15
50	470502	¹⁾	61	88	50	10	15
56	475602	¹⁾	70	102	60	14	15
63	470602	¹⁾	75	102	50	14	15
75	470702	¹⁾	89	120	50	16	15
90	470902		105	136	80	17	20
110	471102		125	158	80	18	30
125	471202		132	158	80	18	30
160	471602	¹⁾	175	210	80	18	30
200	472002	¹⁾	232	268	100	18	40
250	472502	¹⁾	285	320	100	20	40
315	473102	¹⁾	335	370	100	20	40

¹⁾ butt-weld only

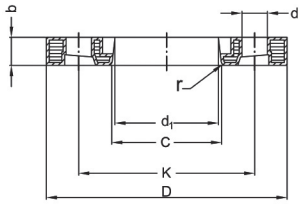
Gasket flat

EPDM



d_1	Code		d	D	b
40/32	470413910		34	82	3
50/40	470513910		42	92	3
56/50	470613810		58	107	3
63/50	470613810		58	107	3
75/65	470713810		69	127	3
90/80	470913810		84	142	3
110/100	471113810		100	162	3
125/100	471213810		114	162	3
160/150	471613810		146	218	3
200/200	472013810		181	273	3
250/250	472513810		226	328	3
315/300	473113810		283	378	3

Profile backing ring PP with ductile iron core



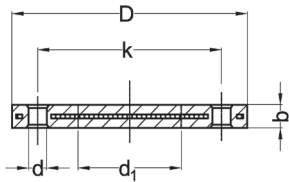
d ₁ /DN	Code	C	D	K*	b	d*	n*	M	r
40/32	470409010	51	142	100	17	18	4	M16	3
50/40	470509010	62	156	110	19	18	4	M16	3
56/50	470609010	78	171	125	20	18	4	M16	3
63/50	470609010	78	171	125	20	18	4	M16	3
75/65	470709010	92	191	145	21	18	4	M16	3
90/80	470909010	108	206	160	21	18	8	M16	3
110/100	471109010	128	226	180	22	18	8	M16	3
125/100	471209010	135	226	180	23	18	8	M16	3
160/150	471609010	178	296	240	28	22	8	M20	3
200/200	472009010	235	350	295	32	22	8	M20	4
250/250	472509010	288	412	350	36	22	12	M20	4
315/300	473109010	338	462	400	42	22	12	M20	4

Profile backing rings with ductile iron core are suitable for non-pressure applications.

n = number of bolts
M = thread
* DIN 2501 PN10

Blind flange PP ductile iron core

Dimensions according to DIN 2501 PN10



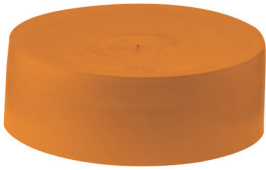
d ₁ /DN	Code	D	K	b	d	n	M
40/32	470485010	140	100	16	18	4	M16
50/40	470585010	150	110	18	18	4	M16
56/50	470685010	165	125	18	18	4	M16
63/50	470685010	165	125	18	18	4	M16
75/65	470785010	185	145	18	18	4	M16
90/80	470985010	200	160	18	18	8	M16
110/100	471185010	220	180	18	18	8	M16
125/100	471185010	220	180	18	18	8	M16
160/150	471685010	285	240	24	22	8	M20
200/200	472085010	340	295	24	22	8	M20
250/250	472585010	400	350	30	22	12	M20
315/300	473185010	463	400	34	22	12	M20

Blind flange PP ductile iron core are suitable for non-pressure applications.

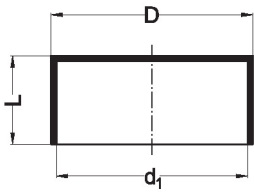
n = number of bolts
M = thread
Reference circle PN10 EN 1092

Protection cap for pipe

HDPE



d_1	Code		D	L
40	400429		42	35
50	400529		52	35
56	405629		58	35
63	400629		65	35
75	400729		78	35
90	400929		93	35
110	401129		113	40
125	401229		129	40
160	401629		164	40

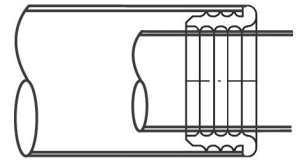
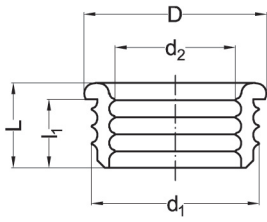


Rubber collar for pipe in pipe joints

NBR



d_1/d_2	Code		D	L	l_1
50/32	513301		54	24	20
50/40	513501		54	24	20
56/32	513303		56	29	23
56/40	513503		56	27	22
63/32	513502		63	24	20
63/40	513602		63	24	20
63/50	513702		63	24	20

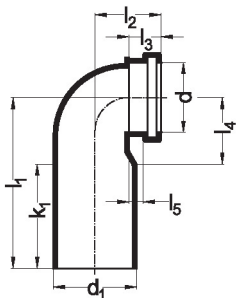


Wall-lavatory bend 90°with protection plug
SBR seal

HDPE



d_1/d	Code		l_1	l_2	l_3	l_4	l_5	k_1
90/90	500984		225	76	34	83	17	120
110/90	501185		225	76	34	95	17	120
110/110	501182	¹⁾	225	75	30	92	19	120

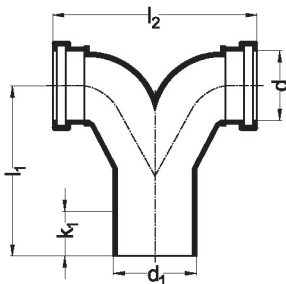
¹⁾ NBR O-ring**Double wall-lavatory bend 90° (vertical)**

with protection plug

HDPE



d_1/d	Code		l_1	l_2	k_1
110/110	501134	¹⁾	185	270	60

¹⁾ NBR O-ring

Double wall-lavatory bend 90° (horizontal)

with protection plug

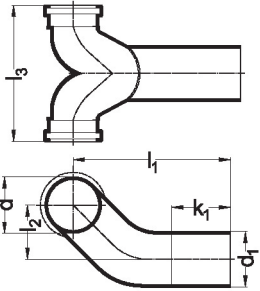
HDPE



d_1/d	Code		l_1	l_2	l_3	k_1
110/90	500935	1)	360	120	275	200
110/110	501135	2)	360	120	270	200

1) EPDM O-ring

2) NBR O-ring

**Wall-lavatory bend 90° (horizontal) left**

with protection plug

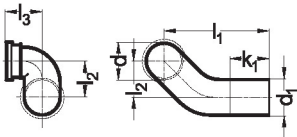
SBR seal

HDPE



d_1/d	Code		l_1	l_2	l_3	k_1
110/90	501032		350	100	75	170
110/110	501132	1)	350	100	75	170

1) NBR O-ring

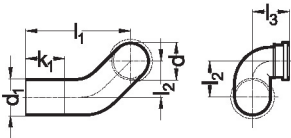


Wall-lavatory bend 90° (horizontal) rightwith protection plug
SBR seal

HDPE



d_1/d	Code		l_1	l_2	l_3	k_1
110/90	501033		350	100	75	170
110/110	501133	¹⁾	350	100	75	170

¹⁾ NBR O-ring**Wall-lavatory socket**

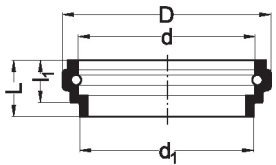
HDPE



d_1/d	Code		D	L	l_1
90/90	500951	¹⁾	113	49	38
110/110	501171	²⁾	130	45	28

¹⁾ EPDM O-ring²⁾ NBR O-ring

Butt-weld only

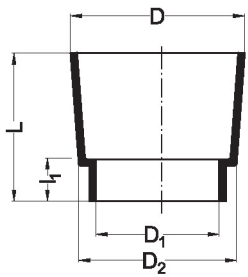


Protection plug

HDPE



d_1	Code		D	D_1	D_2	L	l_1
90	430919		109	90	103	98	27,0
110	431119		130	105	119	98	23,5



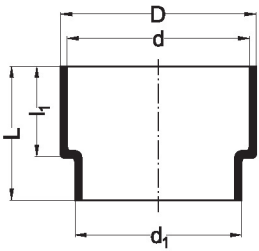
Floor-lavatory socket

HDPE



d_1	Code	d	D	L	l_1
90	500901	120	129	85	55
110	501101	120	129	88	60

Butt-weld only

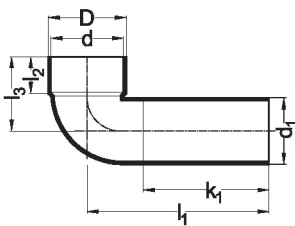


Floor-lavatory bend 90°

HDPE



d_1	Code	d	D	l_1	l_2	l_3	k_1
90	500911	120	129	270	65	123	175
110	501111	120	129	300	60	140	215

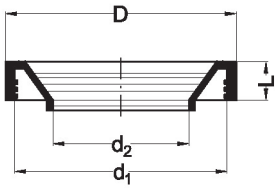


Rubber seal for floor-lavatory socket/bend

d_1	Code		D	d_2	L
129	501113		135	102	25



d_2 = connecting size.



Trap connection 90° bend

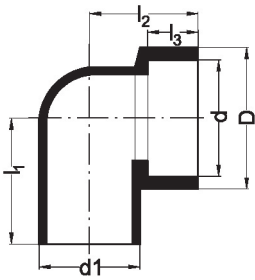
HDPE



d_1	Code	d	D	l_1	l_2	l_3
40	510411	46	56	50	44	20
50	510511	46	53	45	46	18
56	515611	46	56	60	60	35
50	510512	58	65	50	45	20

Butt-weld only

Trap connection bend 90° connect in combination with rubber seal Code 51xx01 or 51xx02.



Trap connection socket

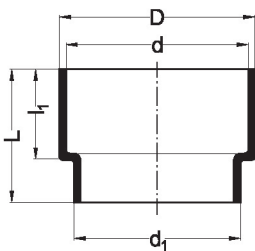
HDPE



d_1	Code	d	D	L	l_1
40	510401	46	53	30	24
50	510501	46	54	38	27
56	515601	46	53	38	25
50	510502	58	66	50	39
56	515602	58	64	46	32

Butt-weld only

Trap connection socket connect in combination with rubber seal Code 51xx01 or 51xx02.

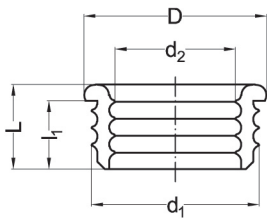


Rubber collar for trap connection bend/socket

NBR



d ₁	Code	d	D	L	l ₁
46	513301	1 ¼" (32)	54	24	20
46	513501	1 ½" (40)	54	24	20
58	513502	1 ¼" (32)	63	24	20
58	513602	1 ½" (40)	63	24	20
58	513702	2" (50)	63	24	20

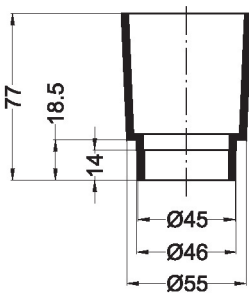


Universal protection plug

for all trap connection bends/sockets



Code
434619



Floor waste gully push-fit

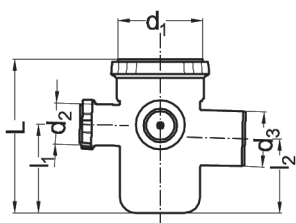
HDPE

SBR seal



$d_1/d_2/d_3$	Code	L	l_1	l_2
110/3x50/75	461105	212	120	100

3 x 50 mm side inlets push-fit (factory closed)
 1 x 110 mm top inlet push-fit
 1 x 75 mm side outlet electrofusable



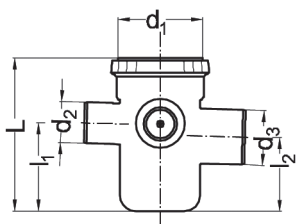
Floor waste gully electrofusable

HDPE



$d_1/d_2/d_3$	Code	L	l_1	l_2
110/3x56/75	461156	212	120	100

3 x 56 mm side inlets electrofusable (factory closed)
 1 x 110 mm top inlet push-fit
 1 x 75 mm side outlet electrofusable



Four way riser electrofusable

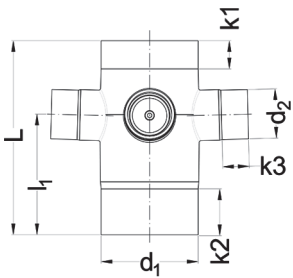
HDPE



d_1/d_2	Code	L	l_1
110/4x56	461111	232	144

4 x 56 mm side inlets electrofusable (factory closed)
 1 x 110 mm top inlet electrofusable
 1 x 110 mm bottom outlet electrofusable

To be applied only in combination with universal trap Code 111109.



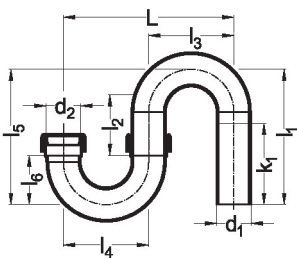
S-trap

HDPE

SBR seal



d_1/d_2	Code	L	l_1	l_2	l_3	l_4	l_5	l_6	k_1
40/40	040401	160	182	95	80	80	162	67	100
50/40	040501	160	192	100	80	80	172	67	140
50/50	050501	200	213	110	100	100	188	73	140
63/50	050601	200	213	110	100	100	188	73	110
63/63	060601	260	254	130	130	130	224	89	170
75/75	070701	300	289	130	150	150	254	99	180



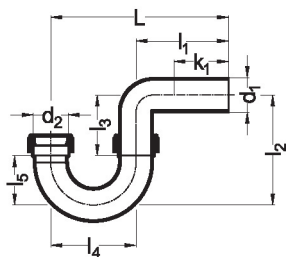
P-trap

HDPE

SBR seal



d_1/d_2	Code	L	l_1	l_2	l_3	l_4	l_5	k_1
40/40	040402	172	92	162	95	80	67	45
50/40	040502	184	104	172	100	80	67	45
50/50	050502	204	104	203	120	100	73	45
63/50	050602	218	118	198	120	100	73	55
63/63	060602	262	132	224	130	130	89	60



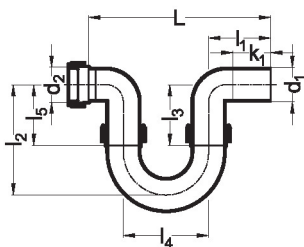
Running trap

HDPE

SBR seal



d_1/d_2	Code	L	l_1	l_2	l_3	l_4	l_5	k_1
40/40	040403	241	92	162	95	80	95	45
50/50	050503	281	104	193	115	100	115	45
63/63	060603	351	132	224	130	130	130	60



Universal trap with flange bushing

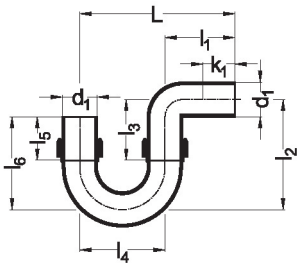
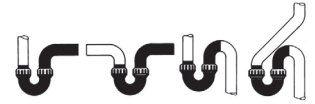
HDPE

SBR seal



d_1	Code	L	l_1	l_2	l_3	l_4	l_5	l_6	k_1
63	060609	255	130	214	140	125	73	149	60
75	070709	293	143	258	155	150	81	184	60
90	090909	445	270	250	150	175	101	203	175
110	111109	520	300	323	165	210	112	255	220

Larger diameters on request.
Possibilities for application: see illustration.



Collar for plug-in socket, plug-in socket short, snap socket and expansion socket

SBR



d _i	Code	A	B	C
40	400413	420450	400420	400410
50	400513	420550	400520	400510
56	405613	425650	405620	
63	400613	420650	400620	400610
75	400713	420750		400710
75	420723		420720	
90	400913	420950		400910
90	420923		420920	
110	401113	421150		401110
110	421123		421120	
125	401213	421250		401210
125	421223		421220	
160	401613	421650		401610
160	421623		421620	
200	402013			402010
200	402023		402060	
250	402523		402560	
315	403123		403160	

A = plug-in socket
 B = snap-expansion socket
 C = snap socket

Protection plug for plug-in socket, plug-in socket short, snap socket and expansion socket

HDPE



d _i	Code	A	B	C
40	400419	420450	400420	400410
50	400519	420550	400520	400510
56	405619	425650	405620	405610
63	400619	420650	400620	400610
75	400719	420750	420720	400710
90	400919	420950	420920	400910
110	401119	421150	421120	401110
125	401219	421250	421220	401210
160	401619	421650	421620	401610
200	402019			402010

A = plug-in socket
 B = snap-expansion socket
 C = snap socket

Protection plug for trap connection socket/bend

HDPE



d_1	Code		A	B
46	404619		51xx01	51xx11
58	405819		51xx02	51xx12

A = trap connection socket

B = trap connection bend

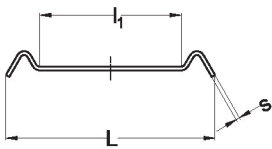
Clamp liners

Stainless steel

2 identical metal clamp liners per set



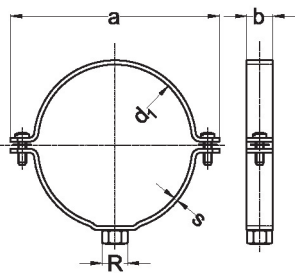
d_i	Code		L	l_i	s
40	700415		40	30	1
50	700515		40	30	1
56	705615		40	30	1
63	700615		40	30	1
75	700715		40	30	1
90	700915		40	30	1
110	701115		40	30	1
125	701215		40	30	1
160	701615		40	30	1
200	702015		50	38	1



Anchor bracket

for fixing to wall

Steel galvanised



d ₁	Code	a	b	s	R
40	700478	93	30	2,5	1/2"
50	700578	104	30	2,5	1/2"
56	705678	113	30	2,5	1/2"
63	700678	113	30	2,5	1/2"
75	700778	126	30	2,5	1/2"
90	700978	143	30	2,5	1/2"
110	701178	161	30	2,5	1/2"
125	701278	178	30	2,5	1/2"
160	701678	215	30	2,5	1/2"
200	702080	283	40	4	1"
250	702580	333	40	4	1"
315	703180	398	40	4	1"

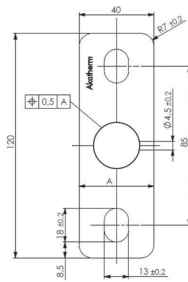
Mounting plate for anchor bracket

for fixing to wall

Steel galvanised

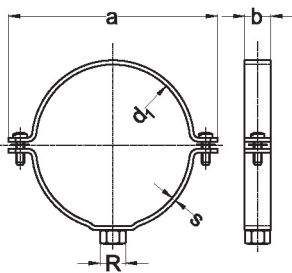


	Code	R	l ₁	l ₂	l ₃	l ₄	S	C
40-160	709478	1/2"	145	38	90	19	4	8,5
200-315	709480	1"	145	38	90	25	4	8,5



Guide bracket
for fixing to wall

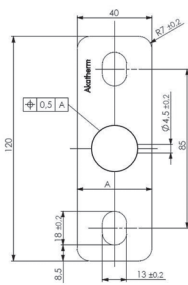
Steel galvanised



d _i	Code	a	b	s	R
40	700410	93	30	2,5	M10
50	700510	104	30	2,5	M10
56	705610	113	30	2,5	M10
63	700610	113	30	2,5	M10
75	700710	126	30	2,5	M10
90	700910	143	30	2,5	M10
110	701110	161	30	2,5	M10
125	701210	178	30	2,5	M10
160	701610	215	30	2,5	M10
200	702080	283	40	4	1"
250	702580	333	40	4	1"
315	703180	398	40	4	1"

Mounting plate for guide bracket
for fixing to wall

Steel galvanised



	Code	R	l ₁	l ₂	l ₃	l ₄	S	C
40-160	709410	M10	145	38	90	14	4	8,5
200-315	709480	1"	145	38	90	25	4	8,5

Electrofusion control box CB160-U



d ₁	Code	Dim.	V~	Hz	kg	A max	W max
40-160	419830	65x200x85	230	50/60	1,7	5	1150

The Akatherm CB160-U control box is suitable for welding electrofusion couplers from d = 40-160 mm.

Electrofusion control box CB315-U



d ₁	Code	Dim.	V~	Hz	kg	A max	W max
40-315	419910	440x220x180	230	50/60	5	10,9	2500

The Akatherm CB315-U control box is suitable for welding electrofusion couplers from d = 40-160 mm (with yellow cable) and electrofusion couplers from d = 200-315 mm (with blue cable). Yellow and blue output leads are supplied as standard with control box Code 419910.

Output leads for control box CB315-U

4 pins



d ₁	Code	System	Colour
40-160	419971	5A/80s	yellow
200-315	419972	220V/420s	blue

Weld extension cable



d ₁	Code	Kleur
40-315	419975	zwart

Connection cable USB



	Code	Kleur
	419977	zwart

Scraper Spider



	Code		L	B	H	kg
	419860	1)	105	80	60	0,460
	419865	2)	260	210	80	1,600

1) excluding Spider accessories

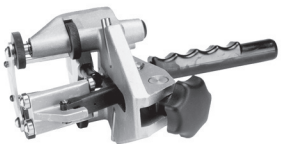
2) including Spider accessories case, rattle, extension for rattle and blades for replacement

For the quick removal of the oxide-layer of pipes d50-125 mm.

Spider accessories

Code	Accessories
419861	Replacement blades
419862	Roller set 3x
419863	Roller holder
419864	Replacement screw M2, 5x6 for blades
419866	Case

Scraper FWSG 225



Code
613409

Rotation scraper for the complete removal of the oxidic layer of PE pipes and fittings d75-225 mm. The scraper is delivered in a useful aluminium transportation case, and includes a set of spare blades.

Manual scraper



Code	
419600	
419601	loose blade

Grease pencil



	Code	
	419620	

Package with 12 pencils.

PE cleaner



	Code	
	601000	

Reclosable container with 100 cleaning cloths.

Pipe cutter



d ₁	Code	
40-63	490910	
50-125	491010	
110-160	491110	

Butt-welding machine 160C



d ₁	Code	L	B	H	kg
40-160	492000	835	565	760	87

d₁ = 40-50-63-75-90-110-125-160.
Suitable for welding Y-branches 45°.

Butt-welding machine 250 C



d ₁	Code	L	B	H	kg
75-250	493000	835	565	760	160

d₁ = 75-90-110-125-160-200-250.
Suitable for welding Y-branches 45°.

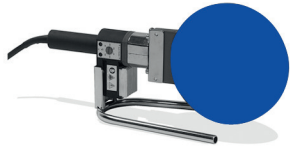
Butt-welding machine 315 C



d ₁	Code	L	B	H	kg
90-315	494000	1200	680	1045	187

d₁ = 90-110-125-160-200-250-315.
Suitable for welding Y-branches 45°.

Manual welding plate



Code
490010

For welding pipe and fittings up to 110 mm size.
The welding plate is delivered including case and holder.

Appendix A: Chemical resistance

The chemical resistance of HDPE is depicted per medium at a number of different temperatures. In general we can define the resistance as follows:

For standard soil and waste systems the resistance of HDPE is perfect. In these pipe systems aggressive fluids are rarely drained. When transporting chemical waste waters in laboratories and the chemical industry the following factors have to be taken in account:

- The medium
- The concentration of this medium
- Temperature
- Duration of exposure
- Volume

The chemical resistance list of the electrometric seals is to aid in establishing the suitability of a certain seal. This is only an indication of its suitability. The chemical deterioration of the polymer chain can lead to changes in the mechanical characteristics like tensile strength and elongation at break etc. The data is valid for a temperature of 20°C. At higher temperatures or longer duration of exposure a more aggressive condition can occur which shortens the lifespan of the seal.

Used symbols

HDPE pipe and fittings:

- +** Resistant, based on the test carried out HDPE is in general.
- a** Suitable material for this application.
- /** Limited resistance, further research necessary.
- No resistance.
- Empty field** No data available.

Elastomeric seals:

- 1** Little or no effect, volume change <10%. In heavy conditions this elastomere can show a small increase in volume and /or loss of physical properties.
- 2** Possible change of physical properties, volume change 10%-20%, the elastomer can show increase in volume and a change in physical properties but can be suitable for static applications.
- 3** Noticeable change of physical properties, large change in volume, and physical properties.
- 4** Elastomeric seal is not suitable. Influence too great.
- Empty field** No data available.

Abbreviations:

- Comm. Comp. = Commercial composition
- HDPE = High Density Polyethylene
- NBR = Acryl nitrile-butadiene rubber
- EPDM = Ethylene propylene copolymer
- FPM = Vinylidene fluoride copolymer
- SBR = Styrol butadiene rubber

Component		Concentration	Pipe and fittings			Elastomeric seals				
Name	Formula		Remark	HDPE °C			NBR °C	EPDM °C	FPM °C	SBR °C
				20	40	60	20	20	20	20
Acetaldehyde	CH ₃ CHO	Aqueous solution	40%	+	+	/	4	2	4	3
Acetaldehyde	CH ₃ CHO	Technically pure	100%	+	/	/	4	2	4	3
Acetic Acid	CH ₃ COOH	Aqueous solution	10%	+	+	+	4	3/4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	30%	+	+	+	4	4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	60%	+	+	+	4	4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	80%	/	/	-	4	4	4	4
Acetic Acid	CH ₃ COOH	Technically pure	100%	+	+	/	4	4	4	4
Acetic Acid Anhydride	(CH ₃ CO) ₂ O	Technically pure	100%	+	/	/	4	2	4	2
Acetone	CH ₃ COCH ₃	Aqueous solution	10%	+	+	+	4	1	4	2/3
Acetone	CH ₃ COCH ₃	Technically pure	100%	/	/	/	4	1	4	2/4
Acetophenone	CH ₃ COC ₆ H ₅	Technically pure	Indetermined	+	+	+	4	1	4	4
Acrylonitrile	CH ₂ =CH-CN	Technically pure	100%	+	+	+	4	4	4	3
Adipic Acid	HOOC(CH ₂) ₄ COOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Alcohol			40%	+						
Alcoholic Spirits			Comm. Comp.	+	+					
Allyl Alcohol	CH ₂ =CH-CH ₂ OH	Aqueous solution	96%	+	+	+				
Alum	Al ₂ (SO ₄) ₃ .K ₂ SO ₄ .4H ₂ O	Aqueous solution	Solution	+	+	+	2	1	1	1
Alum	Al ₂ (SO ₄) ₃ .K ₂ SO ₄ .4H ₂ O	Aqueous solution	Saturated	+	+	+	2	1	1	1
Aluminium Acetate	(CH ₃ COO) ₃ Al	Aqueous solution	Saturated	+	+	+	2	1	4	4
Aluminium Bromide	AlBr ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Aluminium Chloride	AlCl ₃	Aqueous solution	All	+	+	+	2	1	1	1
Aluminium Fluoride	AlF ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Aluminium Nitrate	Al(NO ₃) ₃	Aqueous solution	Saturated	+			1	1	1	1
Aluminium Sulfate	Al ₂ (SO ₄) ₃	Aqueous solution	10%	+	+	+	2	1	1	1
Aluminium Sulfate	Al ₂ (SO ₄) ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Ammonia	NH ₃	Aqueous solution	Solution	+	+	+	2	1	3	2
Ammonia Gas	NH ₃	Aqueous solution	Saturated	+	+	+	2	1	3	2
Ammonia Gas	NH ₃	Technically pure	100%	+	+	+	2	1	3	2
Ammonium Acetate	CH ₃ COONH ₄	Aqueous solution	Saturated	+	+	+				
Ammonium Bifluoride	NH ₄ FHF	Aqueous solution	Saturated	+	+	+				
Ammonium Carbonate	(NH ₄) ₂ CO ₃	Aqueous solution	100%	+	+	+	2	1	2	2
Ammonium Chloride	NH ₄ Cl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Ammonium Fluoride	NH ₄ F	Aqueous solution	25%	+	+	+	1	1	1	1
Ammonium Fosfate	(NH ₄) ₃ PO ₄ X H ₂ O		All	+	+	+	1	1	1	1
Ammonium Hydroxide	NH ₄ OH	Aqueous solution	Solution	+	+	+	4	1	2	4
Ammonium Hydroxide	NH ₄ OH	Aqueous solution	Saturated	+	+	+	4	1	2	4
Ammonium Nitrate	NH ₄ NO ₃	Aqueous solution	Saturated	+	+	/	2	1	1	1
Ammonium Sulfate	(NH ₄) ₂ SO ₄	Aqueous solution	All	+	+	+	1	1	1	1
Ammonium Sulphhydrate	NH ₄ OH(NH ₄) ₂ SO ₄	Aqueous solution	Solution	+						
Ammonium Sulphhydrate	NH ₄ OH(NH ₄) ₂ SO ₃	Aqueous solution	Saturated	+						
Ammonium Sulfide	(NH ₄) ₂ S	Aqueous solution	10%	+	+	+	1	1	1	1
Ammonium Sulfide	(NH ₄) ₂ S	Aqueous solution	Saturated	+	+	+	1	1	1	1
Amyl Acetate	CH ₃ COO(CH ₂) ₄ CH ₃	Technically pure	100%	+	+	+	4	2	4	3
Amyl Alcohol	CH ₃ (CH ₂) ₃ CH ₂ OH		100%	+	+	/	2	2	2	1
Amyl Chloride	CH ₃ (CH ₂) ₄ Cl	Technically pure	100%	-			4	1	4	4
Aniline	C ₆ H ₅ NH ₂	Technically pure	100%	/			4	2/3	1	3
Aniline Chlorhydrate	C ₆ H ₅ NH ₂ HCl	Aqueous solution	Saturated	/	/	/	2	2	1	1
Anthraquinone Sulfonic Acid			Solution	+						
Antimony Trichloride	SbCl ₃	Aqueous solution	90%	+	+	+	1	1	1	1
Aqua Regia	3HCl+1HNO ₃		100%	-	-	-	4	4	2/3	4
Arsenic Acid	H ₃ AsO ₄		Saturated	+	+					
Barium Carbonate	BaCO ₃	Aqueous solution	All	+	+	+				
Barium Chloride	BaCl ₂	Aqueous solution	All	+	+	+	1	1	1	1
Barium Hydroxide	Ba(OH) ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Barium Nitrate	Ba(NO ₃) ₂	Aqueous solution	Saturated	+	+	+				
Barium Sulfate	BaSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Barium Sulfide	BaS	Aqueous solution	Saturated	+	+	+	1	1	1	2
Beer			100%	+	+	+	1	1	1	1

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		20	HDPE °C	60	NBR °C	EPDM °C	FPM °C	SBR °C
Benzaldehyde	C ₆ H ₅ CHO	Aqueous solution	Saturated	+	+	+	4	2	4	3
Benzene	C ₆ H ₆	Technically pure	100%	/	-	-	4	4	3	4
Benzene + Benzine			20/80%	/	-	-	2/3	4	2	4
Benzene Sulfonic Acid	C ₆ H ₅ SO ₃ H	Aqueous solution	10%	-	4	4	1	4		
Benzine (Free Of Pb And Aromatic)	C ₅ H ₁₂ +C ₁₂ H ₂₆		100%	+	+	/	4	4	1	4
Benzoic Acid	C ₆ H ₅ COOH	Aqueous solution	Saturated	+	+	+	4	4	1	4
Benzyl Alcohol	C ₆ H ₅ CH ₂ OH	Technically pure	100%	+	+	/	4	1	1	4
Bleaching Lye	NaClO+NaCl	12,5%	Cl	/	/		4	1	1	4
Borax	Na ₂ B ₄ O ₇	Aqueous solution	All	+	+	+	1	1	1	1
Boric Acid	H ₃ BO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Brine			Comm. Comp.	+						
Bromic Acid	HBrO ₃	10%	+	+			4	1	1	4
Bromine, Liquid	Br ₂	Technically pure	100%	-			4	3	2	4
Bromine, Liquid	Br ₂		High	-			4	4	1	4
Butadiene	CH ₂ =CH-CH=CH ₂	Gas	100%	+			3	4	2	4
Butane Gas	CH ₃ CH ₂ CH ₂ CH ₃	100%	+	+	+		2	4	2	4
Butanediol	OHCH ₂ CH ₂ CH ₂ CH ₂ OH	Aqueous solution	10%	+	+	+				
Butanediol	OHCH ₂ CH ₂ CH ₂ CH ₂ OH	Aqueous solution	Concentrated	/	-	-				
Butyl Acetate	CH ₃ COOCH ₂ CH ₂ CH ₂ CH ₃	Technically pure	100%	/	/	/	4	2	4	4
Butyl Alcohol	CH ₃ (CH ₂) ₃ OH	Technically pure	100%	+	+	+	1	2	1	1
Butyl Ether	(CH ₃ (CH ₂) ₃) ₂ O	Technically pure	100%	/	-	-	4	3	4	4
Butyl Phenol	C ₄ H ₉ C ₆ H ₄ OH	Technically pure	100%	-			4	4	2	4
Butyl Phthalate	HOOCCH ₂ H ₄ COOC ₄ H ₉	Technically pure	100%	+	/	/				
Butylene	CH ₂ =CH-CH ₂ CH ₂	Liquid	100%	-			2	4	1	4
Butylene Glycol	OHCH ₂ -CH=CH-CH ₂ OH	Technically pure	100%	+	+	+	1	1	1	1
Butylene	CH ₂ =CH-CH ₂ CH ₃	Technically pure	100%	-			2	4	1	4
Butyric Acid	CH ₃ CH ₂ CH ₂ COOH	Aqueous solution	20%	+	+	/				
Butyric Acid	CH ₃ CH ₂ CH ₂ COOH	Technically pure	100%	+	+	/				
Calcium Acetate	Ca(CH ₃ COO) ₂	Aqueous solution	Saturated	+	+	+	2	1	4	4
Calcium Bisulfite	Ca(HSO ₃) ₂	Aqueous solution	Saturated	+	+	+	2	1	2	2
Calcium Carbonate	CaCO ₃	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Chlorate	Ca(ClO ₃) ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Calcium Chloride	CaCl ₂	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Hydroxide	Ca(OH) ₂	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Hypochloride	Ca(ClO) ₂	Aqueous solution	Saturated	+	+	+	4	1	1	4
Calcium Nitrate	Ca(NO ₃) ₂	Aqueous solution	50%	+	+	+	1	1	1	1
Calcium Sulfate	CaSO ₄	Aqueous solution	Saturated	+	+	+				
Calcium Sulfide	CaS	Aqueous solution	Saturated	/	/	/	1	1	1	2
Camphor Oil			Comm. Comp.	-	-					
Carbon Dioxide	CO ₂ +H ₂ O	Aqueous solution	Indetermined	+	+	+	1	1	1	1
Carbon Dioxide	CO ₂	Gas	100%	+	+	+	1	1	1	1
Carbon Disulfide	CS ₂	Technically pure	100%	/	-	4	4	1	4	
Carbon Monoxid	CO	Gas	100%	+	+	+	2	2	1	2
Carbon Tetrachloride	CCl ₄	Technically pure	100%	-						
Carbonic Acid	H ₂ CO ₃	Aqueous solution	Saturated	+	+	+				
Chloramine	C ₆ H ₅ SO ₂ NNaCl	Aqueous solution	Solution	+						
Chloric Acid	HClO ₃	Aqueous solution	20%	/						
Chlorine	Cl ₂	Wet	All	/	-	4	3	1	4	
Chlorine	Cl ₂	Gas	100%	/	/	-	4	2	4	4
Chlorine	Cl ₂	Technically pure	100%	-						
Chlorine Water	Cl ₂ +H ₂ O	Saturated	/							
Chloro Benzene	C ₆ H ₅ Cl	Technically pure	100%	/	-	-				
Chloro Sulfonic Acid	HClSO ₃	Technically pure	100%	-	-	-				
Chloroform	CHCl ₃	Technically pure	100%	-			4	4	2	4
Chrome Alum	KCr(SO ₄) ₂	Aqueous solution	Saturated	+	+	+				
Chrome Alum	KCr(SO ₄) ₂	Indetermined	+	+	+					
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	10%	/	-	-	4	2/3	1	4
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	30%	/	-	-	4	2/3	1	4

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		20	HDPE °C 40	60	NBR °C 20	EPDM °C 20	FPM °C 20	SBR °C 20
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	50%	/	-	-	4	2/3	1	4
Citric Acid	C ₃ H ₄ (OH)(COOH) ₃	Aqueous solution	50%	+	+	+	2	1	1	2
Compressed Air with Oil			100%	+	+					
Copper Acetate	Cu(COOCH ₃) ₂		Saturated	+			2	1	4	4
Copper Chloride	CuCl ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Copper Fluoride	CuF ₂	Aqueous solution	All	+	+	+	2	1	1	1
Copper Nitrate	Cu(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+	2	1	1	1
Copper Sulfate	CuSO ₄	Aqueous solution	Solution	+	+	+	1	1	1	1
Copper Sulfate	CuSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Cresol	CH ₃ C ₆ H ₄ OH	Aqueous solution	>=90%	+	+	/				
Cresol	CH ₃ C ₆ H ₅ OH	Aqueous solution	Solution	+	+	/				
Croton Aldehyde	CH ₃ -CH=CH-CHO	Technically pure	100%	/						
Cryolite	Na ₃ AlF ₆	Aqueous solution	Saturated	/	/	-				
Cyclohexane	C ₆ H ₁₂	Technically pure	100%	+	+	+	2	4	1	4
Cyclohexanol	C ₆ H ₁₁ OH	Technically pure	100%	+	/	/	2	4	2	3
Cyclohexanone	C ₆ H ₁₀ O	Technically pure	100%	+	/	/	4	3	4	4
Decalin (Decahydronaftalene)	C ₁₀ H ₁₈	Technically pure	100%	+	/	/				
Detergents		Aqueous solution	Comm. Comp.	+	+	+				
Dextrine			Comm. Comp.	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	All	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	Saturated	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	All	+	+	+	1	1	1	1
Dibutyl Phthalate	C ₈ H ₁₆ (COOC ₄ H ₉) ₂	Technically pure	100%	-			4	2	2	4
Dibutyl Sebacate	C ₈ H ₁₆ (COOC ₄ H ₉) ₂	Technically pure	100%	+			4	2	2	4
Dichloro Benzene	C ₆ H ₄ Cl ₂	Technically pure	100%	/			4	4	2	4
Dichloroacetic Acid	Cl ₂ CHCOOH	Aqueous solution	50%	+	+	+	2	2	2	2
Dichloroacetic Acid	Cl ₂ CHCOOH	Technically pure	100%	+	+	/	3	2	3	3
Dichloroacetic Acid Methyl Ester	Cl ₂ CHCOOH ₃	Technically pure	100%	+	+	+				
Dichloroethylene	CHCl=CHCl	Technically pure	100%	-				2	2	4
Diesel Oil			100%	+	/	/	1	4	1	4
Diethylether	C ₂ H ₅ OC ₂ H ₅	Technically pure	100%	-	-		4	4	4	4
Diglycolic Acid	HOOCCH ₂ OCH ₂ COOH	Aqueous solution	Saturated	+						
Di-Isobutyl Ketone	(CH ₃) ₂ CHCH ₂ COCH ₂ CH(CH ₃) ₂	Technically pure	100%	+	/	-	4	2	4	2/3
Dimethyl Amine	(CH ₃) ₂ NH	Technically pure	100%	/	-					
Dimethyl Formamide	HCON(CH ₃) ₂	Technically pure	100%	+	+	/	4	2	4	3
Diocetyl Phthalate	C ₈ H ₁₆ (COOC ₈ H ₁₇) ₂	Technically pure	100%	+	/	/	4	2	2	4
Dioxane	(CH ₂) ₄ O ₂	Technically pure	100%	+	+	+	4	2/3	4	4
Ethyl Acetate	CH ₃ COOCH ₂ CH ₃	Technically pure	100%	+	/	-	4	2/3	4	4
Ethyl Alcohol	CH ₃ CH ₂ OH	Aqueous solution	96%	+	+	/	2	1	2	1
Ethyl Benzene	C ₆ H ₅ C ₂ H ₅	Technically pure	100%	/	/	/	4	4	2	4
Ethyl Chloride	CH ₃ CH ₂ Cl	Technically pure	100%	/	-	2/3	4	2	4	
Ethyl Ether	CH ₃ CH ₂ OCH ₂ CH ₃	Technically pure	100%	/	3	3	4	4		
Ethylene Chlorohydrin	ClCH ₂ CH ₂ OH	Technically pure	100%	+	+	/	4	2	2	2
Ethylene Diamina	NH ₂ CH ₂ CH ₂ NH ₂	Technically pure	100%	-	-	-	2	1	4	2
Ethylene Dichloride	CH ₂ ClCH ₂ Cl	Technically pure	100%	/	/	4	4	2/3	4	
Ethylene Glycol	HOCH ₂ -CH ₂ OH	Technically pure	100%	+	+	+	1	1	1	1
Ethylene Oxide	C ₂ H ₄ O	Technically pure	100%	-			3	3	4	4
Exhaust fumes			Traces	+	+	+				
Fatty Acids	R>C ₆	Technically pure	100%	+	+	/				
Ferric Chloride	FeCl ₃	Aqueous solution	Saturated	+	+	+	2	1	1	2
Ferric Nitrate	Fe(NO ₃) ₃	Indetermined	+	+	+					
Ferric Sulfate	Fe ₂ (SO ₄) ₃	Aqueous solution	Saturated	+	+	+				
Ferrous Chloride	FeCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	2
Ferrous Nitrate	Fe(NO ₃) ₂	Aqueous solution	Saturated	+	+	+				
Ferrous Sulfate	FeSO ₄	Aqueous solution	Saturated	+	+	+	2	1	1	2
Fertilizer Salts		Aqueous solution	10%	+	+	+				
Fertilizer Salts		Aqueous solution	Saturated	+	+	+				

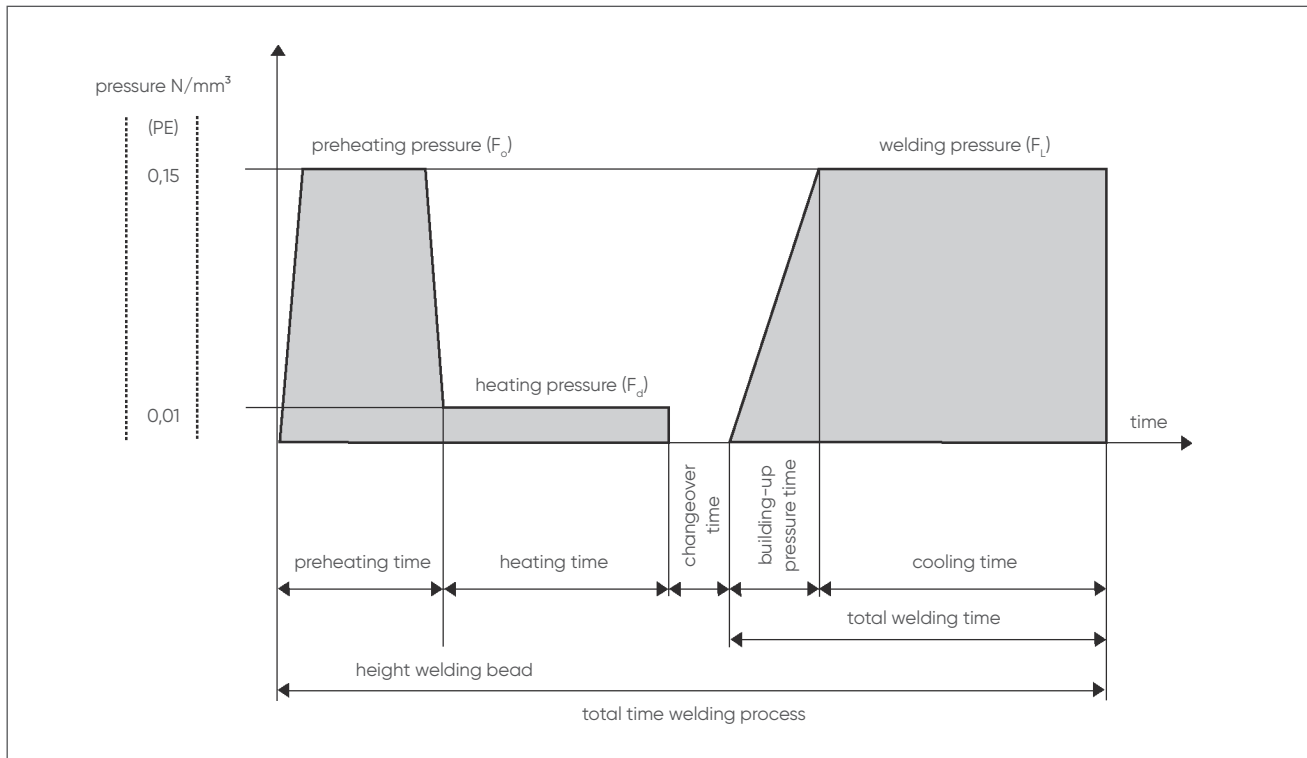
Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE °C			NBR °C	EPDM °C	FPM °C	SBR °C
				20	40	60				
Fluoboric Acid	HBF_6	Technically pure	100%	+	+	+		1	1	1
Fluorine Gas Dry	F_2		100%	-				4	1	4
Fluosilicic Acid	H_2SiF_6	Aqueous solution	32%	+	+	+				
Formaldehyde	CH_2O	Aqueous solution	37%	+	+	+	1	1	1	1
Formamide	HCONH_2	Technically pure	100%	+	+	+	2	2	1	1
Formic Acid	HCOOH	Aqueous solution	50%	+	+	+	4	2	4	2
Formic Acid	HCOOH	Technically pure	100%	+	+	+	4	2	4	2
Freon F-12	CCl_2F_2	Technically pure	100%	-			2	2/3	2	4
Fruit pulp and juice			Comm. Comp.	+						
Furfuryl Alcohol	$\text{C}_5\text{H}_6\text{O}_2$	Technically pure	100%	+	+	/	4	2		4
Gelatine			100%	+	+	+	1	1	1	1
Glycerine	$\text{C}_3\text{H}_5(\text{OH})_3$	Aqueous solution	All	+	+	+	1	1	2	1
Glycocoll	$\text{NH}_2\text{CH}_2\text{COOH}$	Aqueous solution	10%	+	+					
Glycolic Acid	HOCH_2COOH	Aqueous solution	37%	+	+	+				
Gas containing:										
- Carbon Dioxide	CO_2	Gas	All	+	+	+				
- Carbon Monoxid	CO	Gas	All	+	+	+				
- Hydrochloric Acid	HCL	Gas	All	+	+	+				
- Hydrochloric Acid	HCL	Gas	All	+	+	+				
- Hydrofluoric Acid	HF	Gas	< 0,1%	+	+	+				
- Nitrous Vapours	$\text{NO}, \text{NO}_2, \text{N}_2\text{O}_3, \text{NOx}$	Gas	< 0,1%	+	+	+				
- Nitrous Vapours	$\text{NO}, \text{NO}_2, \text{N}_2\text{O}_3, \text{NOx}$	Gas	5%	+	+	+				
- Oleum	$\text{H}_2\text{SO}_4 + \text{SO}_3$	Gas	< 0,1%	-	-	-				
- Oleum	$\text{H}_2\text{SO}_4 + \text{SO}_3$	Gas	5%	-	-	-				
- Sulphur Dioxide Liquid	SO_2	Gas	All	+	+	+				
- Sulphur Trioxide	SO_3	Gas	< 0,1%	-	-	-				
- Sulphuric Acid	H_2SO_4	Gas	All	+	+	+				
Heptane	C_7H_{16}	Technically pure	100%	+	/	-	1	4	1	4
Hexane	C_6H_{14}	Technically pure	100%	+	/	/	1	4	1	4
Hydrazine Hydrate	$\text{NH}_2\text{-NH}_2 \cdot \text{H}_2\text{O}$	Aqueous solution	Solution	+	+	+		2	1	1
Hydrobromic Acid	HBr		10%	+	+	+	3	2	1	3
Hydrobromic Acid	HBr		48%	+	+	+	4	1	1	4
Hydrochloric Acid	HCl	Aqueous solution	10%	+	+	+				
Hydrochloric Acid	HCl	Aqueous solution	30%	+	+	+	2/3	1	2	2/3
Hydrochloric Acid	HCl	Aqueous solution	5%	+	+	+				
Hydrochloric Acid	HCl	Aqueous solution	Saturated	+	+	+				
Hydrocyanic Acid	HCN	Aqueous solution	Solution	+	+	+	2	2	1	2
Hydrocyanic Acid	HCN	Technically pure		+	+	+	2	2	1	2
Hydrofluoric Acid	HF	Aqueous solution	10%	+	+	/	4	3	2/3	3
Hydrofluoric Acid	HF	Aqueous solution	40%	+	/	/	4	3	2/3	3
Hydrofluoric Acid	HF	Aqueous solution	70%	+	/	/	4	3	2/3	3
Hydrogen Gas	H_2		100%	+	+	+	2	1	1	4
Hydrogen Peroxide	H_2O_2	Aqueous solution	10%	+	+	+	2	1	1	2
Hydrogen Peroxide	H_2O_2	Aqueous solution	50%	+	+	/	2	1	1	2
Hydrogen Peroxide	H_2O_2	Aqueous solution	90%	+	-	-	2	1	1	2
Hydrogen Sulfide	H_2S	Aqueous solution	Saturated	+	+	+				
Hydrogen Sulfide	H_2S		100%	+	+	/				
Hydroquinone	$\text{C}_6\text{H}_4\text{O}_2$	Aqueous solution	Saturated	+	+	+	3	4	2	4
Hydroxylamine Sulphate	$(\text{NH}_2\text{OH})_2 \cdot \text{H}_2\text{SO}_4$	Aqueous solution	All	+	+	+				
Iodine Dry And Wet	I_2		3%	/	-		1	2	1	1
Iso-Octane	C_8H_{18}		100%	/	/	-	1	4	1	4
Isopropyl Alcohol	$(\text{CH}_3)_2\text{CHOH}$	Technically pure	100%	+	+	+	2	1	1	2
Isopropyl Ether	$(\text{CH}_3)_2\text{CHOCH}(\text{CH}_3)_2$	Technically pure	100%	/	-	-	2/3	3	4	4
Lactic Acid	$\text{CH}_3\text{CHOHCOOH}$	Aqueous solution	<=28%	+	+	+	2	1	1	3
Lanoline			Comm. Comp.	+	+	+	1	4	1	4
Lard Oil			Comm. Comp.	+						
Lead Acetate	$\text{Pb}(\text{CH}_3\text{COO})_2$	Aqueous solution	Saturated	+	+	+	1	1	4	4
Lead Chloride	PbCl_2	Aqueous solution	Saturated	+	+					
Lead Nitrate	$\text{Pb}(\text{NO}_3)_2$	Aqueous solution	Saturated	+			1	1	1	1

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		20	HDPE °C	60	NBR °C	EPDM °C	FPM °C	SBR °C
Lead Sulfate	PbSO ₄	Aqueous solution	Saturated	+	+	+				
Linseed Oil			Comm. Comp.	/			1	3	1	4
Lubricating Oils			Comm. Comp.	-			2	4	1	4
Lubricating Oils, Free Of Aromatic			Comm. Comp.	+	+	/	1	4	1	4
Magnesium Carbonate	MgCO ₃	Aqueous solution	All	+	+	+	1	1	1	1
Magnesium Chloride	MgCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	1
Magnesium Nitrate	Mg(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+				
Magnesium Sulfate	MgSO ₄		Saturated	+	+	+	2	1	1	1
Maize Oil			Comm. Comp.	+	+	/	1	1	1	4
Maleic Acid	HOOC-CH=CH-COOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Malic Acid	HOOCCH ₂ CHOHCOOH	Aqueous solution	Saturated	+			1	4	1	2
Sodium Bisulfite	NaHSO ₃	Aqueous solution	100%	+	+	+	1	1	1	2
Sodium Bromate	NaBrO ₃	Aqueous solution	All	+	/					
Sodium Bromide	NaBr	Aqueous solution	Saturated	+	+	+				
Sodium Carbonate (Soda)	Na ₂ CO ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Sodium Chlorate	NaClO ₃	Aqueous solution	All	+	+	+	2/3	2	1	4
Sodium Chloride	NaCl	Aqueous solution	Solution	+	+	+	1	1	1	1
Sodium Chloride	NaCl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Chromate	Na ₂ CrO ₄	Aqueous solution	Solution	+						
Sodium Cyanide	NaCN	Aqueous solution	All	+	+	+	2	1	1	1
Sodium Disulphite	Na ₂ S ₂ O ₅	Aqueous solution	All	+			1	1	1	2
Sodium Ferrocyanide	Na ₄ FeCN ₆	Aqueous solution	Saturated	+	+					
Sodium Fluoride	NaF	Aqueous solution	Saturated	+						
Sodium Hydroxide	NaOH	Aqueous solution	10%	+	+	+	3	1	2	2
Sodium Hydroxide	NaOH	Aqueous solution	30%	+	+	+	4	1	3	2
Sodium Hydroxide	NaOH	Aqueous solution	50%	+	+	+	1	1	3	2
Sodium Hypochlorite	NaClO	Aqueous solution	12,50%	/	-		4	1	1	4
Sodium Hypochlorite	NaClO	Aqueous solution	3%	+	/	/	4	1	1	4
Sodium Iodide NaI	Aqueous solution		All	+						
Sodium Metasilicate	Na ₂ SiO ₃	Aqueous solution	<5%	+	+	+				
Sodium Metasilicate	Na ₂ SiO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrate	NaNO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrite	NaNO ₂	Aqueous solution	Saturated	+						
Sodium Oxalate	Na ₂ C ₂ O ₄	Aqueous solution	Saturated	+						
Sodium Perborate	NaBO ₃	Aqueous solution	All	+			2	1	1	2
Sodium Perchlorate	NaClO ₄	Aqueous solution	Indetermined	+						
Sodium Peroxide	Na ₂ O ₂		Solution	+			2	1	1	2
Sodium Persulphate	Na ₂ S ₂ O ₈	Aqueous solution	Saturated	+	+	+				
Sodium Phosphate	Na ₃ PO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Phosphate Monoacid	Na ₂ HPO ₄	Aqueous solution	Saturated	+	+	1	1	1		
Sodium Sulfate	Na ₂ SO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Sulfide	Na ₂ S	Aqueous solution	Solution	+	+	+	2	1	1	3
Sodium Sulfide	Na ₂ S	Aqueous solution	Saturated	+	+	+	2	1	1	3
Sodium Sulfite	Na ₂ SO ₃	Aqueous solution	Saturated	+	+	+				
Sodium Thiocyanate	NaSCN	Aqueous solution	Indetermined	+	+	+				
Sodium Thiosulphate	Na ₂ S ₂ O ₃	Aqueous solution	Saturated	+	+	+	3	1	1	2
Stannic Chloride	SnCl ₄	Aqueous solution	Saturated	+	+	+	1	1	1	2
Stannous Chloride	SnCl ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Stearic Acid	C ₁₇ H ₃₅ COOH	Technically pure	100%	+	/		1	1	1	1
Styrene	C ₆ H ₅ CH=CH ₂		100%	/	-	-	4	4	1	4
Sugar Syrup			Saturated	+	+	+	1	1	1	1
Sulfamic Acid	HSO ₃ NH ₂	Aqueous solution	20%	-						
Sulphur	S		100%	+	+	+				
Sulphur Dioxide Liquid	SO ₂	Aqueous solution	Saturated	+	+	+	+			
Sulphur Dioxide Liquid	SO ₂	Technically pure	100%	-						
Sulphur Dioxide Liquid	SO ₂	Technically pure	100%	+	+	+	+			
Sulphur Trioxide	SO ₃		100%	-						

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		20	HDPE °C	60	NBR °C	EPDM °C	FPM °C	SBR °C
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	10%	+	+	+	2	1	2	2
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	50%	+	+	+	4	1	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	80%	+	+	/	4	2	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	90%	/	/	-				
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	96%	-	-	-	4	4	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution indetermined	98%	-	-	-				
Sulphuric Acid	H ₂ SO ₄	Technically pure	100%	-	-	-				
Sulphurous Acid	H ₂ SO ₃	Aqueous solution	Saturated	+	+	+	2	2	1	2
Tallow Emulsion			Comm. Comp.	+	/	/	2	2	1	4
Tannic Acid	C ₇₆ H ₅₂ O ₄₆	Aqueous solution	All	+	+	+	2	2	2	2
Tartaric Acid	COOH(CHOH) ₂ COOH	Aqueous solution	All	+	+	+				
Tetrachloroethane	CHCl ₂ CHCl ₂	100%	/	-			4	4	1	4
Tetrachloroethylene	Cl ₂ C=CCl ₂	100%	/	-			4	4	2	4
Tetraethyl Lead	Pb(C ₂ H ₅) ₄	Technically pure	100%	+			2	4	1	4
Tetrahydrofurane	(CH ₂) ₄ O		100%	/	-		4	4	4	4
Tetrahydronaphthalene	C ₁₀ H ₁₂		100%	/						
Thionyl Chloride	SOCl ₂	Technically pure	100%	-			2/3	1	1	2/3
Thiophene	C ₄ H ₄ S	100%	/	/			4	4	4	4
Toluene	C ₆ H ₅ CH ₃	Technically pure	100%	/	-	-	4	4	2	4
Toluic Acid	CH ₃ C ₆ H ₄ COOH		50%	/						
Transformer Oil			Comm. Comp.	+	/	/		4	2	4
Tributylphosphate	(C ₄ H ₉) ₃ PO ₄	Technically pure	100%	+	+	+	4	2	3	4
Trichlorethylene	ClCH=CCl ₂	Technically pure	100%	-	-	-	4	4	2	4
Trichloroacetic Acid	CCl ₃ COOH	Aqueous solution	50%	+	/	/	2	2	4	4
Trichloroacetic Acid	CCl ₃ COOH	Technically pure	100%	+	/	-	2	2	4	4
Trichloroethane	CH ₃ CCl ₃	Technically pure	100%	/			4	4	1	4
Tricresylphosphate	(CH ₃ C ₆ H ₄) ₃ PO ₄	Technically pure	100%	+	+	+	4	2	2	4
Triethanolamine	N(CH ₂ CH ₂ OH) ₃	Technically pure	100%	+	+	/	3	1	4	2
Trioctylphosphate	(C ₈ H ₁₇) ₃ PO ₄	Technically pure	100%	/			4	1	2	4
Turpentine Oil		Technically pure	100%	/	-	-	2	4	1	4
Urea	NH ₂ CONH ₂	Aqueous solution	<=10%	+	+	+	1	1	1	1
Urea	NH ₂ CONH ₂	Aqueous solution	33%	+	+	+	1	1	1	1
Urine Indetermined				+	+	+				
Vaseline Oil			Comm. Comp.	+	+	/		1	1	4
Vegetable Oils and fats			Comm. Comp.	+	/		1	4	1	3
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	2	1	2	2
Water	H ₂ O		100%	+	+	+	2	1	2	2
Water, Rain	H ₂ O		100%	+	+	+	1	1	1	1
Water, Salt	H ₂ O+NaCl		Saturated	+	+	+	1	1	1	1
Water, Sea			100%	+	+	+	1	1	1	1
Wine			Comm. Comp.	+	+	+	1	1	1	1
Wine Vinegar		Technically pure	Comm. Comp.	+	+	+				
Xylene	C ₆ H ₄ (CH ₃) ₂		100%	-	4	4	2	4		
Zinc Acetate	Zn(CH ₃ COO) ₂		Indetermined	+	+	+	2	1	4	4
Zinc Chloride	ZnCl ₂	Aqueous solution	Solution	+	+	+	2	1	1	2
Zinc Chloride	ZnCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	2
Zinc Chromate	ZnCrO ₄	Aqueous solution	Indetermined	+	+	+				
Zinc Cyanide	Zn(CN) ₂	Aqueous solution	All	+	+	+				
Zinc Nitrate	Zn(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+				
Zinc Sulfate	ZnSO ₄	Aqueous solution	Solution	+	+	+	1	1	1	1
Zinc Sulfate	ZnSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1

The data is based on the latest knowledge. When in doubt please contact our Technical Support department.

Appendix B: Welding parameters



Diameter d_1 mm	Wall thickness e mm	Preheating pressure/ welding pressure (0,15 N/mm^3) F_o/F_L N	Heating pressure (0,01 N/mm^3) F_d N	Height welding bead mm	Heating time sec.	Changeover time sec.	Building-up pressure time sec.	Cooling time min.
40	3,0	55	4	0,5	29	4	4	4
50	3,0	70	5	0,5	30	4	4	4
56	3,0	75	5	0,5	30	4	4	4
63	3,0	85	6	0,5	31	4	4	4
75	3,0	105	7	0,5	32	5	5	4
90	3,5	145	10	0,5	35	5	5	4
110	4,2	210	14	0,5	42	5	5	6
125	4,8	275	18	1,0	48	5	5	6
160	6,2	450	30	1,0	62	6	6	9
110	3,4	175	12	0,5	35	5	5	4
125	3,9	225	15	0,5	39	5	5	5
160	4,9	370	25	1,0	49	5	5	7
200	6,2	570	38	1,0	62	6	6	9
250	7,8	900	60	1,5	77	6	6	11
315	9,7	1400	93	1,5	77	6	6	11
200	7,7	700	47	1,5	77	6	6	11
250	9,6	1090	73	1,5	97	7	7	13
315	12,1	1730	115	2,0	121	6	8	16

Welding parameters Akatherm HDPE drainage

In the table above the welding parameters can be found for Akatherm HDPE. The exact regulation of the welding machine depends on its mechanical resistance. The tables provided with the machine are to be used for regulating the machine.

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