akatherm

Specialist Drainage Systems

Soil & Waste System

Specification manual

2018

Reference projects

Q1 Tower
Brisbane - Australia

Address Hotel
Dubai - UAE

Extension harbour Rotterdam
Rotterdam - The Netherlands

River park "Ruimte voor de Waal"
Nijmegen - The Netherlands

Australian Embassy
Jakarta - Indonesia

Australian Embassy
Bangkok - Thailand

Kings College Hospital
Dubai - UAE

Berlin Palace
Berlin - Germany

Reference projects

Al Amiri Hospital
Kuwait

11 Hassalstreet
Parramatta - Australia

Jahra Hospital
Al Jahra - Kuwait

Dal Al Shira Hospital
Safat - Kuwait

52/42 Towers
Dubai - UAE

OKB Schools
Khaitan - Kuwait

Jewel Apartments
Gold Coast - Australia

Sabah Al Ahmand Sea City
Kuwait

Drainage is ever more called upon to go beyond basic waste water disposal to deal with rainwater, industrial chemicals and whichever substances requiring special treatment or containment.

This is specialist drainage.

Specialist drainage means more than just a new approach. To make today's complex buildings work, demands a combination of cost-effective pipe design, applied technology and dedicated training. Akatherm offers you this combination. You will find it in this manual.

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. To complete the product range a chapter about tools is added.

This manual also comprises substantial technical details of our complete specialist drainage program. It will assist you with material properties and the application and design of HDPE drainage systems.

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Information and safety recommendations

Validity
This Specification Manual 2018 is valid from February 2018. With the appearance of this manual previous manuals are no longer valid. The actual technical documentation can be downloaded on www.akatherm.com.

This Specification Manual is produced with extreme care. All measurements and weights are approximate and errors and changes reserved. Akatherm BV does not accept any liability for damage caused by not or incorrect mentioned 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

Benefit

Disclaimer
Follow all applicable national and international assembly, installation, accident prevention, safety regulations and the information in this Specification Manual during the installation of drainage systems.

Also follow the applicable laws, standards, guidelines, regulations and instructions for environmental protection, professional associations and the local utility companies.

Applications not covered in this Specification Manual (special applications) require consultation with our Technical Department. For specific advice consult the Akatherm HDPE sales office.

The planning and installation instructions are directly related to the respective Akatherm HDPE products. The reference to standards or regulations is on a general level. Be aware of the current status of guidelines, standards and regulations. Other standards, regulations and guidelines regarding the planning, installation and operation of drainage or building systems need to be taken into account also and are not part of this Specification Manual.

Please check for your safety and for the proper application of our products at regular intervals if your present Specification Manual has been replaced by a new version. The issue date is always mentioned on the cover. The valid technical information can be obtained at your Akatherm HDPE wholesaler, the Akatherm Export Sales Office and be downloaded at www.akatherm.com.

Safety and operating instructions
- 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.

General precautions
- Keep your work area clean and free of obstructing objects.
- Provide adequate lighting of your work area.
- Keep unauthorized persons away of tools and the work area, especially at renovations in inhabited area.
- Use only Akatherm HDPE system components.

During assembly
- Always read and follow the operating instructions of the respective used tool.
- Improper use of tools can cause severe cuts, cause bruising or dismemberment.
- Improper use of tools can damage components and cause leaks.
- Pipe cutters have a sharp blade. Store and handle without risk of injury.
- Note, when cutting the pipes, the safety distance between holding hand and cutting tool.
- Never grip the cutting zone of the tool or moving parts during the cutting process.

Akatherm Specialist drainage systems

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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. The Akatherm Stack-aerator is the high-rise solution for single stack downpipes.

The system has the following features:
- Complete plastic pipe system with excellent mechanical and chemical resistance properties
- Made from polyethylene: a proven material that is tough, elastic and flexible
- Akatherm HDPE pipe is tempered for reduced stress on connections
- Homogenous welded joints offer a completely closed system
- A wide range of mechanical joints for adjustability, flexibility and demounting
- Additives makes HDPE UV and weather resistant
- Akatherm HDPE is highly suited for prefabrication, a cost saving technique
- Non-toxic plastic, 100% recyclable and environmental friendly
- Akatherm Stack-aerator is the perfect high-rise solution

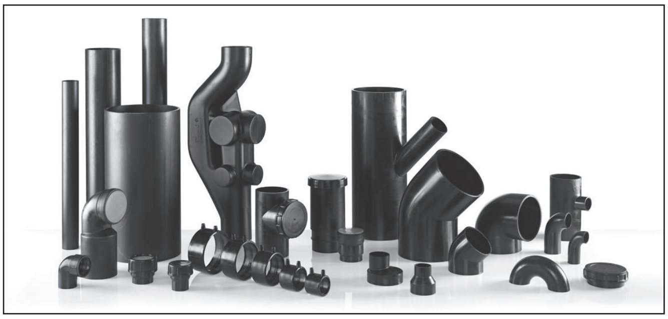


Illustration 1.1

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 continuously at elevated temperature.

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 office for further advice. More information at www.akatherm.com.

Behaviour 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.

System information

1.3 HDPE pipe, fittings and tools

Pipe
Akatherm produces tempered pipe according to the standard EN 1519 which has undergone an extra heat treatment after extrusion. The result is less shrinkage when cooled down from high operational temperature. This gives less stress on joints resulting in a longer life of the pipe system.

The Akatherm tempered 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.

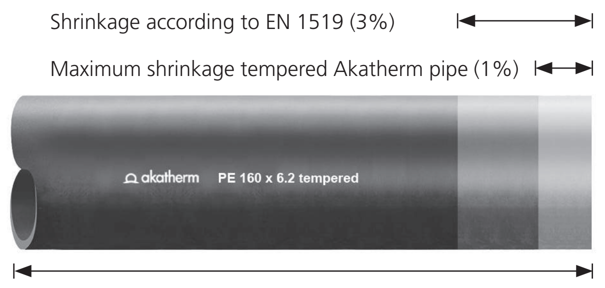


Illustration 1.2

Akatherm HDPE pipe has a standard length of 5 m and is produced according to high quality standard with many international approvals. Akatherm pipe is marked for proper weld alignment.

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 Akatherm as well.

All Akatherm HDPE fittings are electrofusable, 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 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 standardised to improve prefabrication repetition work and to facilitate welding alignment. Each fitting contains a graduated arc at 15° intervals.

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 fitting scrapers
- PE cleaner and marking pencils

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

1.4 Jointing methods

The many jointing methods of Akatherm HDPE offer a solution for every situation.

Depending on the application Akatherm HDPE fittings and pipes can be joined by different methods.

- **To be opened (dismountable)**

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

- **Not to be opened (fixed)**

These are jointing 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)

These 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)

These 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.

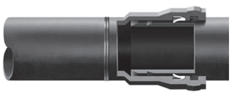
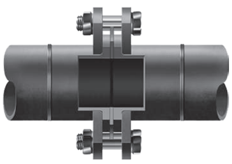
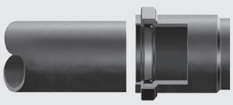
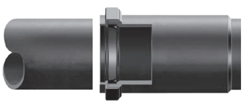
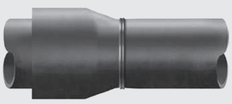
Jointing technique	Product	Welded/mechanical	Pull-tight	Dismountable
Butt-weld joint		Welded	Yes	No
Electrofusion		Welded	Yes	No
Snap Socket		Mechanical	Yes	No
Screw Coupler		Mechanical	Yes	Yes
Flanges		Mechanical	Yes	Yes
Plug-in Socket		Mechanical	No	Yes
Expansion Socket		Mechanical	No	Yes
Contraction Joint		Mechanical	No	No

Table 1.1

System information

1.5 Packaging, transport and storage

Packaging
Akatherm HDPE pipes are packaged in wooden crates that provide bottom, side and top support to the pipes. The crates keep the pipes tightly packed and allow stacking of the crates without pipe damage. Akatherm HDPE is UV resistant and does not require additional foil packaging.

The fittings are packaged in carton boxes stacked on wooden pallets (fumigated if required). Each carton box contains a corner label, clearly indicating the contents on two sides.

Transport
Pipes and fittings must be transported by a suitable vehicle and be secured against movement and deflection. The materials must be properly loaded and unloaded, wherever possible moved by hand or mechanical lifting equipment. Pipes must not be dragged across the ground.

When pipe crates are transported in an open truck, the pipe crate ends should be covered by a net. Sudden acceleration or deceleration can cause that the pipe will slip out of the crate.

Individual lengths of pipe transported loose should be transported side by side and firmly supported over the entire length and secured from movement and defect.

Exposure to rain and snow must be prevented, especially for carton boxes.

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

Storage
Pipes in their original crates:
Pipe crates must be stored on a clear and level ground with the battens supported from the outside by timber or concrete blocks.

Ensure that the wooden frames are aligned squarely when stacking. The first level of the stack should always be laying on the wooden blocks of the pallets.

For stability and safety, pipe crates should not be stacked more than 3 m high.

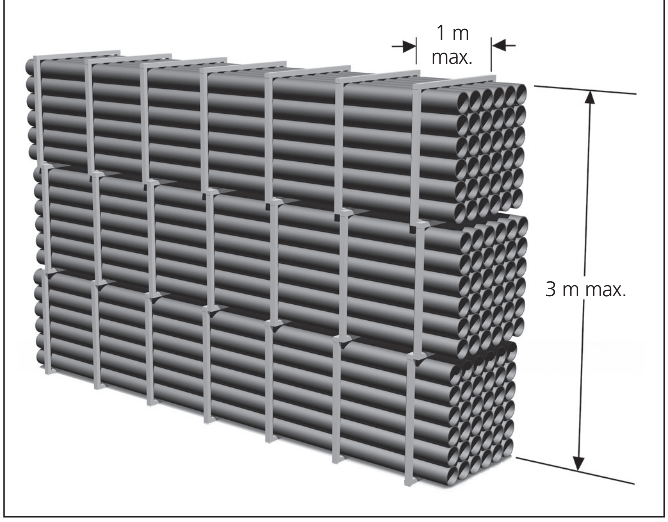


Illustration 1.3

Smaller pipes may be nested inside larger pipes. Side bracing should be provided to prevent stack collapse.

Individual pipe lengths:
Pipe lengths stored individually should be stacked in a pyramid 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 at one-metre centres. On site, pipes may be laid out individually (where appropriate, protective barriers should be placed with adequate warning signs and lamps).

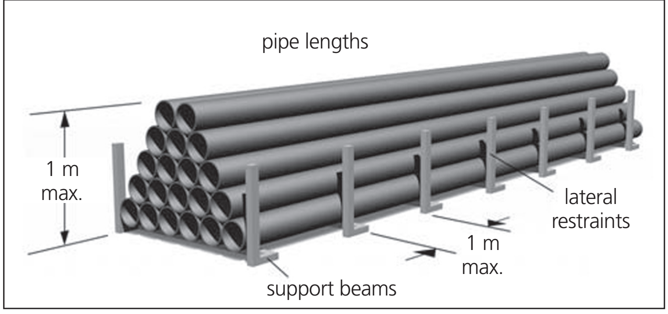


Illustration 1.4

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

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

Outside storage of pipe crates is possible. HDPE is protected against UV radiation and has no negative effect on the pipe's structure and mechanical resistance.

> HDPE pipe subjected to extensive periods of sun can cause pipe bowing of the top row of the pipes, due to single sided heating. Shielding the pipe from direct sunlight will prevent this effect.

1.6 Marking

Akatherm pipes and fittings are marked with:
- Manufacturer's mark or 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)

1.7 Recycling

HDPE pipes and fittings are 100% recyclable.

Left over materials should be recycled as following:
- Remainder pipe: residual waste
- Remainder fittings: residual waste
- Cleaning cloths: residual waste
- Wooden crating: recycled wood
- Carton boxes: recycled paper

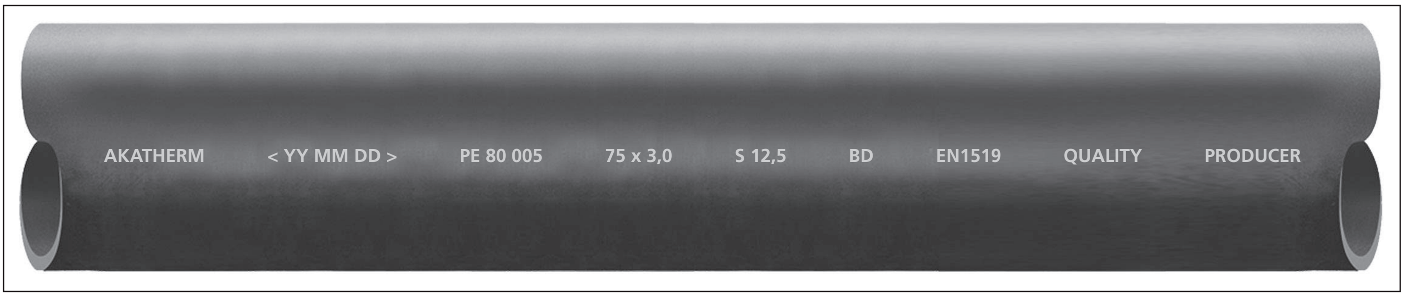


Illustration 1.5

System information

2 Approvals, standards and quality

2.1 Approvals

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

Table 2.1

The actual version and scope of the certificates can be found in the download area at www.akatherm.com

2.2 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.

2.3 Warranty

Of course you want the security that after the design and installation of specialist drainage systems it will perform without any problems. Akatherm is able to guarantee the proper functioning of your drainage system by combining training upfront, technical support during construction and even (if required) inspection afterwards.

All the Akatherm products have a warranty of 10 years. This applies for both soil and waste systems for high-rise buildings and for siphonic roof drainage projects. Details are available on request.

Approvals, standards and quality

3 Akatherm HDPE properties

Polyethylene, PE for short, is a semi crystalline thermoplastic and is a generic term for different kinds of PE. By colouring with 2% of 'carbon black' the PE gets its black colour.

The following kinds of PE are generally used:
- LDPE (Density 0,90-0,91 g/cm³)
- MDPE (Density 0,93-0,94 g/cm³)
- HDPE (Density 0,94-0,97 g/cm³)

In pipe systems generally only HDPE is used. HDPE has a high resistance against acids, bases and aqueous salt-solutions. Below 60°C it is practically unsolvable in organic solutions. HDPE has a good resistance against light ionised radiation without becoming radioactive itself. In paragraph 3.4 the properties and benefits of the Akatherm HDPE are highlighted.

3.1 Technical specifications

	Unit	Test method	Value
Density at 23°C	g/cm³	ISO 1183	0,954
Elasticity modulus	N/mm²	ISO 527	850
Bending creep modulus	N/mm²	DIN 54852-Z4	1000
Tensile strength at 23°C	N/mm²	ISO 527	22
Elongation at break	%	ISO R 527	300
Linear expansion coefficient	mm/mK	DIN 53752	0,18
Indentation hardness	N/mm²	ISO 2039	36 - 46
Ignition temperature	°C	-	~350
Thermal conductivity	W/m . K	DIN 52612	0,37 - 0,43
Shore hardness		ISO 868	61
Crystallite melting range	°C		125 - 131
Operational temperature range	°C	-	-40 - +80*
Melt Flow Rate MFR 190/5	g/10 min	ISO 1133	0,43

** up to 100°C for short periods of time.*

Table 3.1

3.2 Ecological properties of Akatherm HDPE

Akatherm polyethylene consists of only carbon and hydrogen atoms. These substances are not harmful to humans, animals and plants. Akatherm uses High Density Polyethylene classified with recycle mark 3.

Illustration 3.1

Polyethylene is made from oil and electricity without chemical additives released during production. It is not broken down by bacteria very fast and has a long lifetime. The total energy consumption during production and transport is very low compared to steel, copper or cast iron.

Because PE is a thermoplastic polymer it can be melted at the end of its technical lifetime and used for other applications. When PE is burnt, only non-toxic carbon dioxide and water is released.

3.3 Chemical resistance

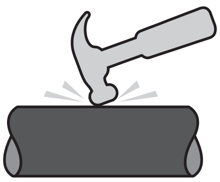
When transporting chemical waste waters the following factors have to be taken in account:
- The medium
- The concentration of this medium
- Temperature
- Duration of exposure
- Volume

Refer to appendix A for a complete chemical resistance table of Akatherm HDPE.

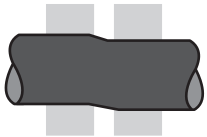
Akatherm HDPE properties

3.4 Properties and benefits

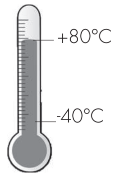
Material advantages



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

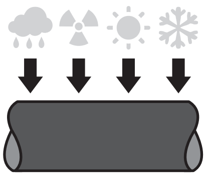


Elastic and flexible:
Adjusts to local ground movement for underground use

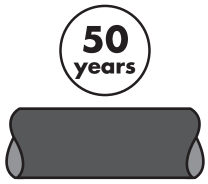


Thermal resistant:
Applications possible between -40°C and 80°C. Up to 100°C for short periods of time.

Chemical resistant:
Suitable for transport of polluted waste water

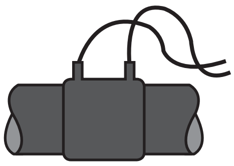


UV & weather resistant:
Unrestricted outside use through carbon black additives

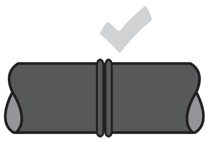


Wear resistant:
Lower cost due to long lifetime

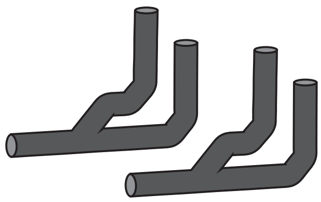
System advantages



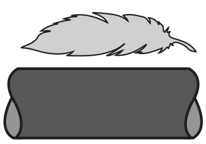
Welded system:
Simple and secure installation using butt-welding and electrofusion



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

Non-toxic:
100% recyclable and environmental friendly

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				⅛″	10,26	0,4						
8				¼″	13,72	0,5						
10				⅜″	17,15	0,7						
15				½″	21,34	0,8						
20				¾″	26,67	1,1						
25				1″	33,4	1,3						
32	40,0	3,0	34,0	1¼″	42,16	1,7	36,4	3,3	29,9			
40	50,0	3,0	44,0	1½″	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	2½″	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	3½″	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				4½″	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

Planning and design

4.3 Building drainage principles

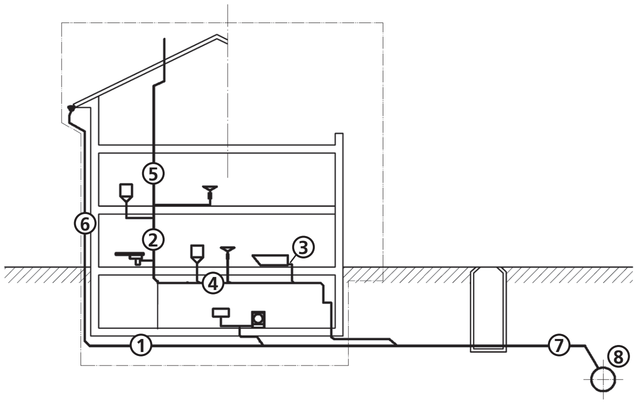
These building drainage guidelines are meant for waste water drainage systems which operate under gravity. It is applicable for drainage systems within dwellings, commercial, institutional and industrial buildings that terminate maximally 0,5 m outside the external wall.

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 under-pressure; 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 under-pressure.



1 Ground pipe	5 Ventilation stack
2 Main stack	6 Rainwater down pipe
3 Branch pipe	7 Domestic drainage
4 Connector pipe	8 Public sewer

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 pro-longed 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 : α = 0,18 mm/m • K
The formula for length change is:

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

Formula 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

ΔT 50° = 10 mm/m

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

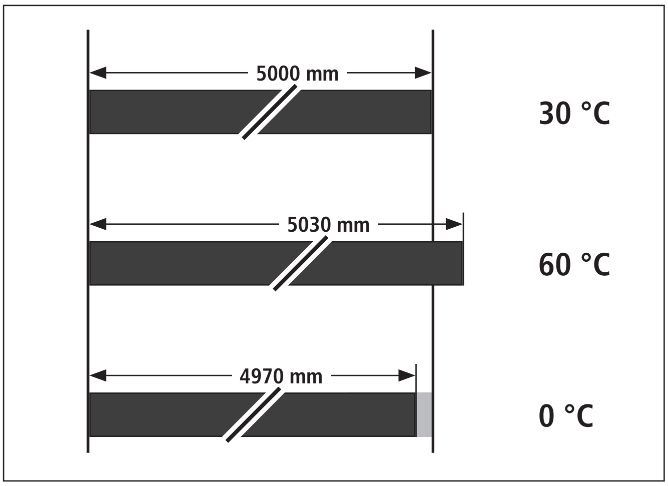


Illustration 4.2

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.

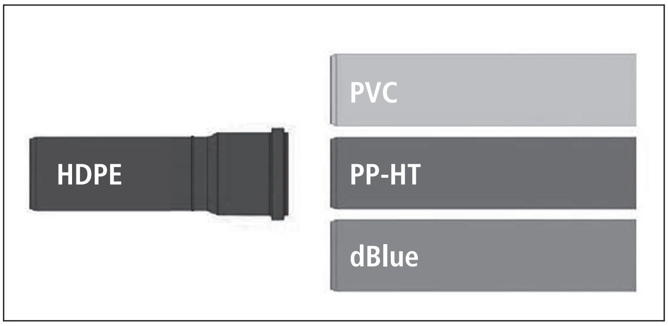


Illustration 4.3

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	42 xx 50
Snap socket	40-200	40 xx 10
Expansion socket	40-315	4x xx 20
Screw coupler	40-110	43 xx 30

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 ½", ¾", 1", 1 ¼", 1 ½" and 2".

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

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4.5.3 Transition to cast iron

The transition from Akatherm HDPE to cast iron requires special transition fittings to allow the change in outer diameter.

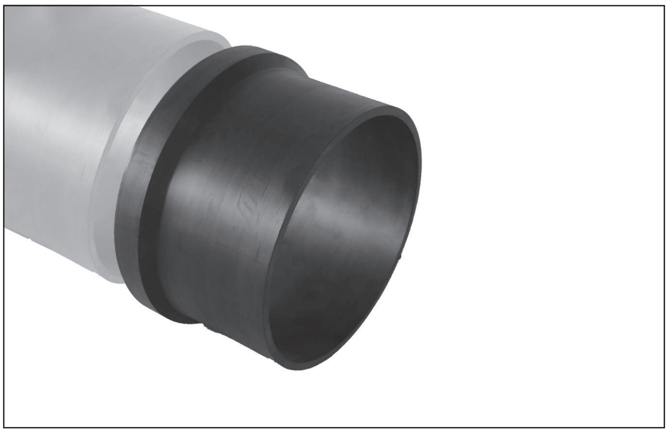


Illustration 4.4

Standard available from Akatherm are transitions to cast iron in HDPE dimensions 200, 250 and 315 mm. Refer to the table below for the dimensions and fitting article numbers.

HDPE (mm)	Cast iron (mm)	Akatherm Code
40	56	
50	66	
75	82	
90	98	
110	118	
125	144	
160	170	
200	222	56 20 50
250	274	56 25 50
315	326	56 31 50

Table 4.3

4.5.4 Transition to stoneware

The transition from Akatherm HDPE to stoneware requires special transition fittings to allow the change in outer diameter.

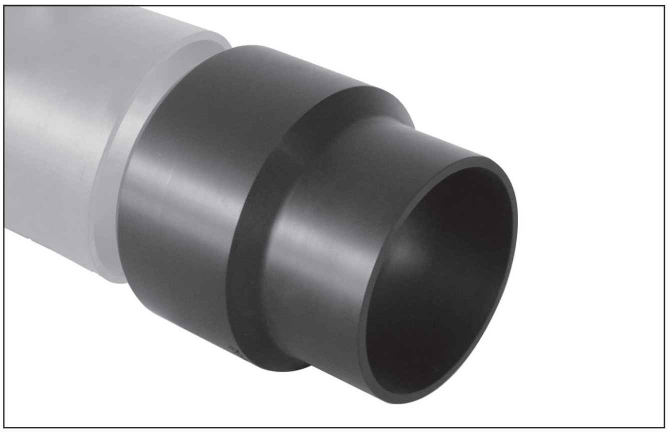


Illustration 4.5

Standard available from Akatherm are transitions to stoneware in HDPE dimensions 110 to 315 mm. Refer to the table below for the dimensions and fitting article numbers.

HDPE (mm)	Stoneware (mm)	Akatherm Code
110	131	56 11 40
125	159	56 12 40
160	186	56 16 40
200	242	56 20 40
250	299	56 25 40
315	355	56 31 40

Table 4.4

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 4.6

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 ¼” and 1 ½”
40	1 ¼” and 1 ½”
50	1 ¼”, 1 ½” and 2”
56	1 ¼”, 1 ½” and 2”

Table 4.5

The socket and bend do not contain the rubber ring, which 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.

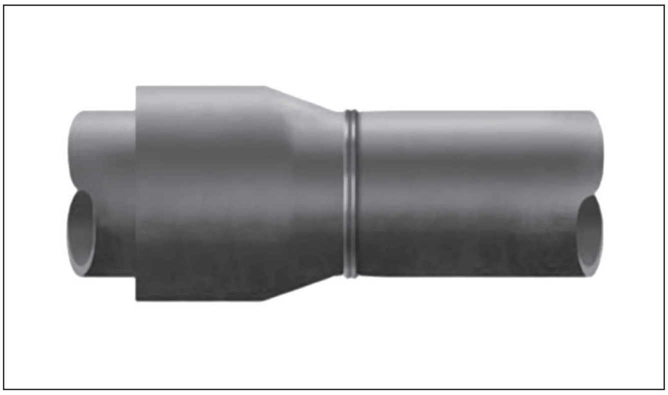


Illustration 4.7

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	55 04 01
40	57-64	55 04 02
50	57-64	55 05 03
50	67-74	55 05 04
56	62-69	55 56 01
63	62-69	55 06 01
63	75-79	55 06 03
75	80-84	55 07 01
75	90-94	55 07 02
90	94-98	55 09 02
110	102-111	55 11 02
110	110-120	55 11 03
110	115-136	55 11 04
125	120-140	55 12 01
125	135-155	55 12 02
160	155-165	55 16 02
160	160-180	55 16 04
200	185-207	55 20 01
250	236-260	55 25 01

Table 4.6

Planning and design

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
- In concrete
- Pipes in poorly conditioned industrial buildings
- Pipes in food and paper applications

Do not insulate pipes in a properly conditioned industrial building that have sufficient air circulation due to heaters and fans. Subject to demands of the contracting or consulting party.

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:

Airborne noise
This is sound that travels through the air from its source. The source causes the air to vibrate. Airborne 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 airborne 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.

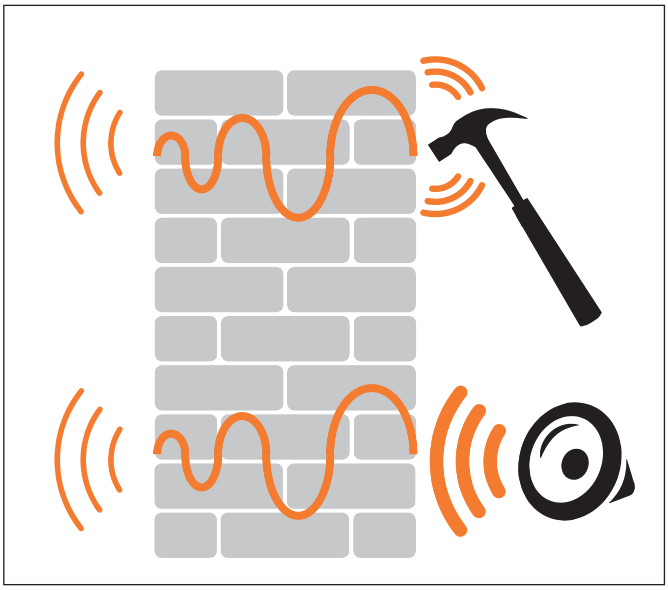


Illustration 4.8

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.

Kind 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 4.7

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 comparting 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° degree 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 4.8

Quick drying concrete
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.

Planning and design

Expansion and contraction compensation

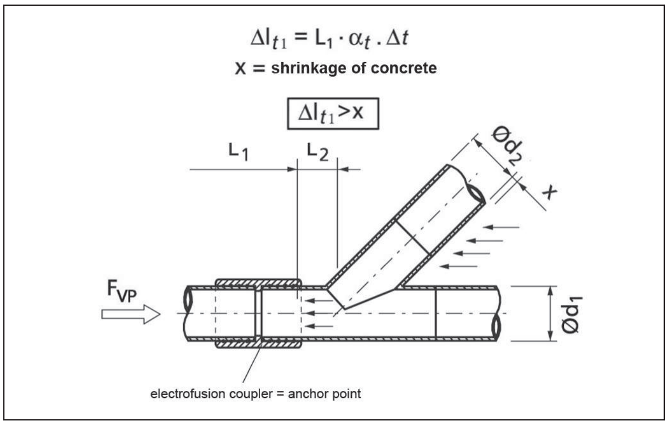


Illustration 4.9 HDPE expansion forces in concrete

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 eletrofusion coupler. The electrofusion coupler acts as an anchor point preventing the additional load to be transferred to the branch (see illustration 4.10).

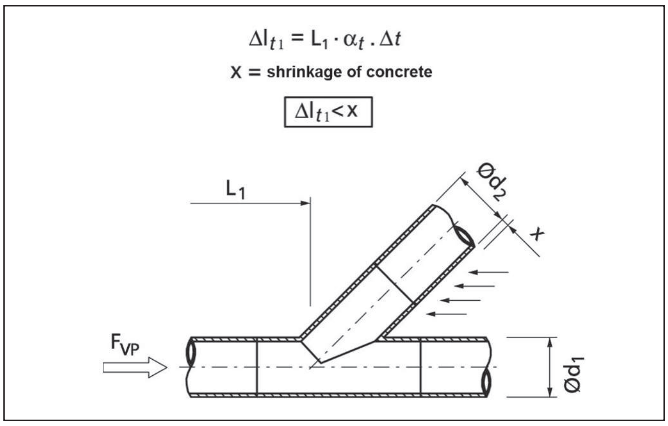


Illustration 4.10 Anchor point with an electrofusion coupler

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 4.11).

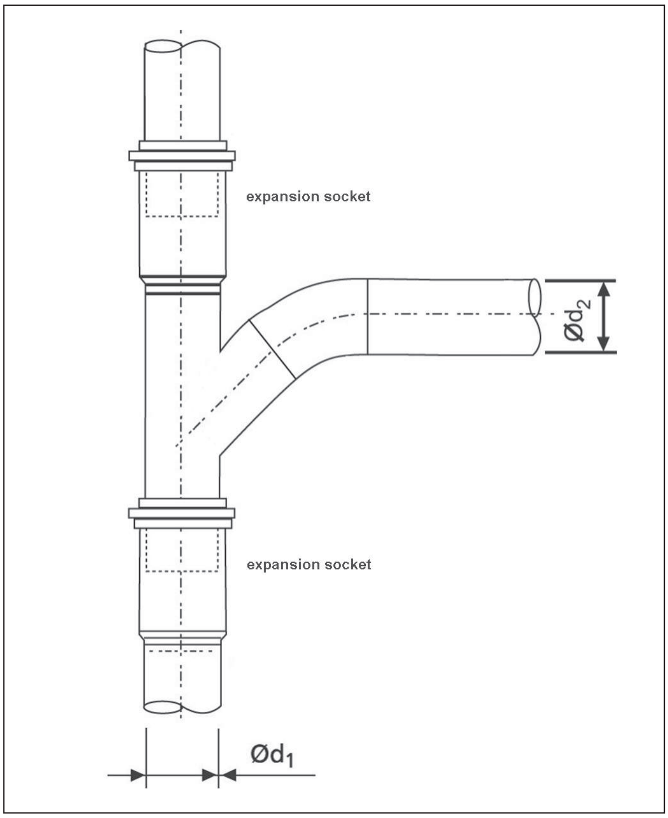


Illustration 4.11 Anchor point with (snap) expansion sockets

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.

Planning and design

5 High-rise drainage design

Emporis Standard ESN 18727 defines high-rise 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 high-rise 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 high-rise 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

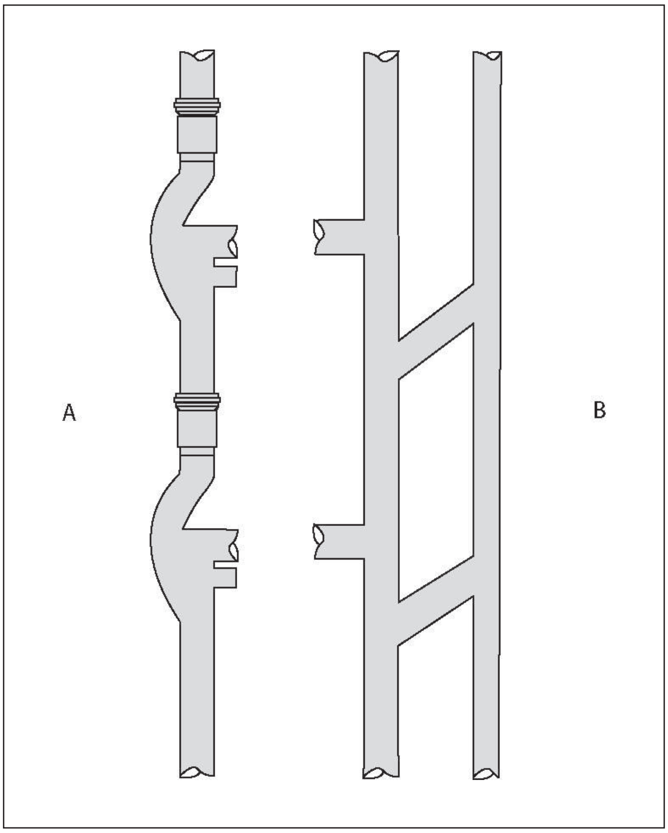


Illustration 5.2

Akatherm system with Akatherm HDPE Stack-aerator (A)
- Single stack system
- Suited for high-rise 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

High-rise drainage design

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's.

The capacity of a high-rise 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 high-rise drainage system have to be limited.

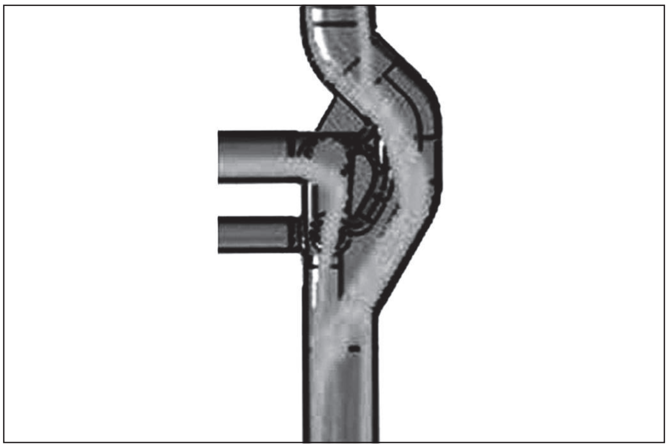


Illustration 5.3

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 complete stack in one dimension, 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).

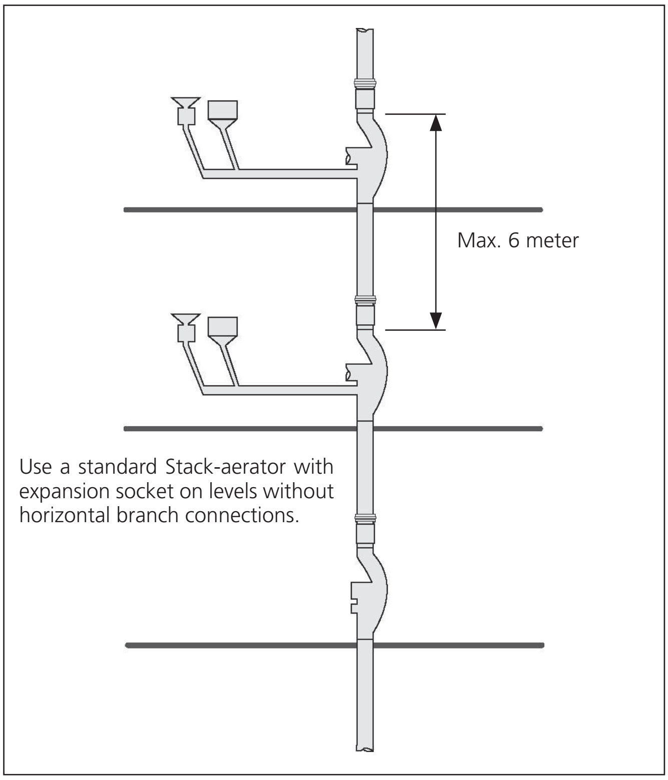


Illustration 5.4

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.

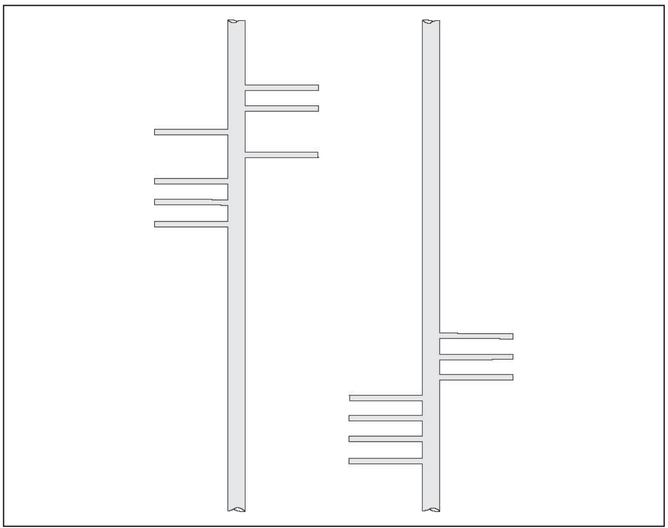


Illustration 5.5

Deflecting the stack

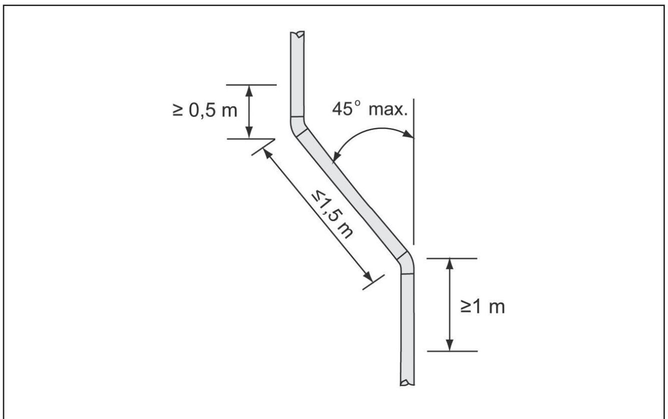


Illustration 5.6

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.

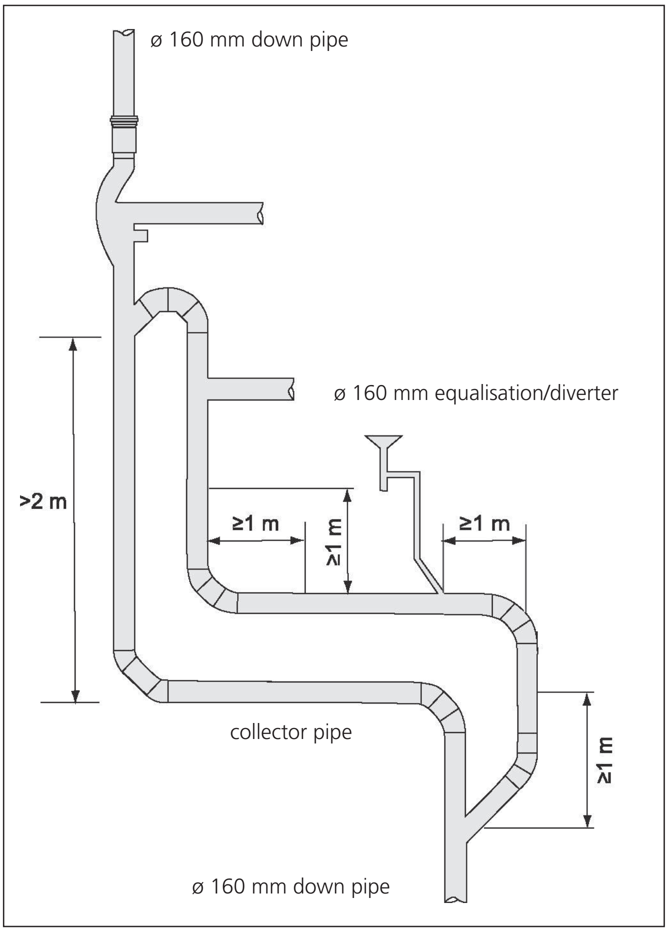


Illustration 5.7

High-rise drainage design

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.

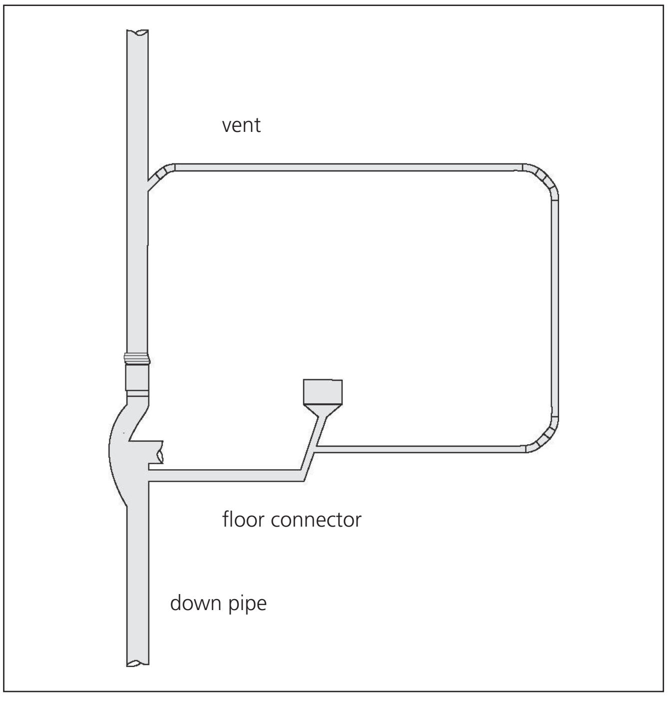


Illustration 5.8

Details about maximum total and per-storey drainage flows that may be handled by a Stack-aerator down pipe can be found in paragraph 5.6 'Stack-aerator 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.

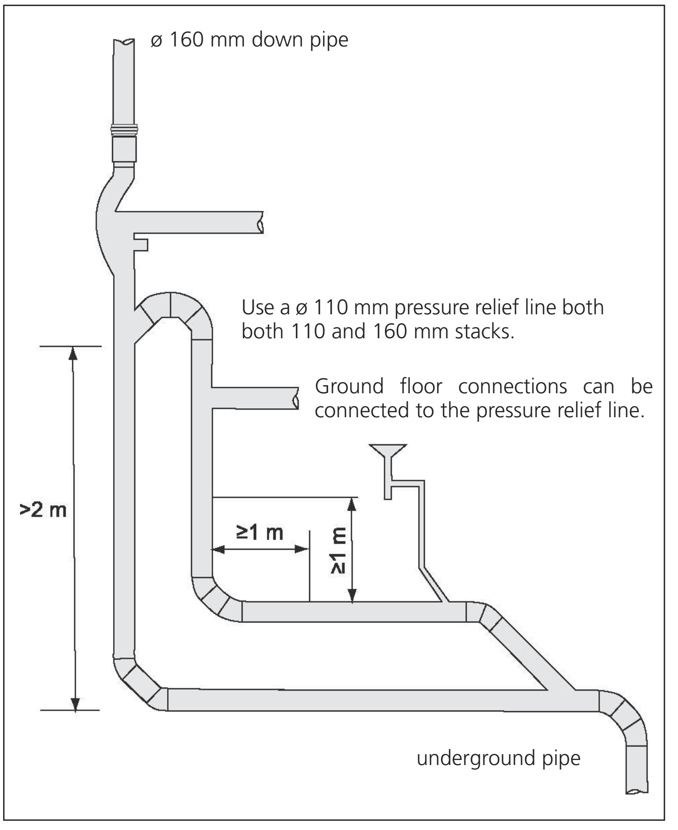


Illustration 5.9 End of the Stack-aerator down pipe

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.

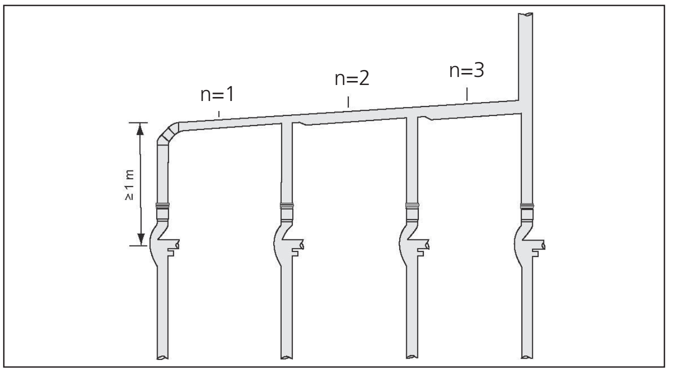


Illustration 5.10

	Minimum ø of combined pressure-relief pipe	
Down pipe (n)	**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-sheer 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-sheer 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 5.6.

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.

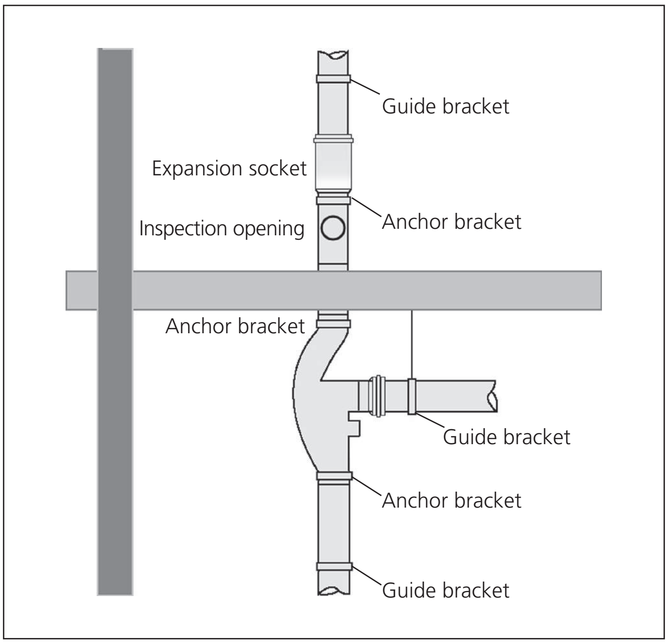


Illustration 5.11

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.

High-rise drainage design

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

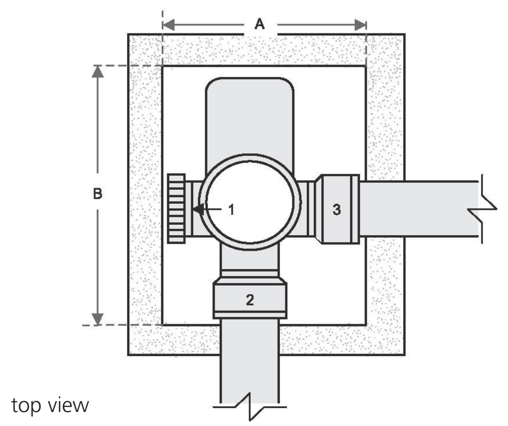


Illustration 5.12

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 Qi 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.

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

Equation 5.1 Combined drainage equation (l/s)

Q_a = Combined simultaneous drainage (l/s)
p = Simultaneity coefficient as indicated in table 5.4 ($(l/s)^{0,5}$)
n = Number of drain fixtures (-)
Q_i = Basic drainage unit for drain fixture i as stated in table 5.3 (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 5.6 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 (Qi), 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	1,100

Table 5.7

In this building, the $\sum_{i=1}^{n} Q_i$ is 1,100 l/s and the simultaneity coefficient 0,5. The total flow Q_a is therefore:

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

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.

High-rise drainage design

Underground pipe calculations
Usually, several down pipes are incorporated in a high-rise 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.

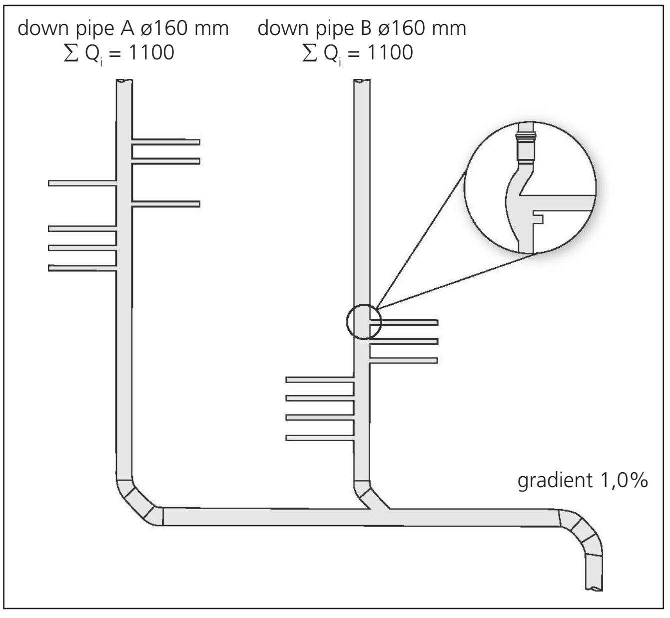


Illustration 5.13

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

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

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 buildings 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 system 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.

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, 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.

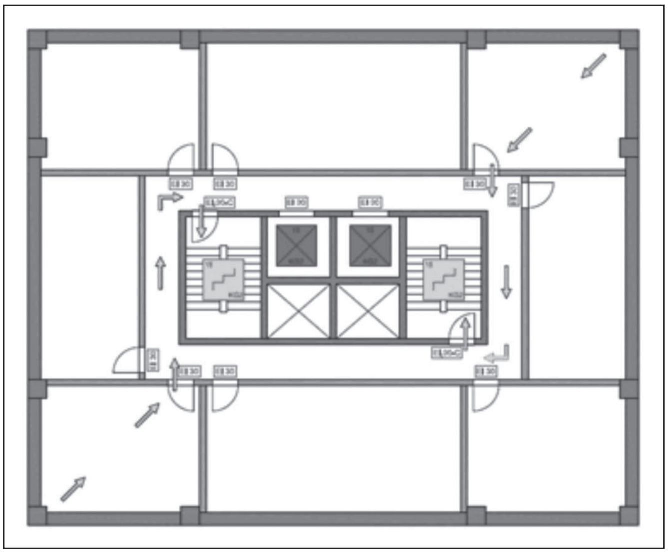


Illustration 6.1

6.1.1 The four stages of fire development
Fire in a building evolves in four stages.

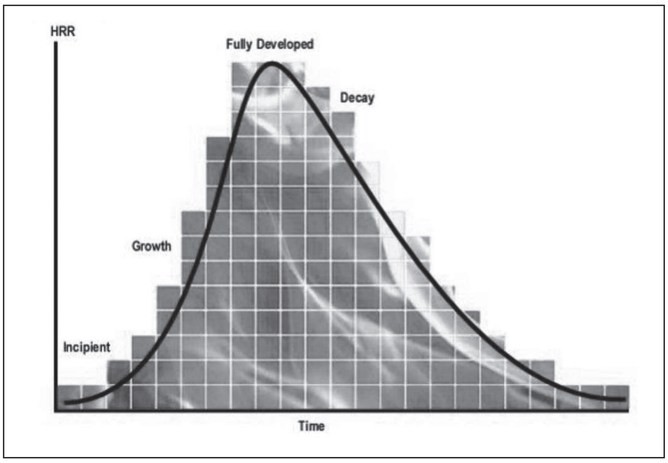


Illustration 6.2

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, before the following stages are reached. Recognizing a fire in this stage provides your best chance at suppression or escape.

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, ceiling height and the potential for “thermal layering”. It is during this shortest of the four stages when a deadly “flashover” can occur; potentially trapping, injuring or killing firefighters.

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.

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 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 neighbouring 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.

Passive fire protection

6.2 Fire collar protection

The fire behaviour 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.

Illustration 6.3

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 specific fire safety testing regulation in conformity with UL, ASTM, BS or ASNZS please contact your Akatherm sales representative.

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

6.2.1 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.

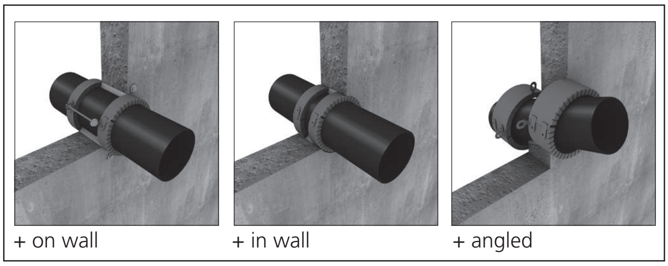


Illustration 6.4

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

6.2.2 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.

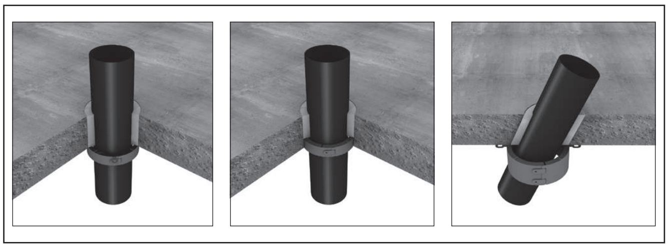


Illustration 6.5

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

6.3 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/m³	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	-	-	-	-
	> 150 mm	> 450 kg/m³	Promastop-FC3	90°	In wall	-/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	-	-
			Promastop-FC6	90°	On wall	-/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	-	-	-
			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	-	-
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	-	-	-
			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	-	-
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	-	-	-	-
			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	-	-	-	-
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	-	-	-	-
	> 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	-	-	-	-
	> 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	-	-	-	-

Table 6.1

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/m³	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	-	-	-
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	-	-

Table 6.2

Passive fire protection

6.4 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 6.3

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 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 6.4

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 6.5

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 breaks 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.

Passive fire protection

7 Fixing system and thermal movement

The Akatherm HDPE pipe system expands and contracts under influence of temperature changes. The pipe system therefor has to be installed correctly. This chapter describes the different pipe installation methods, bracket assembly methods and the correct bracket distances.

7.1 Choice of pipe installation methods

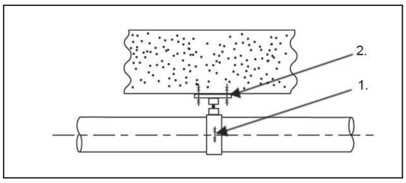
The choice of the pipe fixing system is essential to correctly install the pipe system. Depending on the temperature of the medium, the ambient temperature and the building constraints there are the following options:

1. Free moving guide bracket system with axial movement correction by means of:
   - (Snap) expansion sockets
   - Deflection leg
   - Deflection leg with (snap) expansion socket
2. Rigid anchor point bracket syste
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.



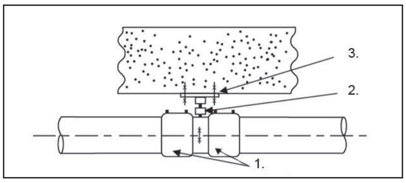
1. Guide bracket
Code 70xx10/70xx80
2. Mounting plate for guide bracket
Code 7094xx

Illustration 7.1 Guide bracket

7.2.2 Anchor point bracket

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

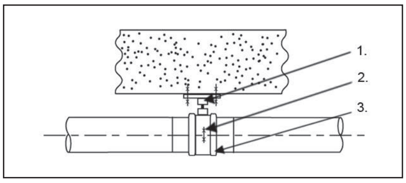
Anchor bracket with 2 electrofusion couplers



1. Electrofusion coupler
Code 41xx95
2. Anchor bracket
Code 70xxxx
3. Mounting plate for anchor bracket
Code 7094xx

Illustration 7.2 Anchor bracket with 2 electrofusion couplers Code 41xx95

Anchor bracket with double-flange bushing



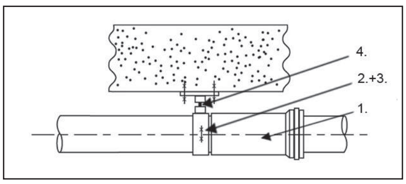
1. Mounting plate for anchor bracket
Code 7094xx
2. Anchor bracket
Code 70xxxx
3. Double-flange bushing
Code 43xx15

Illustration 7.3 Anchor bracket with double-flange bushing Code 43xx15

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.

7.2.3 Anchor bracket with expansion socket

This method of installation is used for flexible installations 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.



1. Expansion socket
Code 40xx20/42xx20
2. Clamp liner Code 70xx15
3. Anchor bracket
Code 70xxxx
4. Mounting plate for anchor bracket
Code 7094xx

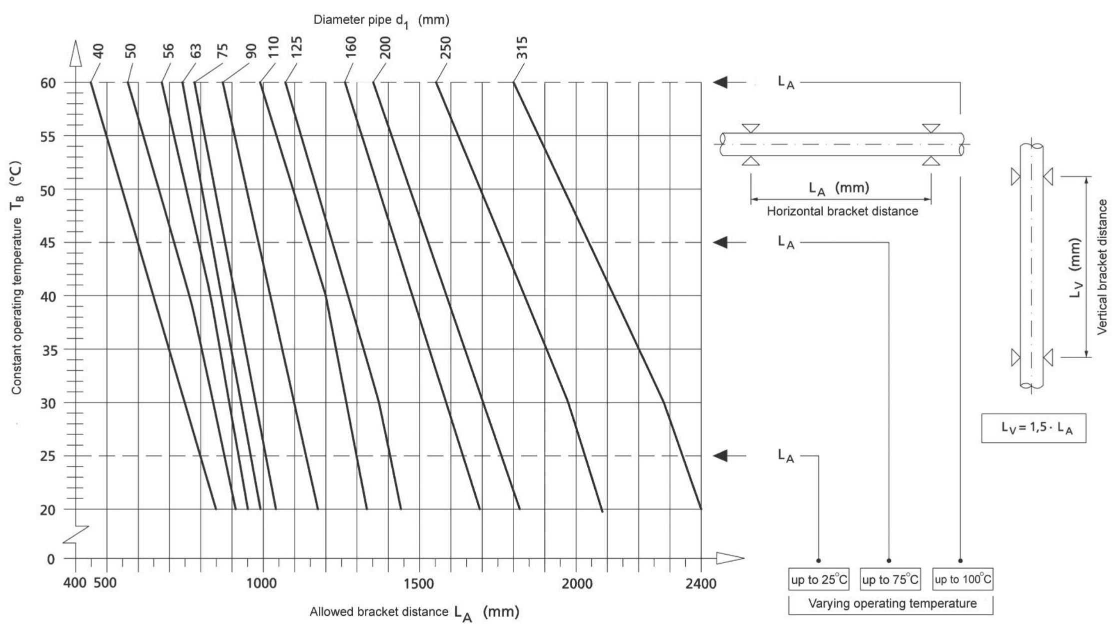
Illustration 7.4 Anchor bracket with expansion socket Code 40xx20

The anchor bracket must be fixed to the building in such a way that it can resist the forces caused by the internal friction resistance of the expansion socket.

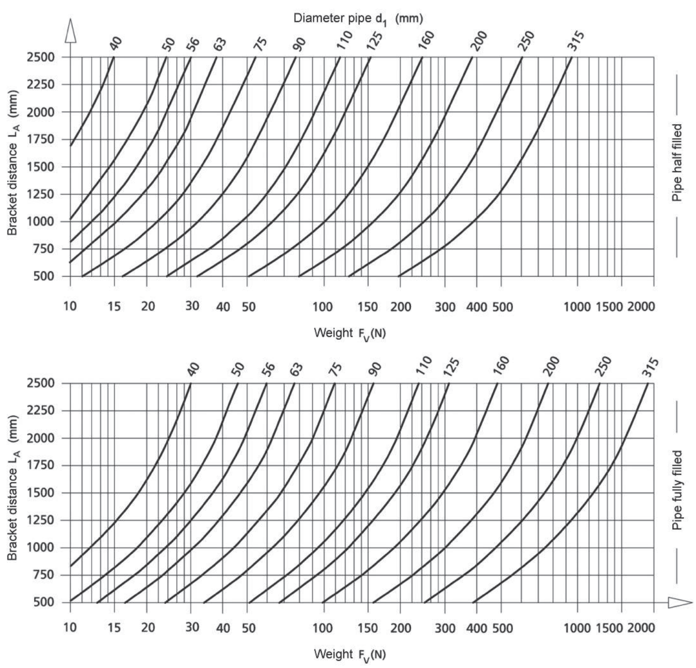
Fixing system and thermal movement

7.3 General 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 graphic drawing 7.2).

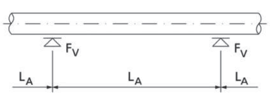


Graphic drawing 7.1 Bracket distances for vertical and horizontal HDPE pipe systems with standard filling



Pipe half filled	
Pipe d_e (mm)	Weight G (N/m)
40	6,0
50	9,5
56	12,0
63	15,5
75	22,0
90	31,5
110	47,0
125	61,0
160	99,5
200	156,0
250	243,5
315	387,0

Pipe fully filled	
Pipe d_e (mm)	Weight G (N/m)
40	12,0
50	19,0
56	24,0
63	31,0
75	44,0
90	63,0
110	94,0
125	122,0
160	199,0
200	312,0
250	487,0
315	774,0



Graphic drawing 7.2 Bracket distances and weights for half filled and fully filled pipe systems at 20°C

7.4 Guide bracket system with expansion sockets

7.4.1 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 or can be taken from graphic drawing 7.3.

$$\Delta l_t = L_{pipe} \cdot \alpha_t \cdot t_{max} \cdot 10^3$$

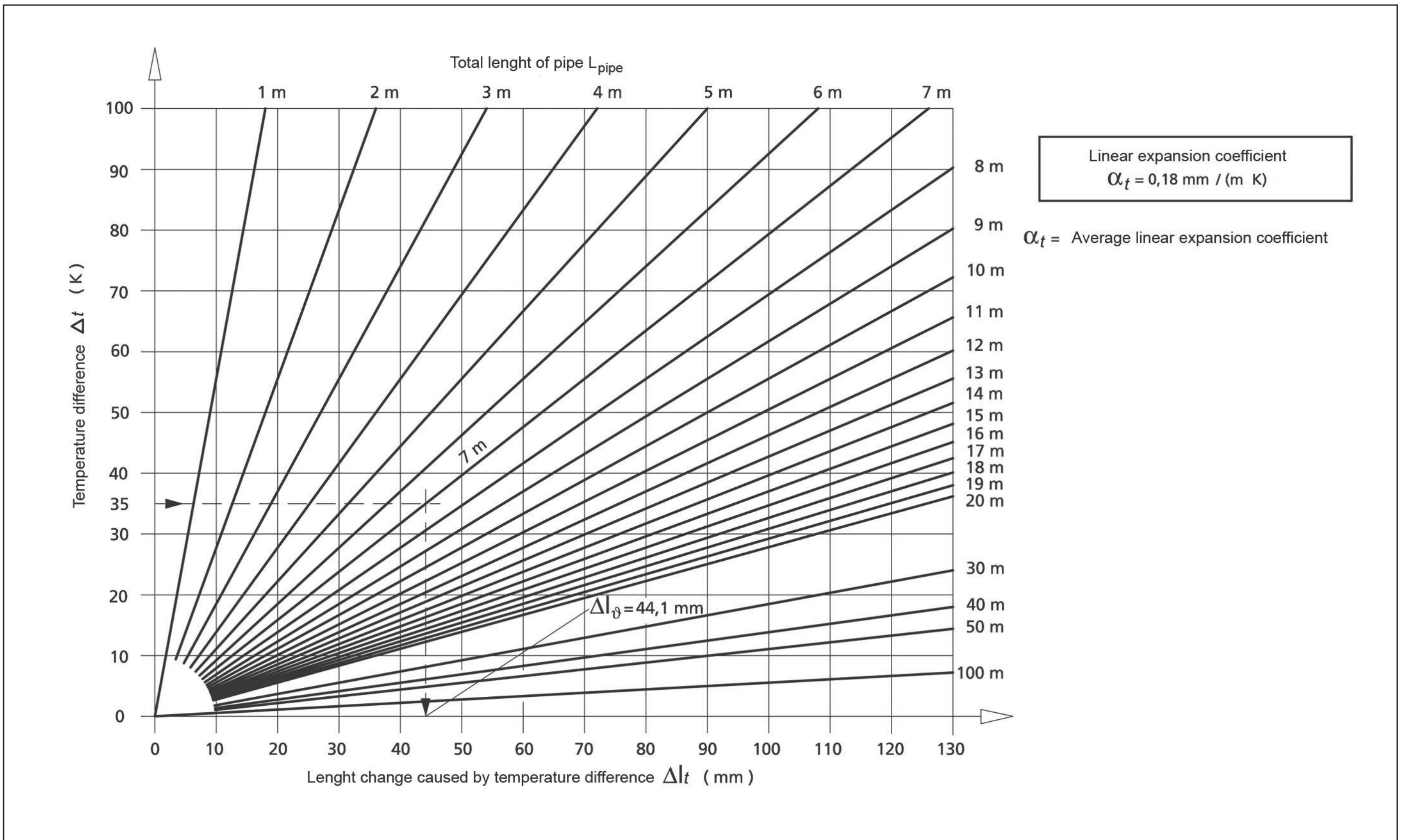
Equation 7.1 Length change caused by temperature difference

Δl_t = Length change (mm)
L_{pipe} = Total length of pipe (m)
αt = Linear expansion coefficient (mm / m°K)
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.

d_1 (mm)	Code	Total length (mm)	Min. insertion depth 20°C (mm)	Max. expansion (mm)
40	**40 04 20**	132	76	56
50	**40 05 20**	132	76	56
56	**40 56 20**	132	76	56
63	**40 06 20**	132	76	56
75	**42 07 20**	256	32	146
90	**42 09 20**	256	33	144
110	**42 11 20**	256	35	141
125	**42 12 20**	256	37	139
160	**42 16 20**	256	40	143
200	**40 20 20**	230	120	110
250	**40 25 20**	250	125	125
315	**40 31 20**	270	126	144

Table 7.1 Length change with expansion sockets



Graphic drawing 7.3 Length change caused by temperature difference

Fixing system and thermal movement

Akatherm HDPE expansion sockets can accommodate the expansion and contraction of max. 6 m. This rule of thumb can be used when no further calculations are made. This general rule is only applicable with $\Delta \leq 37.5°C$.

The number of expansion sockets can specifically be calculated by using Equitation 7.1. For example:

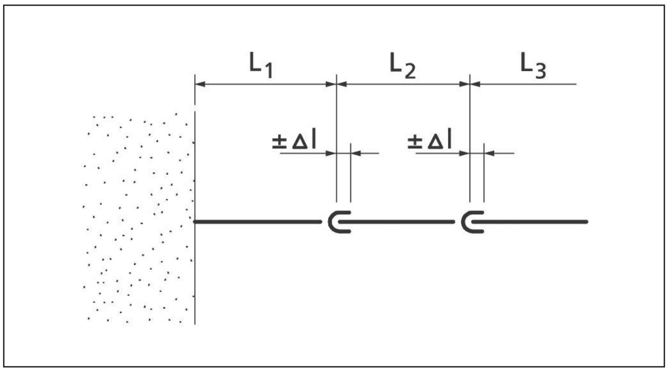


Illustration 7.5 Pipe section with expansion sockets

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

In a pipe section of 110 mm diameter this results in 227/141 = ~1.6 = 2 expansion sockets. Therefore, based upon the calculation only 2 expansion sockets are needed as opposed to the general rule of thumb (18/6 = 3 expansion sockets). By calculating the maximum expansion a more cost efficient installation can be made.

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 x 227/141= ~0,8 = 1 expansion socket.

The general rules can be applied for pipe lengths ≤ 5m in most drainage applications. With extreme high temperatures possibly in combination with a complex route the number of expansion sockets may need to be calculated.

7.4.2 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.

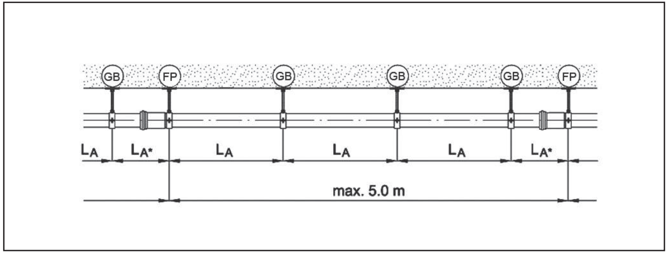


Illustration 7.6 Horizontal installation with expansion sockets without support trays

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

d_1	L_A	L_A*
50	0,8 m	0,4 m
56	0,8 m	0,4 m
63	0,8 m	0,4 m
75	0,8 m	0,4 m
90	0,9 m	0,5 m
110	1,1 m	0,6 m
125	1,3 m	0,7 m
160	1,6 m	0,8 m
200	2,0 m	1,0 m
250	2,0 m	1,0 m
315	2,0 m	1,0 m

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

7.4.3 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.

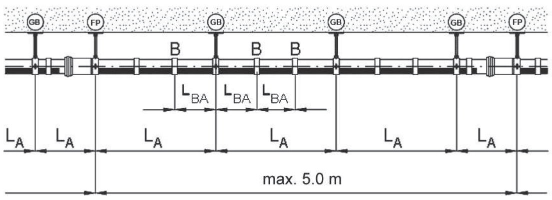


Illustration 7.7 Bracket distances horizontal installation with expansion sockets without support trays

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_1	L_A	L_A*	L_{BA}
50	1,0 m	0,5 m	0,5 m
56	1,0 m	0,5 m	0,5 m
63	1,0 m	0,5 m	0,5 m
75	1,2 m	0,6 m	0,5 m
90	1,4 m	0,7 m	0,5 m
110	1,7 m	0,9 m	0,5 m
125	1,9 m	1,0 m	0,5 m
160	2,4 m	1,2 m	0,5 m
200	3,0 m	1,5 m	0,5 m
250	3,0 m	1,5 m	0,5 m
315	3,0 m	1,5 m	0,5 m

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

7.4.4 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.

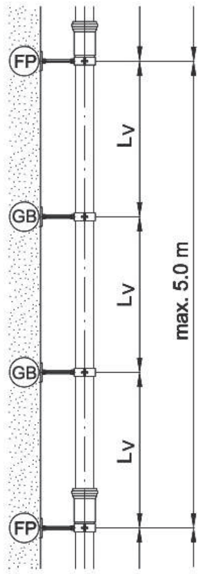


Illustration 7.8 Vertical installation

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

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

Table 7.4 Bracket distances vertical installation to the wall to the wall

Fixing system and thermal movement

7.5 Guide bracket system with deflection leg

7.5.1 Deflection leg calculation

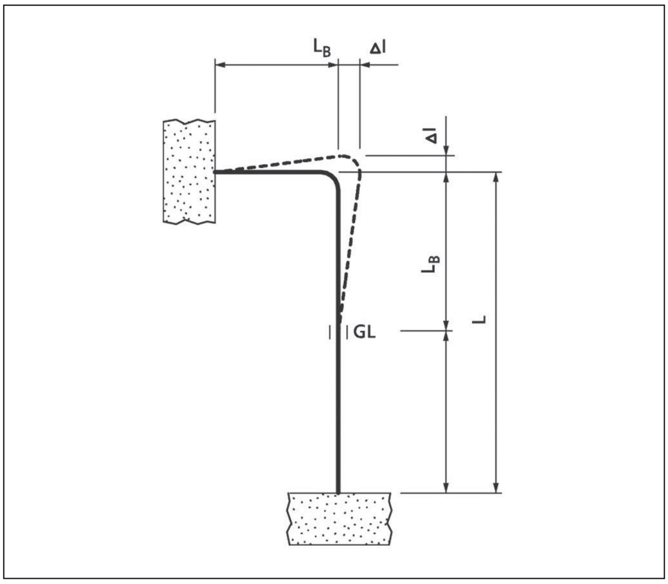


Illustration 7.9 Installation with deflection leg

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 or graphic drawing 7.4 and 7.5, depending on temperature of installation and operation.

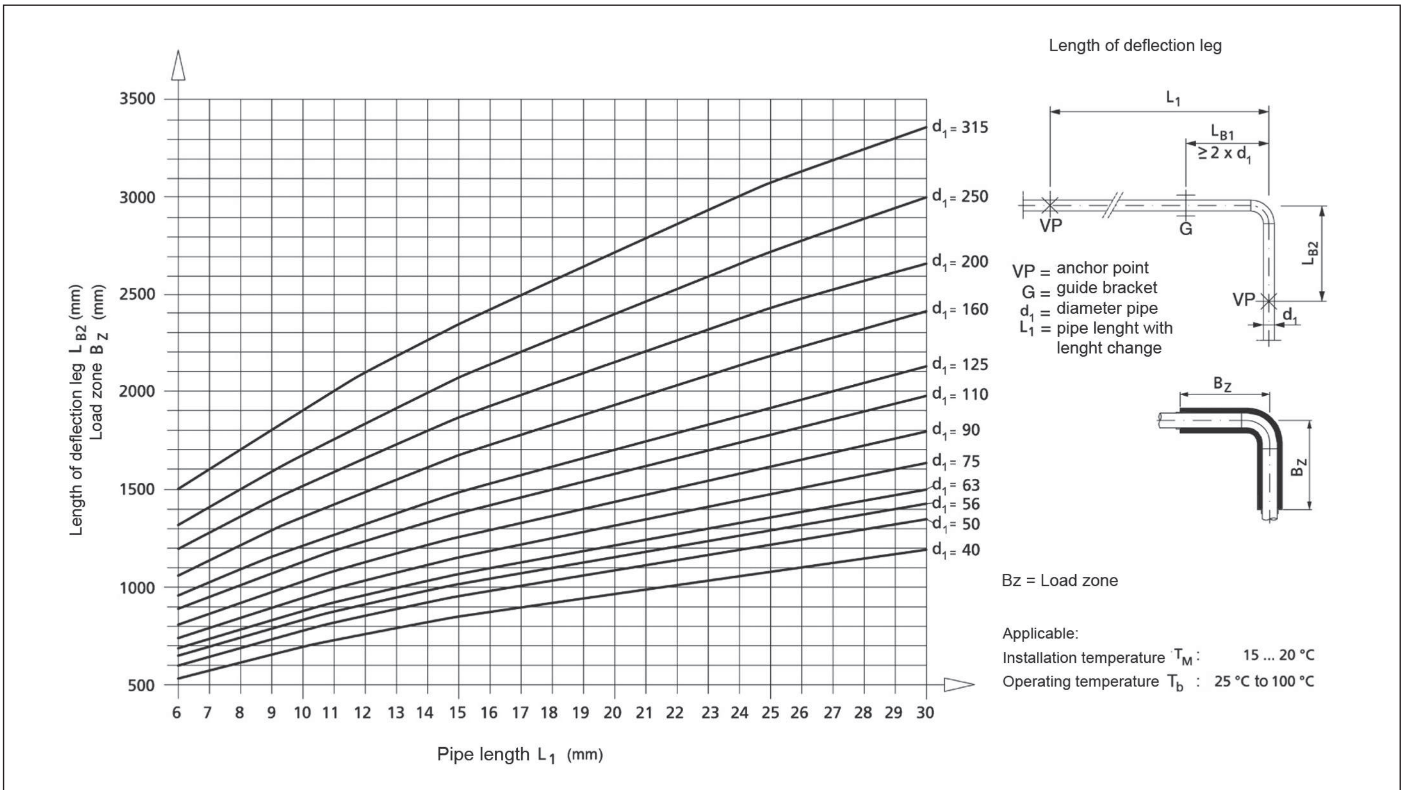
$$L_B \geq 10 \times \sqrt{\Delta l \times d_{1,2}}$$

Equation 7.2 Computing the length of deflection leg

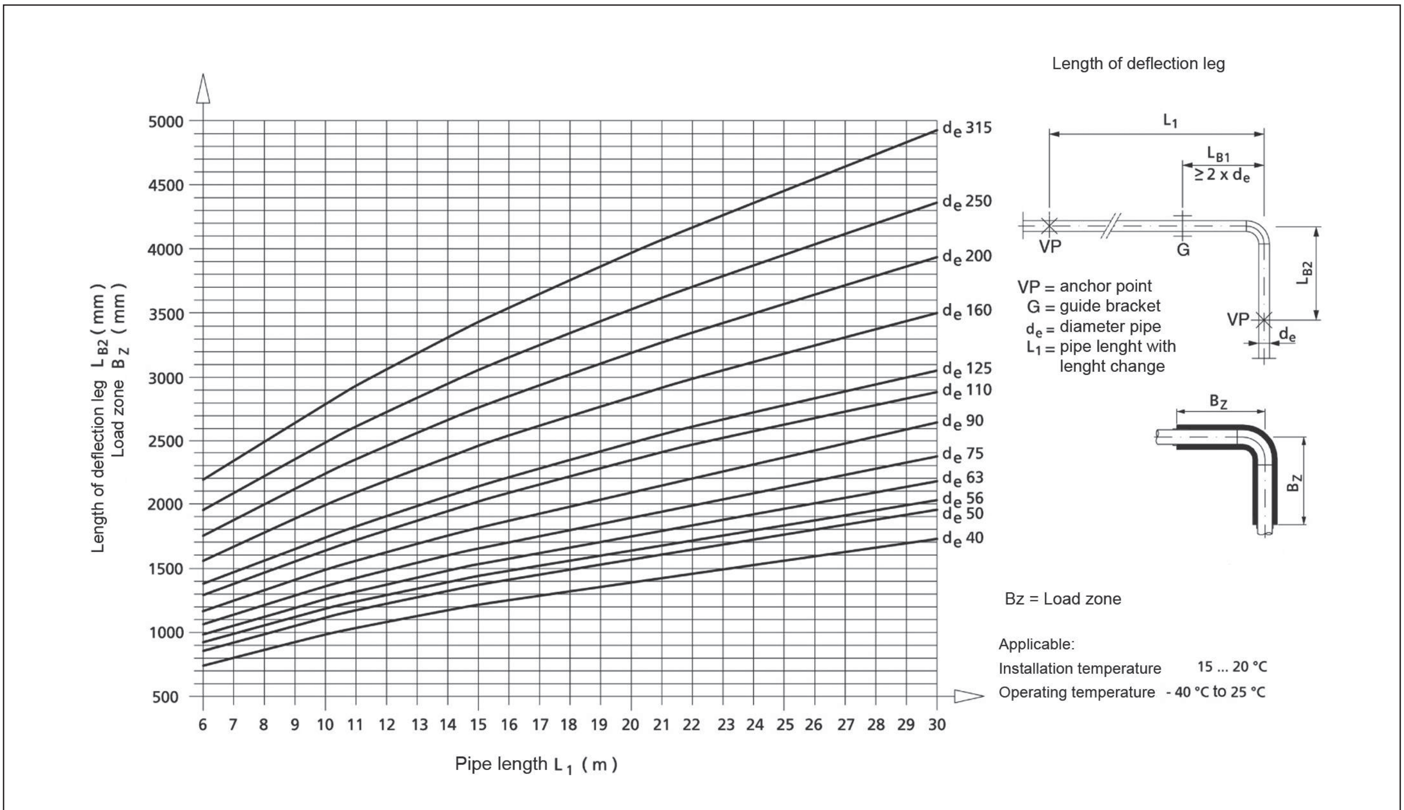
L_B = Length of deflection leg (mm)
d_1 = Diameter pipe
Δl = Length change caused by expansion

First the length change Δl has to be determined at a temperature difference $\Delta_{t\ max}$ (see paragraph 7.4.1).

Fixing system and thermal movement



Graphic drawing 7.4 Length deflection leg at operating temperature 25°C-100°C



Graphic drawing 7.5 Length deflection leg at operation temperature -40°C-25°C

Fixing system and thermal movement

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 7.5.2).

Fixing system

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

Equation 7.3

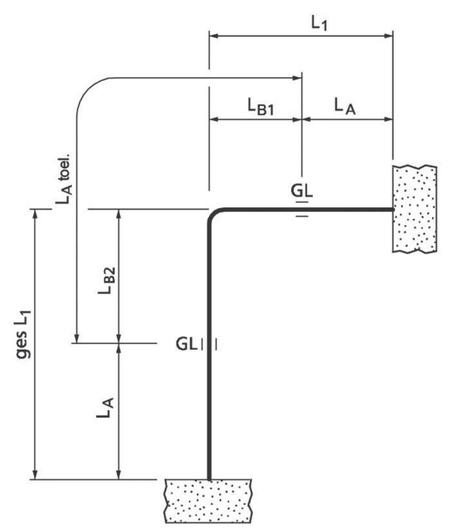


Illustration 7.10 Check fixing system

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 7.5.

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

Table 7.5 Bracket distances horizontal installation with anchor brackets

7.5.2 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 7.11 you will find an example.

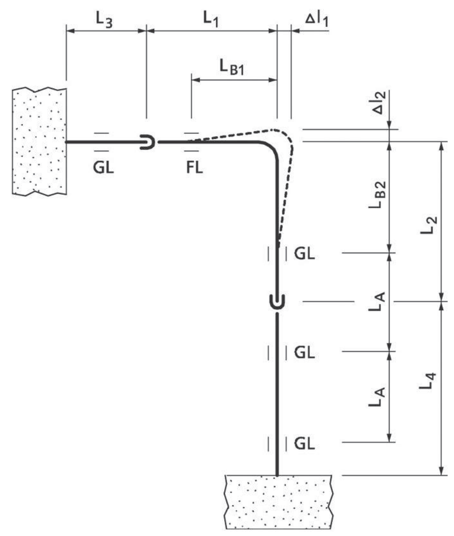


Illustration 7.11 Installation with deflection leg and expansion sockets

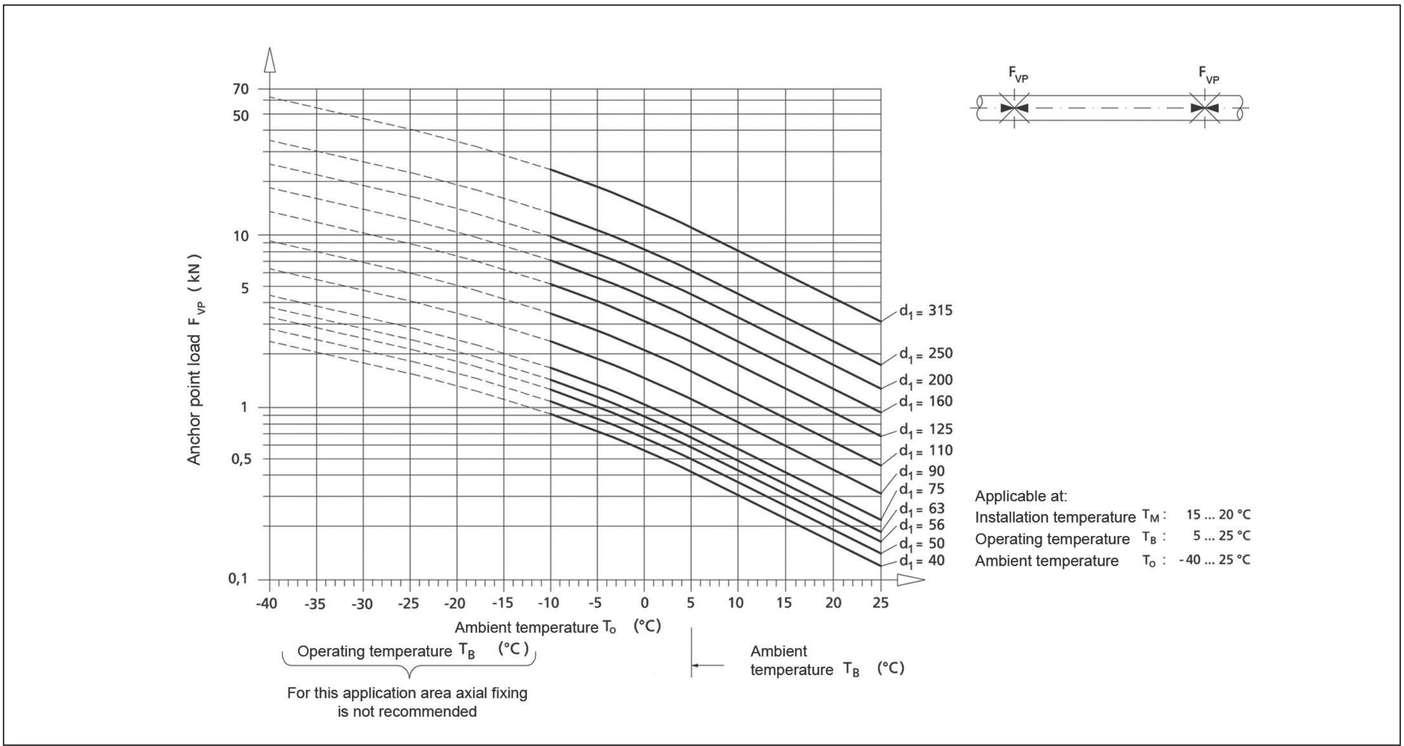
Operating temperature: +15°C/+75°C
Pipe lengths L_1 - $L_4 \leq 5$ m

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.

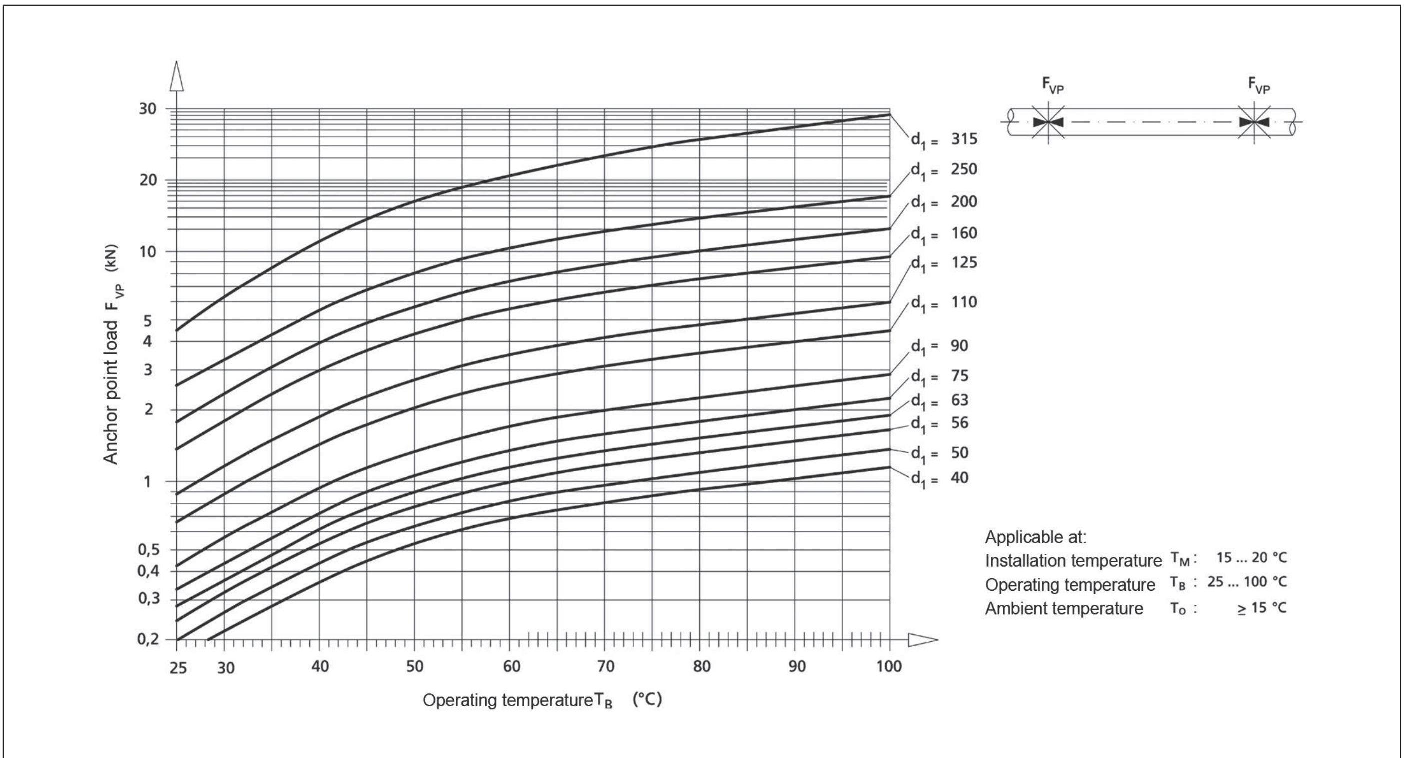
7.6 Anchor point bracket system

7.6.1 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 graphic drawing 7.6).



Graphic drawing 7.6 Anchor point load at ambient temperature -40°C - 25°C



Graphic drawing 7.7 Anchor point load at ambient temperature >15°C

Fixing system and thermal movement

7.6.2 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.

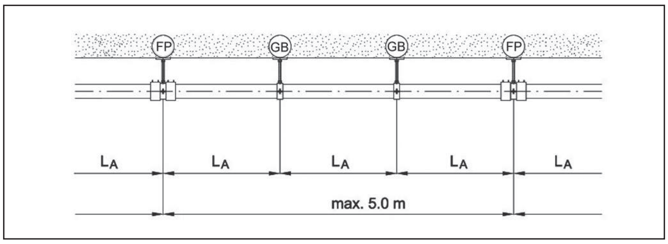


Illustration 7.12 Horizontal installation with anchor points

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

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

Table 7.6 Bracket distances horizontal installation with anchor brackets

7.6.3 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.

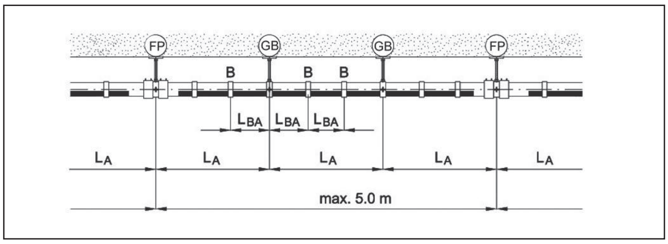


Illustration 7.13 Horizontal installation with anchor points and support trays

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

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

Table 7.7 Bracket distances horizontal installation with anchor brackets and support trays

Fixing system and thermal movement

7.6.4 Vertical installation

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

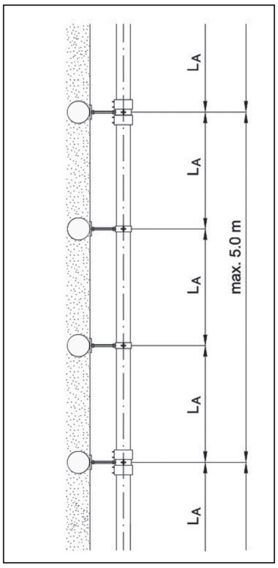


Illustration 7.14 Vertical installation with anchor points

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

Table 7.8 Bracket distances vertical installation with anchor brackets

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

7.6.5 Distance of the bracket to the wall or ceiling

In table 7.9 the diameters of the connecting pipe are listed per pipe dimension and distance from the wall/floor (see illustration 7.15).

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

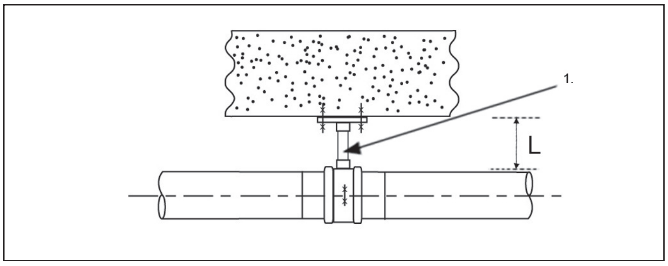


Illustration 7.15 1 = diameter of the connecting tube

Distance to wall/floor	Pipe diameter d_1										
L (mm)	**50**	**56**	**63**	**75**	**90**	**110**	**125**	**160**	**200**	**250**	**315**
100	½″	½″	¾″	¾″	1″	1″	1¼″	1½″	-	-	-
150	¾″	¾″	1″	1″	1″	1¼″	1¼″	2″	-	-	-
200	¾″	¾″	1″	1″	1¼″	1½″	1½″	2″	-	-	-
250	1″	1″	1″	1″	1¼″	1½″	2″	-	-	-	-
300	1″	1″	1¼″	1¼″	1¼″	2″	2″	-	-	-	-
350	1¼″	1¼″	1¼″	1¼″	1½″	2″	2″	-	-	-	-
400	1¼″	1¼″	1¼″	1¼″	1½″	2″	-	-	-	-	-
450	1¼″	1¼″	1½″	1½″	2″	2″	-	-	-	-	-
500	1¼″	1¼″	1½″	1½″	2″	-	-	-	-	-	-
550	1¼″	1¼″	1½″	1½″	2″	-	-	-	-	-	-
600	1½″	1½″	1½″	1½″	2″	-	-	-	-	-	-

Table 7.9

Fixing system and thermal movement

7.7 Embedding HDPE in concrete

7.7.1 Installation guidelines before pouring concrete

High density polyethylene (HDPE) is well suited to be embedded in concrete due to its physical characteristics and is guaranteed for this usage. Depending on the installation circumstances and materials used, certain installation practices are applied due to the maximum pipe strength and pipe expansion under influence of temperature changes.

HDPE pipe with s12.5 has a maximum allowed negative pressure of 800 mbar, our class s16 pipe has a maximum negative pressure of 450 mbar. When the concrete is poured and is still liquid, the outer pressure can exceed 800 mbar. To compensate this, the pipe can be filled with water and closed making it an uncompressible closed system. When quick drying concrete is used, the exothermic reaction (a chemical reaction that is accompanied by the release of heat) can heat up the HDPE pipe and degrade the material and lowering the allowed negative pressure. Before pouring the concrete, the pipe system has to be secured against movement.

7.7.2 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 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.

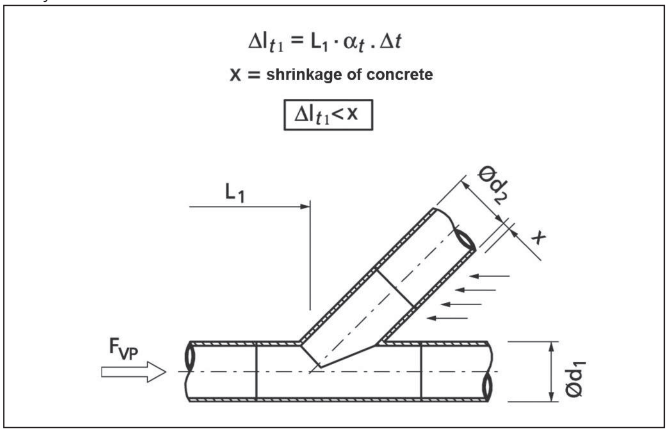


Illustration 7.16 HDPE expansion forces in concrete

All 45° and 88,5° branches are subdued to the expansion force (F_{VP}) 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 7.17).

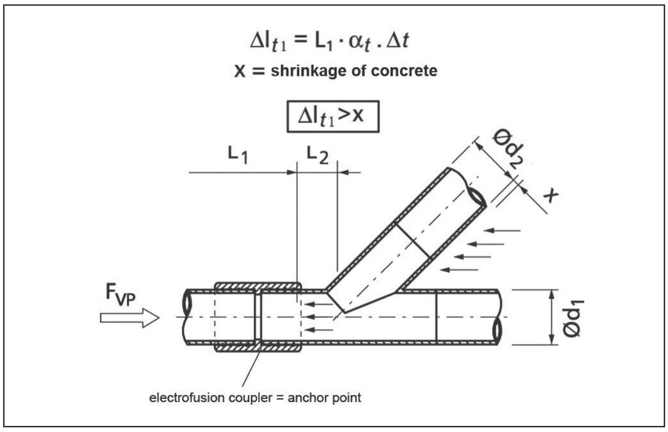


Illustration 7.17 Anchor point with an electrofusion coupler

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 7.18).

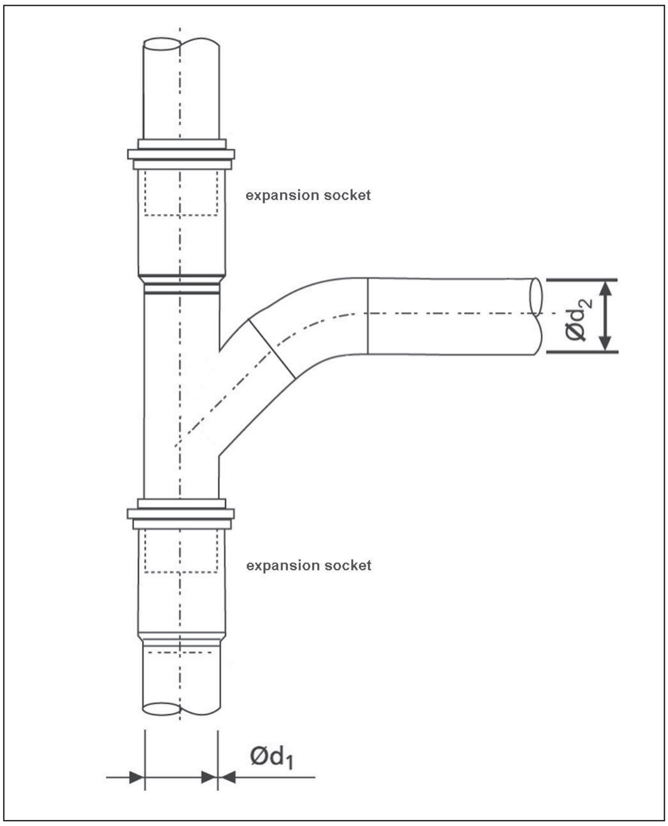


Illustration 7.18 Anchor point with (snap) expansion sockets

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.

7.8 Underground installation of HDPE

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. It is, in effect, the stability of Akatherm HDPE in withstanding these pressures that makes it possible to lay the pipes at substantial depth. The suitability depends on such factors as depth, groundwater level, density of the soil and traffic load.

7.8.1 Loads

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, request assistance from our Technical Support department.

7.8.2 Construction and installation of underground pipe systems

Trench base (bedding) - zone 1

The state and form of the trench base must match the mechanical properties of the thermoplastic 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 narrow in order to keep the final soil pressure as low as possible. The space between pipe and trench wall must be at least 100 mm.

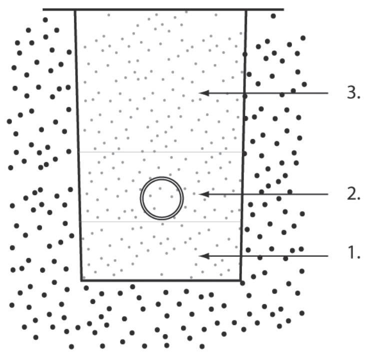


Illustration 7.19

The height of zone 1 depends on the soil conditions and the nominal pipe width, and is calculated using the following equation.

$$H_{so} = H_m + \frac{DN}{10}$$

Equation 7.4

H_{so} = height of the soil in zone 1 (mm)
H_m = minimum initial thickness
normal soil conditions: 100 mm
rocky or thick soil: 150 mm
DN = nominal pipe width (mm)

Fixing system and thermal movement

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 unburdening effect.

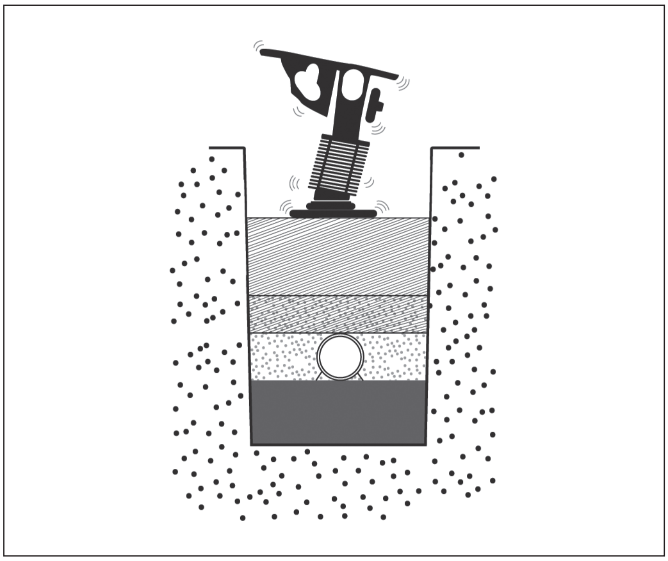


Illustration 7.20

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.

Filling of trench (protective layer) - zone 3
The trench is backfilled in layers and compacted. Types of soil and materials that can cause dents may not be used to backfill the trench (e.g. ash, waste, stones). The use of heavy compacting equipment to compact the soil is not permissible for soil layers <1,0 m. The required thickness of zone 3 depends on trench form and pipe-wall thickness. Our Technical Support department can advise you in this regard.

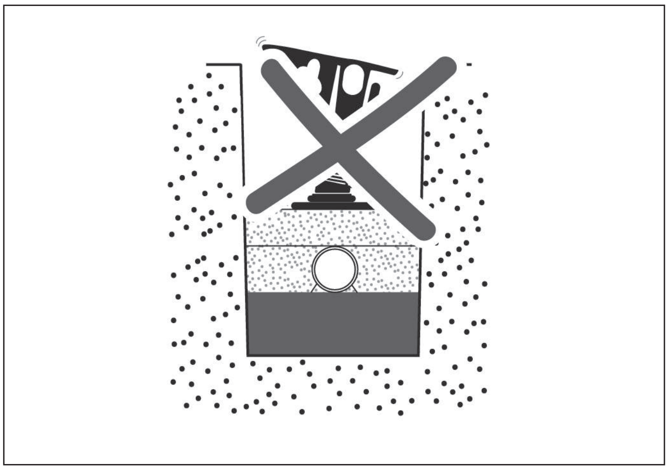


Illustration 7.21

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

8 Jointing methods

8.1 Joint methods

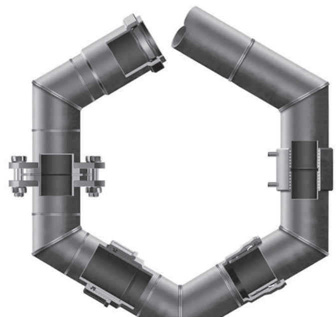


Illustration 8.1

Akatherm HDPE is made of High Density Polyethylene, a material with welded joints. Secure and durable connections lasting 50 to 100 years. Welded joints are made without additional glue or rubber rings joints and are actually the strongest points of the pipe system. HDPE welded joints are both pull tights 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 application. Joints are divided in welded/mechanical and pull-tight/not pull-tight. Pull tight joints can't come apart under influence of external forces.

Joint method	*Welded/mechanical*	*Pull-tight*
Electrofusion	Welded	Yes
Butt-weld	Welded	Yes
Plug-in socket	Mechanical	No
Snap socket	Mechanical	Yes
Screw-thread	Mechanical	No
Screw-thread with bushing	Mechanical	Yes
Flange	Mechanical	Yes
Contraction sleeve	Mechanical	No
Metal Coupling	Mechanical	No

8.2 Butt-weld joint

Illustration 8.2

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

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

Preparations
Establish a work space where the jointing can be done without being effected by major weather conditions. The use of wind shields is advised to keep the weld plate at a constant temperature. Temperature -5°C/+40°C.

Without removing the oxygen layer a weld cannot be guaranteed. The oxidation layer will form again within one hour. The butt-weld needs to be made right after machining the ends.

Used surface of heating element for welding diameter d_1	Δt_{tot}
d1 = 40-160	8°C
d1 = 200-315	10°C

Table 8.1 Maximum temperature variation heating element

Jointing methods

Welding process
The butt-welding of Akatherm HDPE operates according to the following steps:

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

Verify the alignment between the machined surfaces. Remove the plastic shaving. Do not dirty or touch the machined surfaces.

> ! Without removing the oxygen layer a weld cannot be guaranteed.

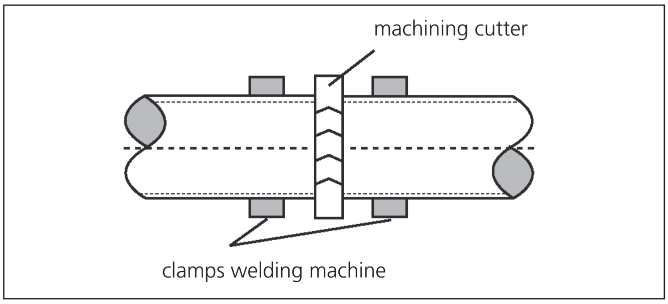


Illustration 8.3 Machining the surface

Preheating under pressure
Press the two ends to be jointed gradually to the heating element until a bead is created. The size of the bead is a good indication that the appropriate pressure and time is used. For pressure and bead size see table 8.2.

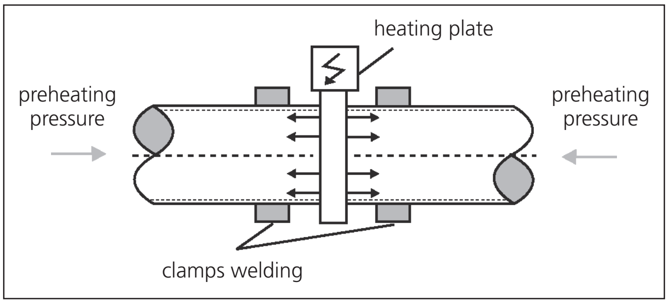


Illustration 8.4 Preheating under pressure

Heating up 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 table 8.2.

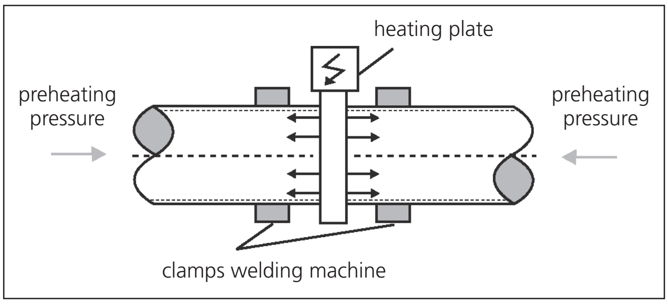


Illustration 8.5 Obtaining the correct heating depth

Change over
Remove the heating element from the jointing areas and immediately join the two ends. 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 times for changing over can be found in table 8.2.

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 building-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. When the pressure buildup is too slow the material cools down. 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. Do not cool artificially.

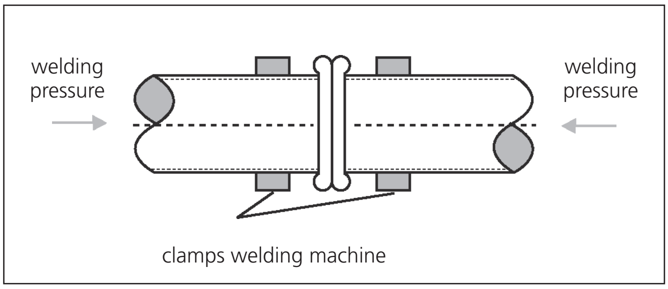
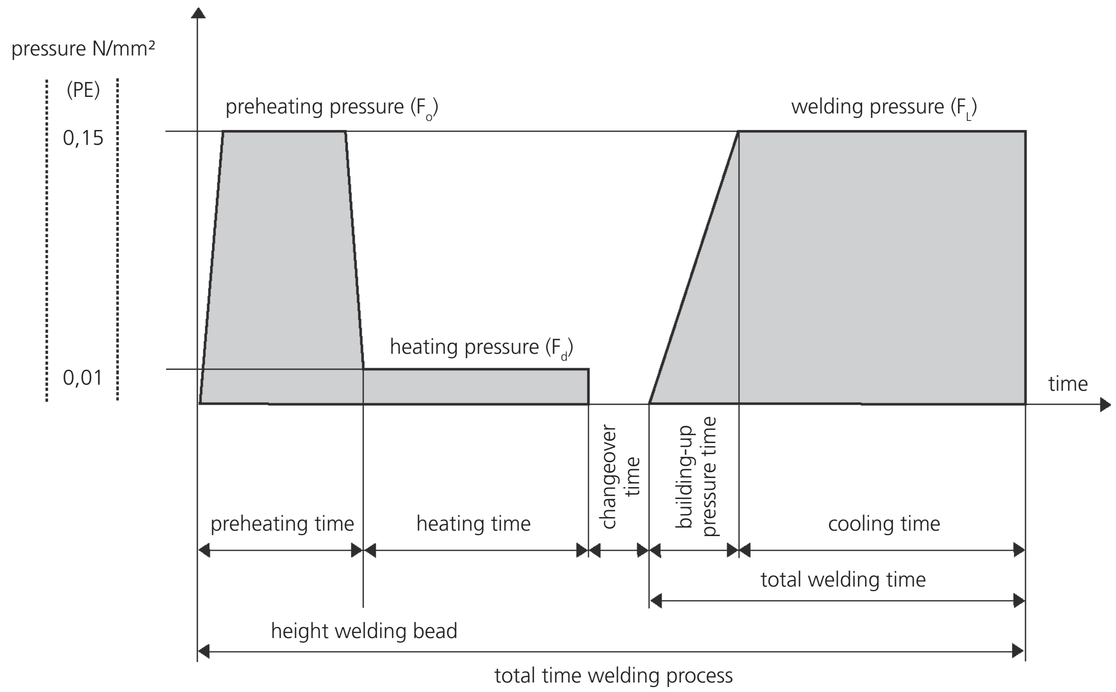


Illustration 8.6 Welding and cooling

The welded components can be removed from the machine when 50% of the cooling period has elapsed, providing that this is done carefully, with no load or strain being placed on the joint. The joint must then be left undisturbed for the remainder of the cooling period.



Graphic drawing 8.1

Diameter d_1 mm	Wall thickness e mm	Preheating pressure/welding pressure (0,15 N/mm²) F_o/F_L N	Heating pressure (0,01 N/mm²) 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

Table 8.2 Welding parameters Akatherm HDPE drainage

In table 8.2 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.

Jointing methods

Evaluating the butt-weld joint

The butt-weld can be evaluated using destructive and non destructive evaluation methods. For these evaluations special equipment has to be used. Butt-welds can easily be judged by a visual inspection, making this the recommended method for a first evaluation.

The shape of the welding bead is an indication for the proper operation of the welding process. Both welding beads should have the same shape and size. The width of the welding bead should approximately be 0,5 x the height. 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 8.7 a good weld is shown with a uniform welding bead. At a visual inspection this would be classified as an “acceptable” weld.

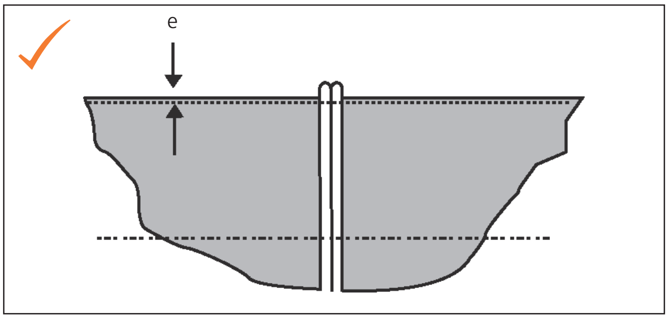


Illustration 8.7 Butt-weld with even welding beads (acceptable)

Mis-alignment between fittings and pipe can occur for several reasons. Oval pipe ends or irregular necking of the pipe can cause an incomplete fit. If this sagging is less than 10% of the wall thickness the weld can still be classified as “acceptable” (see illustration 8.8).

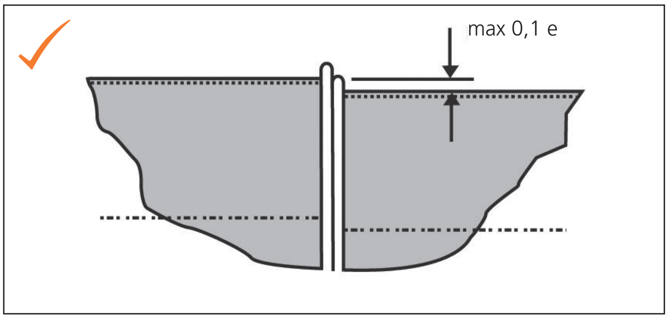


Illustration 8.8 Butt-weld with mis-alignment of pipe (acceptable)

Illustration 8.9 shows a joint with beads that are too big. The uniformity indicates a good joint preparation. However, heat supply and/or jointing pressure seem to be too high. A purely visual assessment would still classify the weld as “acceptable”.

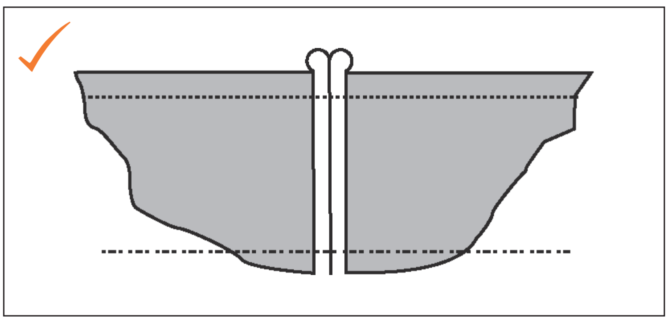


Illustration 8.9 Butt-weld with big welding beads (acceptable)

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 “not acceptable”.

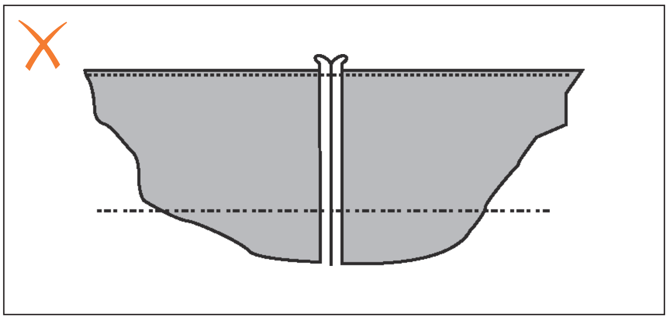


Illustration 8.10 Butt-weld (not acceptable)

In illustration 8.11 a cross-section of a regular, round fusion bead, free of notches or sagging is shown. Special attention should be paid to the fact that the collar value ‘K’ is greater than 0.

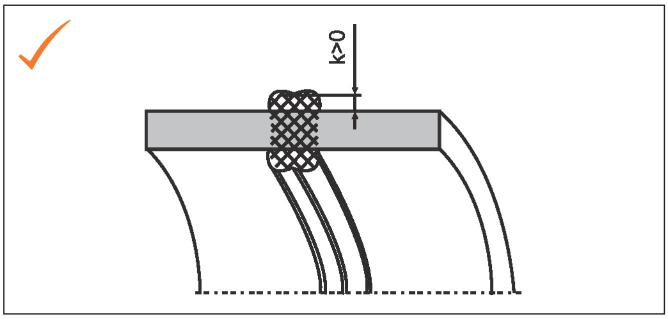


Illustration 8.11 Cross section of a good butt-weld

Welding by hand

In general butt-welds are made using an Akatherm butt-welding machine. However up to the diameter d1 = 75 mm the weld can be made by hand. At 90 mm and above the welding pressures are too big to make a good weld by hand. The welding process is identical to butt-welding with a machine:

Preheating

Push the pipe/fittings against the heating plate until the required welding bead has been formed (for height of welding bead see table 8.2).

Heating up

Hold the pipe/fittings against the heating plate with no pressure (for time see table 8.2).

Change over/welding/cooling

As the spigots are thoroughly heated up both parts need to be joined as quickly as possible using a gently buildup of pressure. The jointing has to be carried out accurately because moving the parts during and after jointing is not possible.

Keep the parts jointed together under pressure as long as the welding bead is still plasticized (this can be checked by pressing your fingernail into the bead). The joint then needs to cool down without any additional load. The use of a support structure is recommended when jointing long pipe parts. Using a butt-welding machine gives a better result under all circumstances.

8.3 Electrofusion joint

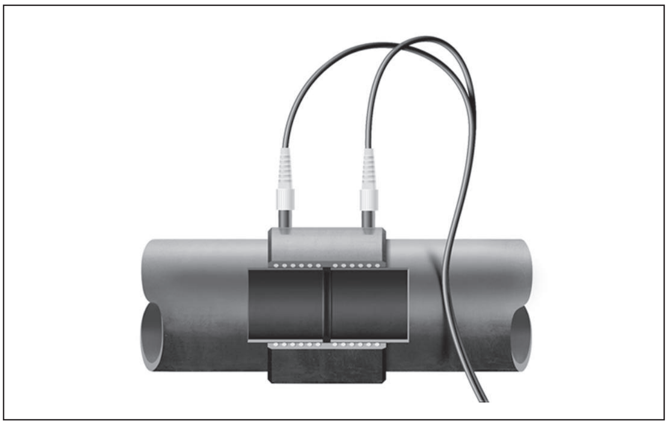


Illustration 8.12

Electrofusion is a rapid and simple way of permanent jointing. Using the electrofusion couplers and equipment, pipes, fittings and prefabricated pipe sections can efficiently be assembled. All Akatherm products can be welded by electrofusion unless specifically stated in the product table.

Preparations
The following guidelines are of importance when making a proper electrofusion joint:

- Establish a work space where the welding can be done without being effected by major weather conditions. Temperature -10°C/+40°C.
- Check if the equipment functions properly. Welding equipment used on site deserves special attention.
- The resistance wire in the electrofusion coupler lies at the surface for a good heat exchange. The resistance wires need to be covered by the inserted pipe or fitting to guarantee a proper working.
- Complete insertion is essential to utilize the fusion and cold zones in the coupler.
- Make sure both ends inserted into the coupler have been properly scraped and have been cleaned. Both pipes and fittings need removal of the oxidation layer.

The resistance wires are positioned in the fusion zone. On both sides of a fusion zone, 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 caused by the expanding HDPE and the heat from the resistance wires.

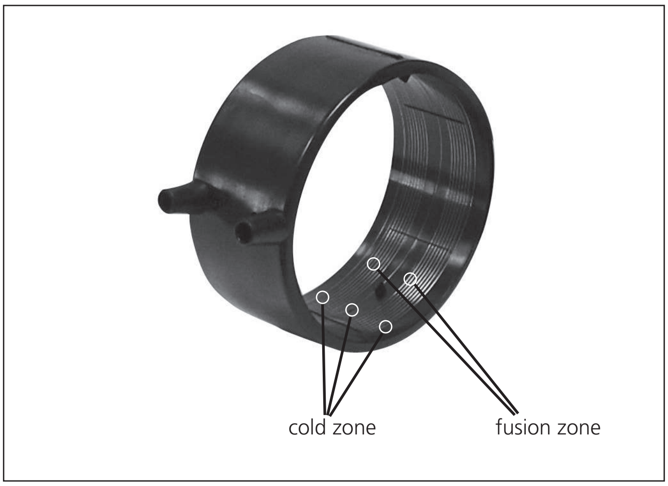


Illustration 8.13 Electrofusion coupler with fusion and cold zones

Warning: Without removing the oxygen layer a weld cannot be guaranteed. The oxidation layer will form again within one hour. The butt-weld needs to be made right after machining the ends.

Jointing methods

Welding process

Cut pipe square

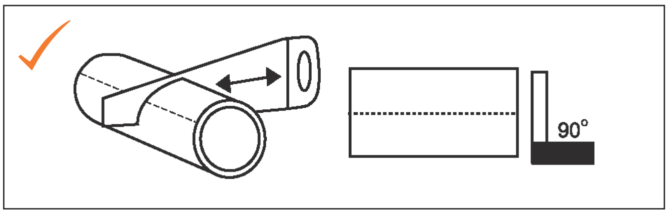


Illustration 8.14

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

Mark surface for scraping

Mark insertion depth +10 mm to ensure that across the full welding zone the oxidized layer will be removed.

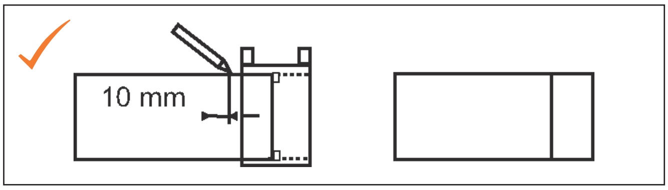


Illustration 8.15

Scrape pipe and mark insertion depth

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

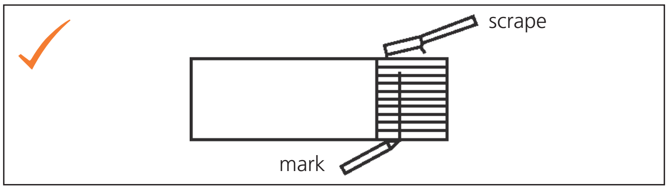


Illustration 8.16

Clean electrofusion coupler

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

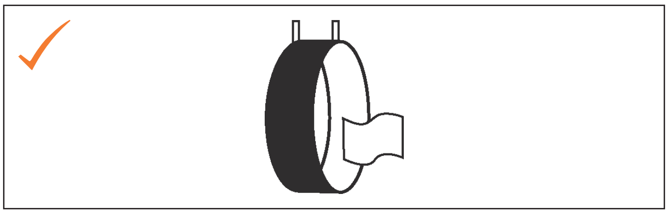


Illustration 8.17

Insert pipe/fitting until marked line

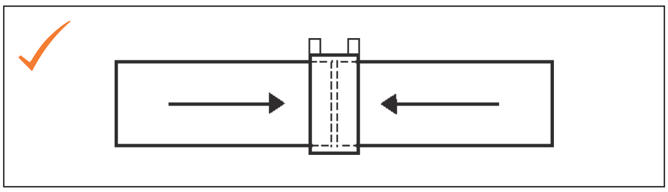


Illustration 8.18

Ensure that the pipe is pushed into the coupler as straight as possible and up to the marked insertion depth. This will ensure that all the wires are covered with HDPE during the fusion cycle.

Prevent misalignment

Misalignment will cause extra load on the fusion zone causing additional HDPE to melt resulting in the outpouring of HDPE or wire movement.

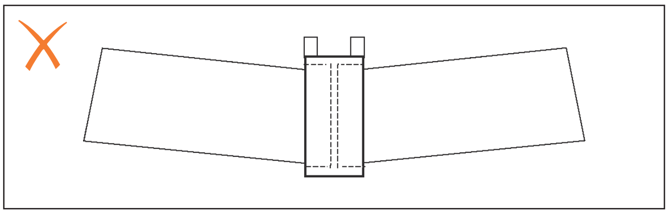


Illustration 8.19

Prevent joint movement during welding

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.

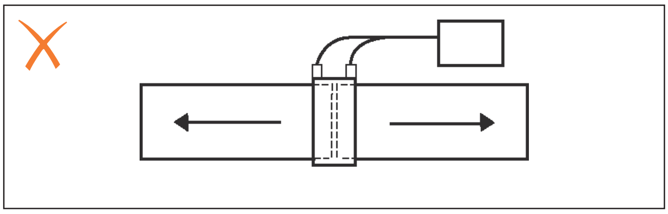


Illustration 8.20

Prevent coupler from sliding down when center stop removed

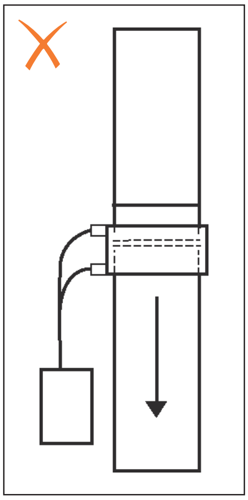


Illustration 8.21

An electrofusion coupler sliding down will cause movement of the wires and possibly a short circuit and thus a bad weld or fire hazard.

Remove vertical loading during welding

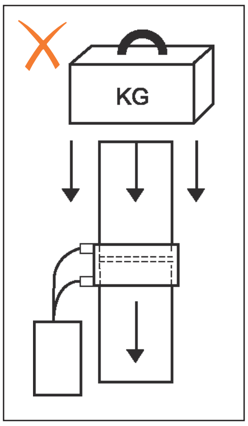


Illustration 8.22

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.

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. For welding times and cooling down times see table 8.3. For extensive instructions see the manual of CB315 and CB160. The joint assembly should not be disturbed during the fusion cycle and for the specified cooling time afterwards.

diameter d_1 mm	system	welding time sec	cooling time min
40-160	Constant current 5A	80	20
200-315	Constant power 220V	420	30

Table 8.3 Welding parameters electrofusion couplers

The full load can only be applied after the complete cooling time.

The cooling period can be reduced by 50% when there is no additional load or strain during cooling.

Never weld a coupler twice

During the fusion cycle the right amount of energy is put in to the fusion zones to make a good electrofusion joint. 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 can even cause fire.

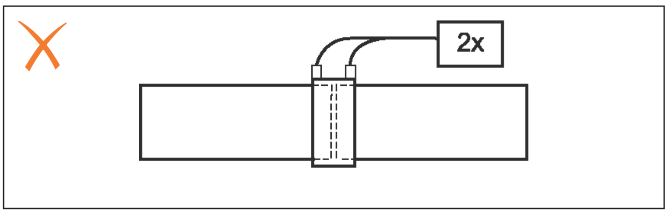


Illustration 8.23

Illustration 8.24

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 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.

A joint can be marked o.k. when the welding indicators are protuded, 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 be touched 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 of pipe and fitting can cause problems during assembly and welding of the components. The maximum allowed deformation of pipe or fitting spigot is 0,02 x d_1. This results in a maximum difference between the largest and smallest diameter corresponding with table 8.4. The pipe or fitting spigot needs to be "rounded" using clamps when the deformation is larger.

diameter d_1	d_1 max - d_1 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 8.4 Deformation pipe

Jointing methods

8.4 Plug-in joint

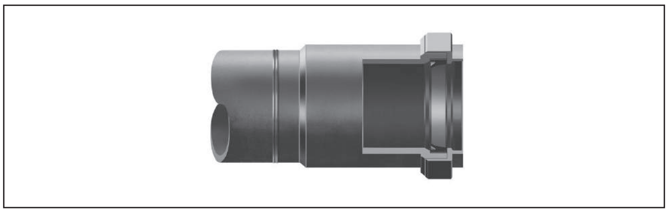


Illustration 8.25

A plug-in joint is an easy to make detachable and not pull-tight jointing method.

Jointing process:

Cut pipe square and remove burr

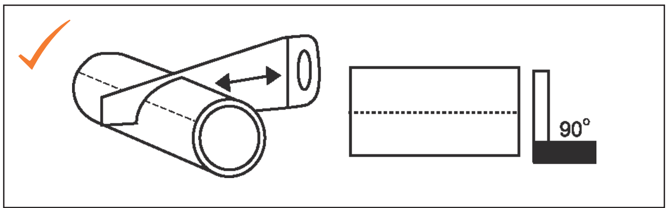
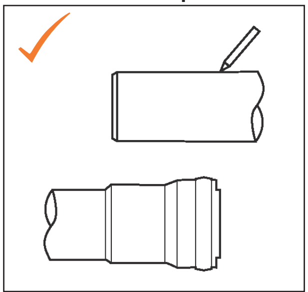


Illustration 8.26

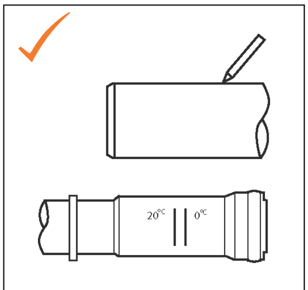
Mark insertion depth



Plug-in socket:
The pipe needs to be inserted in the plug-in socket using the full insertion depth.

A plug-in joint is not to be used to accommodate the expansion and contraction of a pipe system.

Illustration 8.27

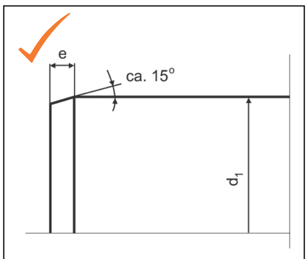


Expansion socket:
A snap-expansion socket is used to accommodate the expansion and contraction in a pipe system.

The insertion depth is marked on the socket for both ambient temperatures of 0° and 20°C. For detailed information see also paragraph 7.4.

Illustration 8.28

Chamfer pipe end



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

Illustration 8.29

Make joint
Lubricate the pipe end and insert the pipe up to the marked insertion depth.

8.5 Snap joint

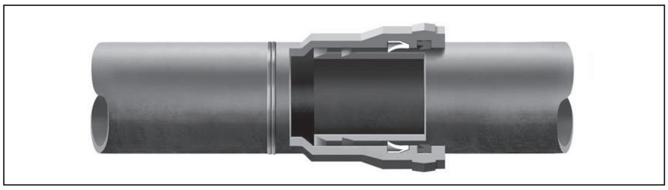


Illustration 8.30

For making pull-tight connections, snap (expansion) sockets are available. These sockets are plug-in sockets with an extra snap ring which provides, in combination with a groove in the pipe, a pull-tight connection.

Jointing process:

Cut pipe square and remove burr

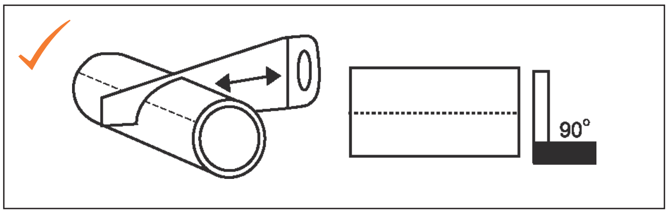
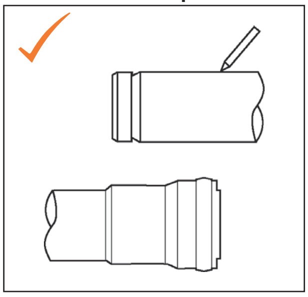


Illustration 8.31

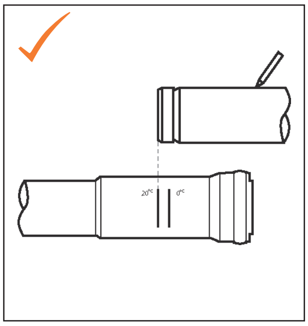
Mark insertion depth



Snap socket:
The pipe needs to be inserted in the snap socket using the full insertion depth.

A snap socket is not to be used to accommodate the expansion and contraction of a pipe system.

Illustration 8.32

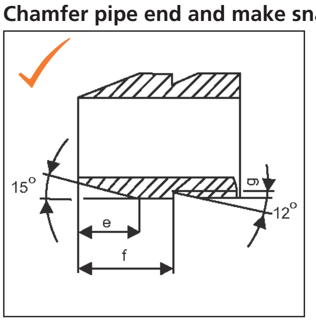


Snap-expansion socket:
Snap-expansion sockets are available from d40 to 75 mm and are used to accommodate the expansion and contraction in a pipe system.

The insertion depth is marked on the socket for both ambient temperatures of 0° and 20°C. For detailed information see also paragraph 7.4.

Illustration 8.33

Chamfer pipe end and make snap groove



The pipe end needs to be chamfered under an angle of 15°. The groove needs to be cut under an angle of 12°.

The correct dimensions can be found in table 8.5. To get an even cut and chamfer it is recommended to use an Akatherm groove cutter.

Illustration 8.34

d_1	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 8.5 Dimensions chamfer and groove

Make joint
Lubricate the pipe end and insert the pipe up to the marked insertion depth. A distinguished click can be heard when the snap ring is inserted in the groove.

Remark:
When the groove is not made, the Akatherm snap and snap-expansion sockets are detachable like a not pull-tight joint.

8.6 Screw-threaded joint

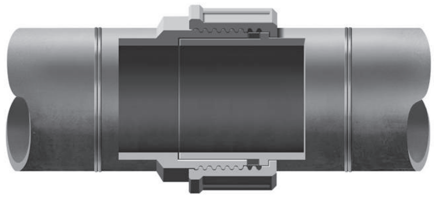


Illustration 8.35

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.

Jointing process:
- **Cut pipe square and remove burr**
- **Disassemble screw threaded joint**
  Yellow 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.

Jointing process:
- **Cut pipe square and remove burr**
- **Disassemble screw threaded joint**
  Yellow 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.

Jointing methods

8.7 Flange joint

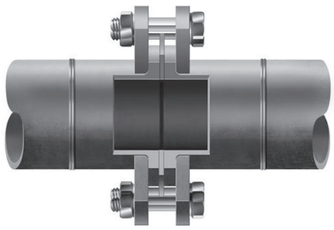


Illustration 8.36

The flanged joint is a detachable joint not that common in soil and waste systems. It is the ideal jointing 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 8.6

d_1 (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 8.6 Bolt torque for non-pressure applications

8.8 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 8.37

8.9 Metal coupling

Illustration 8.38

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

8.10 Pipe-in-pipe joint

A detachable and not pull-tight joint between two pipes with different diameters can easily be made using a rubber collar. A one size collar can be used for several different pipe diameters.

Jointing process:

- Cut pipe square
- Place the rubber collar inside the pipe with the largest diameter
- Place the smaller diameter pipe through the collar

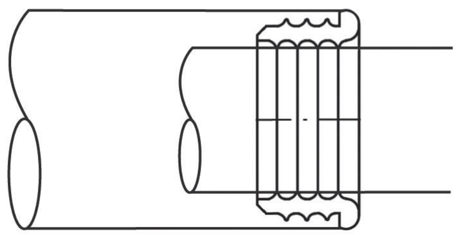


Illustration 8.39

9 Prefabrication

9.1 Choosing to prefabricate

Prefabrication of pipe systems refers to the manufacturing of standardised and factory-made pipe sections in large quantities, which are then assembled during installation on the building site. The fittings and pipe are buttwelded together during prefabrication, after which the prefabricated sections are installed on site.

Advantages:
- Saves time during installation
- Reliable butt-welded joints made under factory conditions

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.

Illustration 9.3 Installation under difficult conditions

9.2 HDPE as a material

Of course, pipe systems can be prefabricated from other materials. The properties of HDPE offer specific advantages as a material for this manner of installation:
- Easy handling due to the light weight of HDPE. A related advantage is the lower transport costs.
- Minimal risk of breakage and deformation during transport and handling because HDPE is a 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.

9.3 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 “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 line at 45° with intervening short lines at each 15°. The pipe is also marked with two continuous lines.

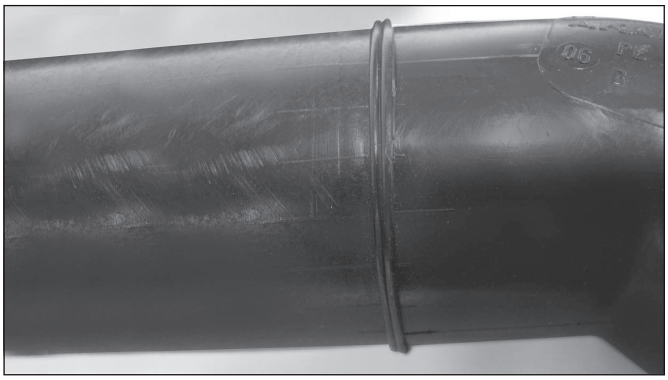


Illustration 9.4 Fitting with graduated arc

Prefabrication

Protection plugs

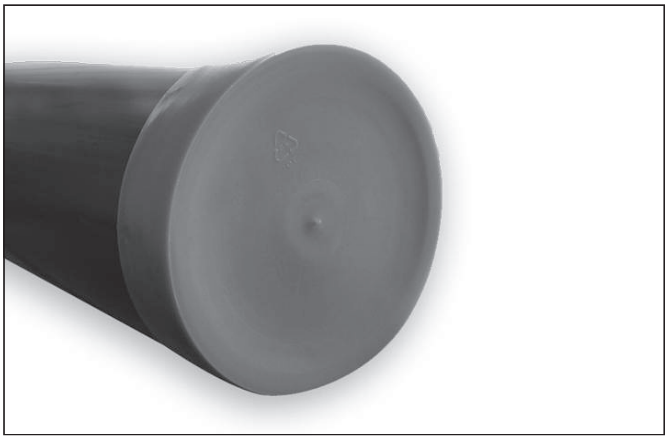


Illustration 9.5 Protection plugs for pipe (Code 40xx29)

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

9.4 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.

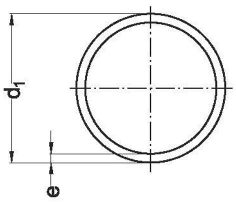
BIM will change the way architects and builders work. By combining the advantages of Akatherm HDPE and the intelligent functions of BIM, pipe systems can be prefabricated. Ultimately saving time and ensuring reliable joints, made under factory conditions.

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.

Pipe tempered HDPE

Pipe length = 5 m

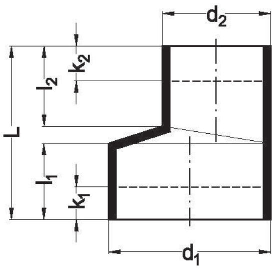


d_1	Code	S	e	A (cm^2)	kg/m
40	**10 04 00**	12,5	3,0	9,1	0,36
50	**10 05 00**	12,5	3,0	15,2	0,45
56	**10 56 00**	12,5	3,0	19,6	0,51
63	**10 06 00**	12,5	3,0	25,5	0,58
75	**10 07 00**	12,5	3,0	37,4	0,70
90	**10 09 00**	12,5	3,5	54,1	0,98
110	**10 11 00**	12,5	4,2	80,7	1,43
125	**10 12 00**	12,5	4,8	104,2	1,85
160	**10 16 00**	12,5	6,2	171,1	3,04
200	**10 20 10**	12,5	7,7	267,6	4,69
250	**10 25 10**	12,5	9,6	418,4	7,30
315	**10 31 10**	12,5	12,1	664,2	11,60
200	**10 20 00**	16	6,2	276,4	3,84
250	**10 25 00**	16	7,7	431,5	5,99
315	**10 31 00**	16	9,7	685,4	9,45

A (cm^2) = cross sectional area of flow.

Fittings

Reducer eccentric HDPE

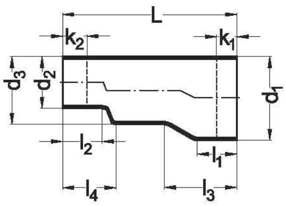


d_1/d_2	Code	L	l_1	l_2	k_1	k_2
50/40	**16 05 04**	80	35	37	20	20
56/40	**16 56 04**	80	35	37	20	20
56/50	**16 56 05**	80	35	37	20	20
63/40	**16 06 04**	80	35	37	20	20
63/50	**16 06 05**	80	35	37	20	20
63/56	**16 06 56**	80	35	37	20	20
75/40	**16 07 04**	80	35	30	20	20
75/50	**16 07 05**	80	35	37	20	20
75/56	**16 07 56**	80	35	37	20	20
75/63	**16 07 06**	80	35	37	20	20
90/40	**16 09 04**	80	30	33	20	20
90/50	**16 09 05**	80	30	34	20	20
90/56	**16 09 56**	80	30	36	20	20
90/63	**16 09 06**	80	30	39	20	20
90/75	**16 09 07**	80	30	44	20	20
110/40	**16 11 04**	80	31	34	20	20
110/50	**16 11 05**	80	31	34	20	20
110/56	**16 11 56**	80	31	35	20	20
110/63	**16 11 06**	80	31	34	20	20
110/75	**16 11 07**	80	31	36	20	20
110/90	**16 11 09**	80	31	41	20	20
125/50	**16 12 05**	80	35	37	20	20
125/56	**16 12 56**	80	35	37	20	20
125/63	**16 12 06**	80	35	37	20	20
125/75	**16 12 07**	80	35	30	20	20
125/90	**16 12 09**	80	35	32	20	20
125/110	**16 12 11**	80	36	36	20	20
160/110	**16 16 11**	80	28	36	20	20
160/125	**16 16 12**	80	32	36	20	20

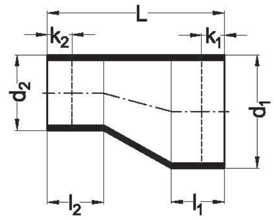
Reducer eccentric long HDPE

d_1/d_2	Code	Type	L	l_1	l_2	l_3	l_4	d_3	k_1	k_2
200/110	**14 20 11**	A	335	95	36	165	55	160	75	20
200/125	**14 20 12**	A	335	95	36	165	55	160	75	20
200/160	**14 20 16**	B	260	95	95				75	75
250/200	**14 25 20**	B	290	105	95				85	75
315/200	**14 31 20**	A	580	115	95	235	190	250	95	75
315/250	**14 31 25**	B	340	115	105				75	85

A



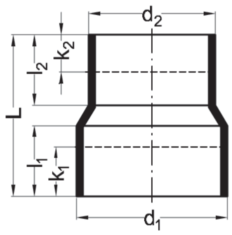
B



![akatherm]

Fittings

Reducer concentric HDPE

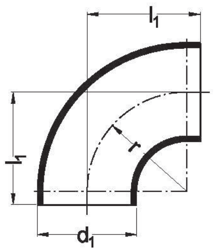


d_1/d_2	Code		L	l_1	l_2	k_1	k_2
40/32	**15 04 03**		80	30	30	15	15
50/32	**15 05 03**		80	30	30	15	15
50/40	**15 05 04**		80	30	30	15	15
56/40	**15 56 04**		80	30	30	15	15
56/50	**15 56 05**		80	30	30	15	15
63/40	**15 06 04**		80	30	30	15	15
63/50	**15 06 05**		80	30	30	15	15
63/56	**15 06 56**		80	30	30	15	15
75/40	**15 07 04**		80	30	30	15	15
75/50	**15 07 05**		80	30	30	15	15
75/56	**15 07 56**		80	30	30	15	15
75/63	**15 07 06**		80	30	30	15	15
90/40	**15 09 04**		80	30	30	15	15
90/50	**15 09 05**		80	30	28	15	15
90/56	**15 09 56**		80	30	30	15	15
90/63	**15 09 06**		80	30	30	15	15
90/75	**15 09 07**		80	30	28	15	15
110/40	**15 11 04**		80	30	30	15	15
110/50	**15 11 05**		80	30	30	15	15
110/56	**15 11 56**		80	30	30	15	15
110/63	**15 11 06**		80	30	30	15	15
110/75	**15 11 07**		80	30	30	15	15
110/90	**15 11 09**		80	30	30	15	15
125/50	**15 12 05**		80	30	30	15	15
125/56	**15 12 56**		80	30	30	15	15
125/63	**15 12 06**		80	30	30	15	15
125/75	**15 12 07**		80	30	30	15	15
125/90	**15 12 09**		80	30	30	15	15
125/110	**15 12 11**		80	35	30	15	15
160/110	**15 16 11**		80	35	30	15	15
160/125	**15 16 12**		80	39	30	15	15
200/160	**15 20 16**	1)	149	50	40	40	30
250/160	**15 25 16**	1)	194	60	40	50	30
250/200	**15 25 20**	1)	182	60	50	50	40
315/200	**15 31 20**	1)	230	90	80	80	70
315/250	**15 31 25**	1)	230	90	90	80	80

1) *butt-weld only*

Bend 90°

HDPE

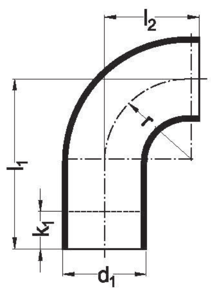


d_1	Code		l_1	r
160	**11 16 91**	1)	160	160
200	**11 20 91**	1)	205	200
250	**11 25 91**	1)	290	265
315	**11 31 91**	1)	340	300

1) *butt-weld only*

Bend 90° with long side

HDPE



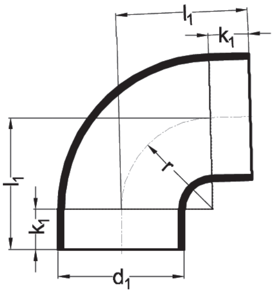
d_1	Code		l_1	l_2	r	k_1
40	**11 04 92**	1)	93	43	40	45
50	**11 05 92**	1)	103	53	50	45
56	**11 56 92**	1)	120	59	56	55
63	**11 06 92**	1)	130	66	65	60
75	**11 07 92**	1)	140	78	75	60
90	**11 09 92**	1)	153	93	90	60
110	**11 11 96**	1)	270	100	100	170
125	**11 12 92**	1)	190	128	125	60

1) *electrofusable at one side*

Fittings

Bend 88,5° electrofusable

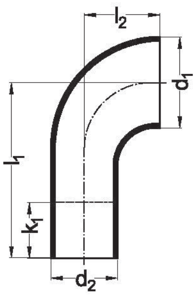
HDPE



d_1	Code	l_1	l_2	r	k_1
110	**11 11 98**	116	116	80	25

Bend reduced 90°

HDPE



d_1/d_2	Code		l_1	l_2	k_1
50/40	**17 05 04**	1)	90	40	40
63/50	**17 06 05**	1)	119	50	50

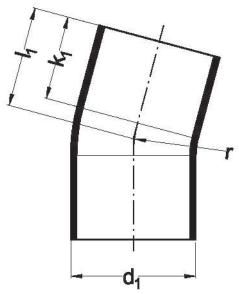
1) *electrofusable at one side*

Bend 15°

HDPE

welded version

d_1	Code	l_1	r	k_1
110	**18 11 15**	125	165	65
125	**18 12 15**	150	188	45
160	**18 16 15**	175	240	100
200	**18 20 15**	200	300	125
250	**18 25 15**	225	375	135
315	**18 31 15**	250	473	175

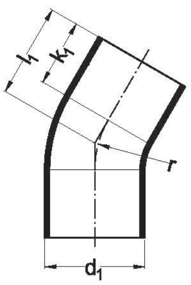


Bend 30°

HDPE

welded version

d_1	Code	l_1	r	k_1
110	**18 11 30**	125	165	60
125	**18 12 30**	150	188	85
160	**18 16 30**	175	240	100
200	**18 20 30**	200	200	115
250	**18 25 30**	225	255	125
315	**18 31 30**	250	320	135



Fittings

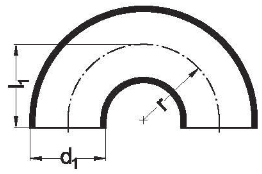
Bend 180°

HDPE

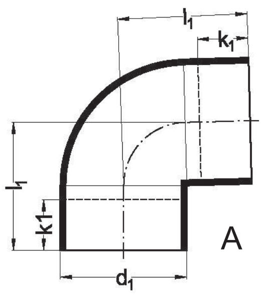
d_1	Code		l_1	r
40	**11 04 99**	1)	38	40
50	**11 05 99**	1)	55	50
56	**11 56 99**	1)	47	49
63	**11 06 99**	1)	60	64

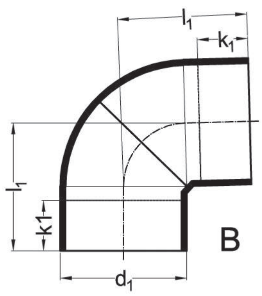
1) *butt-weld only*

Bends 180° are suitable for the fabrication of traps.



Elbow 88,5° HDPE





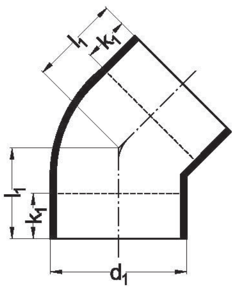
d_1	Code		Type	l_1	k_1
40	**12 04 88**		A	55	25
50	**12 05 88**		A	60	20
56	**12 56 88**		A	65	20
63	**12 06 88**		A	70	20
75	**12 07 88**		A	75	20
90	**12 09 88**		A	80	20
110	**12 11 88**		A	95	25
125	**12 12 88**		A	100	25
160	**12 16 88**		A	120	25
200	**12 20 88**	1)	B	290	60
250	**12 25 88**	2)	B	350	60
315	**12 31 88**	2)	B	360	60

1) *fabricated*

2) *fabricated / wall thickness e according to S12,5*

Fittings

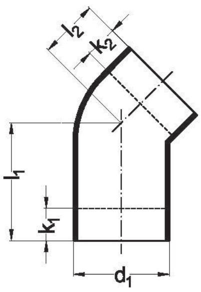
Elbow 45° HDPE



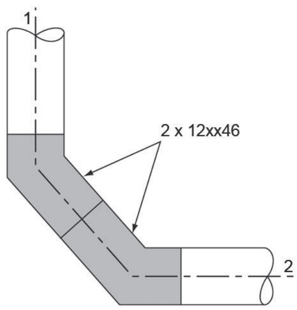
d_1	Code		l_1	k_1
40	**12 04 45**		40	20
50	**12 05 45**		45	20
56	**12 56 45**		45	20
63	**12 06 45**		50	20
75	**12 07 45**		50	20
90	**12 09 45**		55	20
110	**12 11 45**		60	25
125	**12 12 45**		65	25
160	**12 16 45**		69	20
200	**12 20 45**		173	60
250	**12 25 45**	1)	182	60
315	**12 31 45**	1)	195	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	**12 07 46**	145	50	120	25
90	**12 09 46**	150	55	120	25
110	**12 11 46**	147	60	120	25

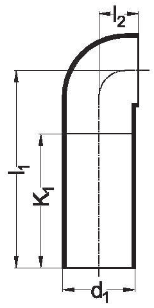


Elbows 45° with long side are applied for making the transition from stack to building drain acc. to EN 12056 (see drawing).

1 stack
2 building drain

Elbow 90° with long side

HDPE



d_1	Code		l_1	l_2	k_1
90	**12 09 93**	1)	270	50	175
110	**12 11 93**	1)	300	60	220

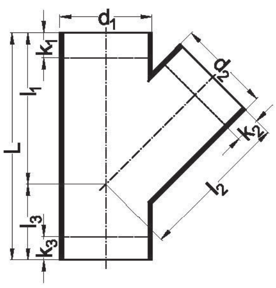
1) *electrofusable at one side*

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

Fittings

Y-branch 45°

HDPE



d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
40/40	**30 04 04**		135	90	45	30	30	25
50/40	**30 05 04**		165	110	55	45	45	40
50/50	**30 05 05**		165	110	55	20	20	35
56/40	**30 56 04**		180	120	60	35	30	60
56/50	**30 56 05**		180	120	60	30	30	40
56/56	**30 56 56**		180	120	60	25	25	40
63/40	**30 06 04**		195	130	65	40	45	45
63/50	**30 06 05**		195	130	65	30	30	50
63/56	**30 06 56**		195	130	65	25	25	45
63/63	**30 06 06**		195	130	65	20	20	40
75/40	**30 07 04**		210	140	70	60	50	65
75/50	**30 07 05**		210	140	70	40	30	70
75/56	**30 07 56**		210	140	70	35	25	55
75/63	**30 07 06**		210	140	70	35	25	45
75/75	**30 07 07**		210	140	70	25	25	40
90/40	**30 09 04**		240	160	80	65	55	75
90/50	**30 09 05**		240	160	80	50	40	80
90/56	**30 09 56**		240	160	80	45	35	75
90/63	**30 09 06**		240	160	80	40	30	70
90/75	**30 09 07**		240	160	80	35	30	65
90/90	**30 09 09**		240	160	80	20	20	50
110/40	**30 11 04**		270	180	90	75	60	95
110/50	**30 11 05**		270	180	90	55	50	95
110/56	**30 11 56**		270	180	90	45	40	90
110/63	**30 11 06**		270	180	90	40	35	85
110/75	**30 11 07**		270	180	90	35	30	75
110/90	**30 11 09**		270	180	90	30	25	65
110/110	**30 11 11**		270	180	90	20	20	55
125/40	**30 12 04**		300	200	100	115	60	75
125/50	**30 12 05**		300	200	100	115	60	75
125/56	**30 12 56**		300	200	100	110	50	45
125/63	**30 12 06**		300	200	100	60	45	105
125/75	**30 12 07**		300	200	100	50	40	95
125/90	**30 12 09**		300	200	100	35	30	30
125/110	**30 12 11**		300	200	100	25	25	25
125/125	**30 12 12**		300	200	100	20	20	20
160/50	**30 16 05**	1)	375	250	125	120	115	65
160/56	**30 16 56**	1)	375	250	125	120	115	65
160/63	**30 16 06**	1)	375	250	125	120	115	65
160/75	**30 16 07**		375	250	125	120	115	65
160/90	**30 16 09**		375	250	125	110	105	55
160/110	**30 16 11**		375	250	125	50	40	45
160/125	**30 16 12**		375	250	125	10	20	40
160/160	**30 16 16**		375	250	125	10	15	25
200/50	**30 20 05**	2)	540	360	180	95	15	175
200/56	**30 20 56**	2)	540	360	180	95	15	175
200/63	**30 20 06**	2)	540	360	180	95	15	175
200/75	**30 20 07**	3)	540	360	180	95	160	175
200/90	**30 20 09**	3)	540	360	180	80	150	165

1) *fabricated*

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

3) *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
200/110	**30 20 11**	3)	540	360	180	65	140	150
200/125	**30 20 12**	3)	540	360	180	55	130	140
200/160	**30 20 16**	3)	540	360	180	35	85	115
200/200	**30 20 20**	3)	555	375	180	0	0	95
250/75	**30 25 07**	1)	660	440	220	170	205	235
250/90	**30 25 09**	1)	660	440	220	160	195	225
250/110	**30 25 11**	1)	660	440	220	150	185	215
250/125	**30 25 12**	1)	660	440	220	140	175	205
250/160	**30 25 16**	1)	660	440	220	120	130	180
250/200	**30 25 20**	1)	660	440	220	90	50	150
250/250	**30 25 25**	1)	900	600	300	160	160	250
315/75	**30 31 07**	1)	840	560	280	255	280	325
315/90	**30 31 09**	1)	840	560	280	245	270	315
315/110	**30 31 11**	1)	840	560	280	235	260	305
315/125	**30 31 12**	1)	840	560	280	220	250	290
315/160	**30 31 16**	1)	840	560	280	200	205	270
315/200	**30 31 20**	1)	840	560	280	175	125	240
315/250	**30 31 25**	1)	840	560	280	140	130	205
315/315	**30 31 31**	1)	950	610	340	170	170	280

1) *fabricated*

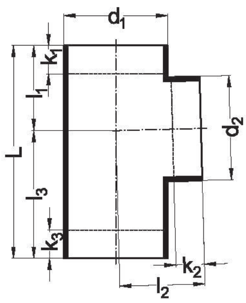
2) *fabricated from branch 200/75 mm with concentric reducer*

3) *wall thickness e according to S12,5*

Fittings

Branch 88,5°

HDPE



d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
40/40	**20 04 04**		130	55	75	25	25	45
50/40	**20 05 04**		150	60	90	30	25	60
50/50	**20 05 05**		150	60	90	25	25	55
56/50	**20 56 05**		175	70	105	35	30	70
56/56	**20 56 56**		175	70	105	30	30	65
63/40	**20 06 04**		175	70	105	30	30	70
63/50	**20 06 05**		175	70	105	35	30	70
63/56	**20 06 56**		175	70	105	30	30	65
63/63	**20 06 06**		175	70	105	30	30	60
75/40	**20 07 04**		175	70	105	40	25	75
75/50	**20 07 05**		175	70	105	35	25	70
75/56	**20 07 56**		175	70	105	30	25	65
75/63	**20 07 06**		175	70	105	25	25	60
75/75	**20 07 07**		175	70	105	25	25	55
90/40	**20 09 04**		200	80	120	45	25	85
90/50	**20 09 05**		200	80	120	45	25	85
90/56	**20 09 56**		200	80	120	40	25	85
90/63	**20 09 06**		200	80	120	35	25	80
90/75	**20 09 07**		200	80	120	30	25	75
90/90	**20 09 09**		200	80	120	25	25	70
110/40	**20 11 04**		225	90	135	60	25	100
110/50	**20 11 05**		225	90	135	50	25	95
110/56	**20 11 56**		225	90	135	45	25	90
110/63	**20 11 06**		225	90	135	40	25	90
110/75	**20 11 07**		225	90	135	35	25	85
110/90	**20 11 09**		225	90	135	30	25	75
110/110	**20 11 11**		225	90	135	20	20	65
125/50	**20 12 05**	1)	250	100	150	60	25	110
125/56	**20 12 56**	1)	250	100	150	55	25	105
125/63	**20 12 06**	1)	250	100	150	50	25	105
125/75	**20 12 07**		250	100	150	45	25	100
125/90	**20 12 09**		250	100	150	40	25	90
125/110	**20 12 11**		250	100	150	30	20	80
125/125	**20 12 12**		250	100	150	20	20	70
160/50	**20 16 05**	1)	350	140	210	75	30	145
160/56	**20 16 56**	1)	350	140	210	75	30	145
160/63	**20 16 06**	1)	350	140	210	65	30	140
160/75	**20 16 07**	1)	350	140	210	80	45	150
160/90	**20 16 09**	1)	350	140	210	55	30	125
160/110	**20 16 11**		350	140	210	60	45	135
160/125	**20 16 12**		350	140	210	50	45	125
160/160	**20 16 16**		350	140	210	30	35	105
200/75	**20 20 07**	1)	360	180	180	90	60	90
200/90	**20 20 09**	1)	360	180	180	80	60	80
200/110	**20 20 11**	1)	360	180	180	70	60	70
200/125	**20 20 12**	1)	360	180	180	65	60	65
200/160	**20 20 16**	1)	360	180	180	45	60	45
200/200	**20 20 20**	1)	360	180	180	25	60	25
250/110	**20 25 11**	1)	440	220	220	110	70	110
250/125	**20 25 12**	1)	440	220	220	105	70	105
250/160	**20 25 16**	1)	440	220	220	85	70	85

1) *fabricated*

-- to be continued --

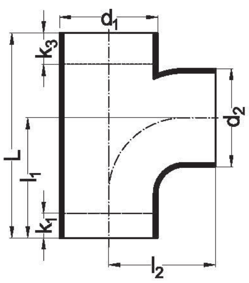
Branch 88,5° - continuation -

d_1/d_2	Code		L	l_1/l_2	l_3	k_1	k_2	k_3
250/200	**20 25 20**	1)	480	240	240	65	40	65
250/250	**20 25 25**	1)	480	240	240	40	40	40
315/110	**20 31 11**	1)	560	280	280	170	90	170
315/125	**20 31 12**	1)	560	280	280	165	90	165
315/160	**20 31 16**	1)	560	280	280	145	90	145
315/200	**20 31 20**	1)	560	280	280	120	65	120
315/250	**20 31 25**	1)	560	280	280	95	65	95
315/315	**20 31 31**	1)	560	280	280	70	65	70

1) *fabricated*

Branch swept entry 88,5°

HDPE



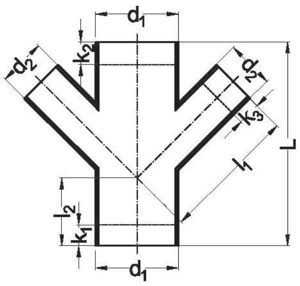
d_1/d_2	Code	L	l_1	l_2	k_1	k_3
110/110	**25 11 11**	225	135	130	30	30

Fittings

Double branch 45°

HDPE

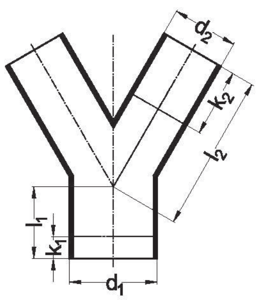
d_1/d_2	Code	L	l_1	l_2	k_1	k_2	k_3
110/40	**36 11 04**	270	180	100	110	65	45
110/50	**36 11 05**	270	180	100	100	65	45
110/110	**36 11 11**	270	180	100	65	20	20



Y-piece 60°

HDPE

d_1/d_2	Code	l_1	l_2	k_1	k_2
50/40	**37 05 04**	55	110	40	50
63/50	**37 06 05**	65	130	50	60
110/110	**37 11 11**	90	102	-	-

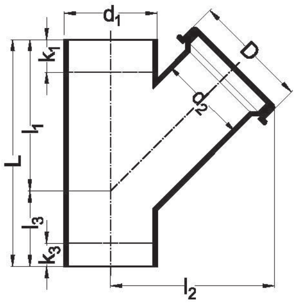


Clean out branch 45°

HDPE

d_1/d_2	Code	D	L	l_1	l_2	l_3	k_1	k_3
110/110	**33 11 00**	140	270	180	195	90	20	55
125/110	**33 12 00**	140	300	200	200	100	25	25
160/110	**33 16 00**	140	375	250	220	125	45	45

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

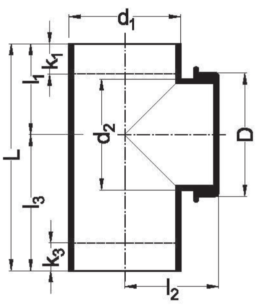


Clean out branch 90°

HDPE

d_1/d_2	Code	D	L	l_1	l_2	l_3	k_1	k_3
40/40	**23 04 00**	64	130	55	80	75	25	45
50/50	**23 05 00**	72	150	60	72	90	25	55
56/56	**23 56 00**	83	175	70	100	105	30	65
63/63	**23 06 00**	87	175	70	100	105	30	60
75/75	**23 07 00**	91	175	70	100	105	25	55
90/90	**23 09 00**	118	200	80	100	120	25	70
110/110	**23 11 20**	127	225	90	105	135	20	65
125/110	**23 12 00**	140	250	100	123	150	20	80
160/110	**23 16 20**	134	350	140	120	210	60	135
200/110	**23 20 00**	140	360	180	160	180	90	90
250/110	**23 25 00**	140	440	220	185	220	110	110
315/110	**23 31 00**	140	560	280	220	280	170	170

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



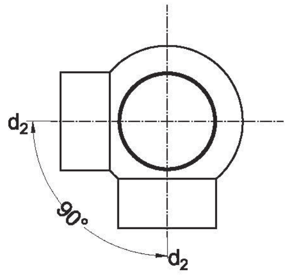
Fittings

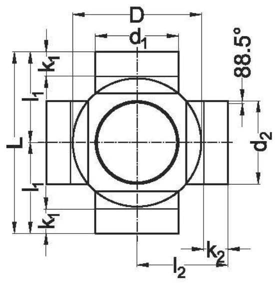
Double ball branch 88,5° - 90°

HDPE

fabricated - 90°

d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 14**	275	135	140	170	30	15
110/56	**24 11 15**	275	135	140	170	30	15
110/63	**24 11 16**	275	135	140	170	30	15
110/75	**24 11 17**	275	135	140	170	30	15
110/90	**24 11 19**	275	135	140	170	30	15
110/110	**24 11 01**	275	135	140	170	30	30
125/50	**24 12 14**	260	130	145	190	30	20
125/56	**24 12 15**	260	130	145	190	30	20
125/75	**24 12 17**	260	130	145	190	30	20
125/110	**24 12 01**	260	130	125	190	30	40
125/125	**24 12 12**	260	130	125	190	30	40





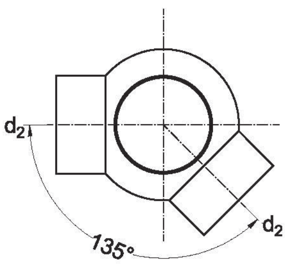
Double ball branches can be applied in soil and waste stacks.

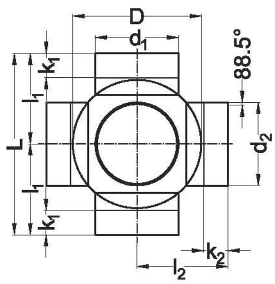
Double ball branch 88,5° - 135°

HDPE

fabricated - 135°

d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 24**	275	135	140	170	30	15
110/56	**24 11 25**	275	135	140	170	30	15
110/63	**24 11 26**	275	135	140	170	30	15
110/75	**24 11 27**	275	135	140	170	30	15
110/90	**24 11 29**	275	135	140	170	30	15
110/110	**24 11 02**	275	135	140	170	30	30
125/50	**24 12 24**	260	130	145	190	30	20
125/56	**24 12 25**	260	130	145	190	30	20
125/75	**24 12 27**	260	130	145	190	30	20
125/110	**24 12 02**	260	130	125	190	30	40
125/125	**24 12 22**	260	130	125	190	30	40





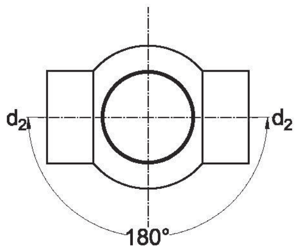
Double ball branches can be applied in soil and waste stacks.

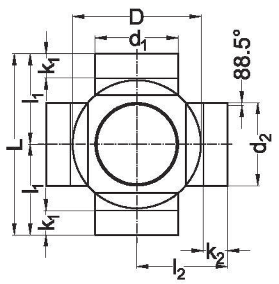
Double ball branch 88,5° - 180°

HDPE

fabricated - 180°

d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 34**	275	135	140	170	30	15
110/56	**24 11 35**	275	135	140	170	30	15
110/63	**24 11 36**	275	135	140	170	30	15
110/75	**24 11 37**	275	135	140	170	30	15
110/90	**24 11 39**	275	135	140	170	30	15
110/110	**24 11 03**	275	135	140	170	30	30
125/50	**24 12 34**	260	130	145	190	30	20
125/56	**24 12 35**	260	130	145	190	30	20
125/75	**24 12 37**	260	130	145	190	30	20
125/110	**24 12 03**	260	130	125	190	30	40
125/125	**24 12 32**	260	130	125	190	30	40





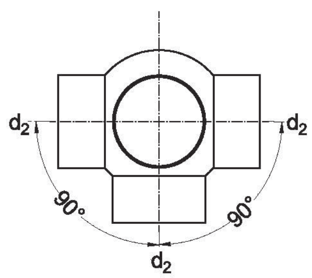
Double ball branches can be applied in soil and waste stacks.

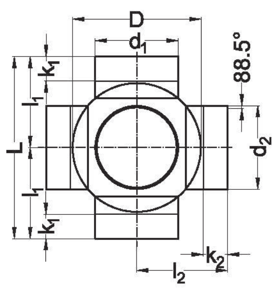
Triple ball branch 88,5° - 90°

HDPE

fabricated - 90°

d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**34 11 14**	275	135	140	170	30	15
110/56	**34 11 15**	275	135	140	170	30	15
110/63	**34 11 16**	275	135	140	170	30	15
110/75	**34 11 17**	275	135	140	170	30	15
110/90	**34 11 19**	275	135	140	170	30	15
110/110	**34 11 01**	275	135	140	170	30	30
125/50	**34 12 14**	260	130	145	190	30	20
125/56	**34 12 15**	260	130	145	190	30	20
125/75	**34 12 17**	260	130	145	190	30	20
125/110	**34 12 01**	260	130	125	190	30	40
125/125	**34 12 12**	260	130	125	190	30	40





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

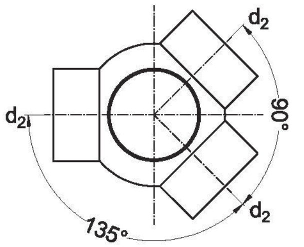
akatherm

Fittings

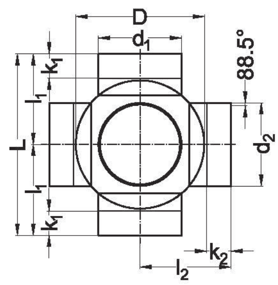
Triple ball branch 88,5° - 135°

HDPE

fabricated - 135°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**34 11 24**	275	135	140	170	30	15
110/56	**34 11 25**	275	135	140	170	30	15
110/63	**34 11 26**	275	135	140	170	30	15
110/75	**34 11 27**	275	135	140	170	30	15
110/90	**34 11 29**	275	135	140	170	30	15
110/110	**34 11 02**	275	135	140	170	30	30
125/50	**34 12 24**	260	130	145	190	30	20
125/56	**34 12 25**	260	130	145	190	30	20
125/75	**34 12 27**	260	130	145	190	30	20
125/110	**34 12 02**	260	130	125	190	30	40
125/125	**34 12 22**	260	130	125	190	30	40

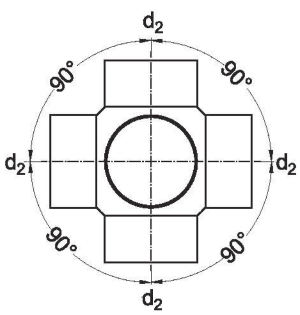


Triple ball branches can be applied in soil and waste stacks.

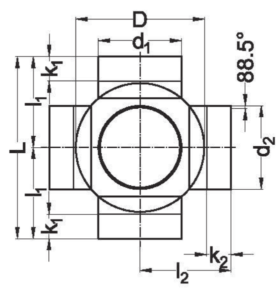
Fourfold ball branch 88,5° - 90°

HDPE

fabricated - 90°



d_1/d_2	Code	L	l_1	l_2	D	k_1	k_2
110/50	**44 11 14**	275	135	140	170	30	15
110/56	**44 11 15**	275	135	140	170	30	15
110/63	**44 11 16**	275	135	140	170	30	15
110/75	**44 11 17**	275	135	140	170	30	15
110/90	**44 11 19**	275	135	140	170	30	15
110/110	**44 11 01**	275	135	140	170	30	30
125/50	**44 12 14**	260	130	145	190	30	20
125/56	**44 12 15**	260	130	145	190	30	20
125/75	**44 12 17**	260	130	145	190	30	20
125/110	**44 12 01**	260	130	125	190	30	40
125/125	**44 12 12**	260	130	125	190	30	40



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

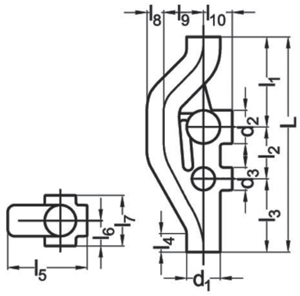
Stack-aerator

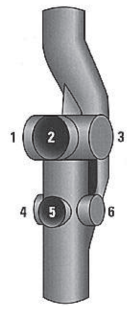
HDPE

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	**60 11 17** [1]	75	705	295	170	240	60	279	89	178	55	130	94
160/110	**60 16 17** [1]	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*

2) *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.

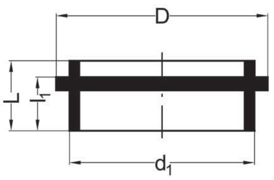
Fittings

End cap HDPE

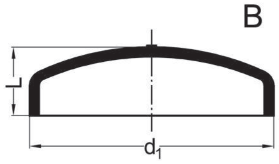
d_1	Code	Type	L	D	l_1
40	**67 04 07** [1]	A	15	46	11
50	**67 05 07** [1]	A	16	57	12
56	**67 56 07** [1]	A	16	64	12
63	**67 06 07** [1]	A	18	71	14
75	**67 07 07** [1]	A	21	85	16
90	**67 09 07** [1]	A	19	100	19
110	**67 11 07** [1]	A	19	120	19
125	**67 12 09** [1]	B	50		
160	**67 16 09** [1]	B	38		
200	**67 20 09** [1]	B	50		
250	**67 25 09** [1]	B	30		
315	**67 31 09** [1]	B	30		

[1] *butt-weld only*

A

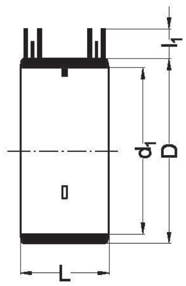


B



Electrofusion coupler

HDPE



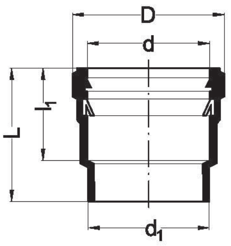
d_1	Code	D	L	l_1	System
40	**41 04 95**	52	54	22	5A/80s
50	**41 05 95**	62	54	22	5A/80s
56	**41 56 95**	68	54	22	5A/80s
63	**41 06 95**	75	54	22	5A/80s
75	**41 07 95**	87	54	22	5A/80s
90	**41 09 95**	102	56	22	5A/80s
110	**41 11 95**	123	60	16	5A/80s
125	**41 12 95**	137	66	22	5A/80s
160	**41 16 95**	172	66	22	5A/80s
200	**41 20 65**	233	175	31	220V/420s
250	**41 25 65**	283	175	31	220V/420s
315	**41 31 65**	349	175	31	220V/420s

The Akatherm 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.

Connecting fittings

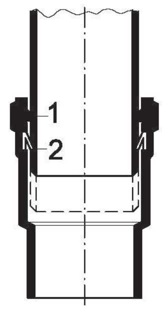
Snap socket HDPE
with protection plug

SBR seal



d_1	Code		D	d	L	l_1
40	**40 04 10**	1)	55	41	73	55
50	**40 05 10**	1)	65	51	77	55
63	**40 06 10**	1)	78	64	90	70
75	**40 07 10**	1)	90	76	90	70
90	**40 09 10**	1)	110	91	90	70
110	**40 11 10**	1)	130	111	90	70
125	**40 12 10**	1)	150	126	94	70
160	**40 16 10**	1)	190	162	134	105
200	**40 20 10**	1)	230	202	155	125

1) *butt-weld only*



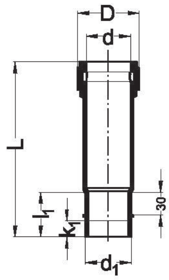
The snap socket can be used as a plug-in connection and a pull tight connection. The snap ring (besides the rubber sealing ring) provides the possibility to make a pull tight connection between pipe and snap socket, provided that a groove is cut into the pipe with a groove cutter (see chapter Tools).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

1 sealing ring
2 snap ring

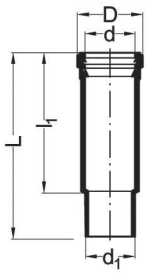
Expansion socket with anchor point
with protection plug

HDPE

SBR seal



A

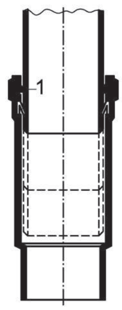


B

d_1	Code		Type	D	d	L	l_1	k_1
40	**40 04 20**		B	58	41	172	135	
50	**40 05 20**		B	68	51	172	135	
56	**40 56 20**		B	74	57	172	135	
63	**40 06 20**	1)	B	78	64	155	135	
75	**42 07 20**		A	100	76	256	75	35
90	**42 09 20**		A	116	91	256	75	35
110	**42 11 20**		A	137	112	256	75	35
125	**42 12 20**		A	153	127	256	75	35
160	**42 16 20**		A	189	162	265	75	35
200	**40 20 20**	2)	B	230	202	310	245	
250	**40 25 20**	2)	B	300	253	330	265	
315	**40 31 20**	2)	B	370	319	360	290	

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.

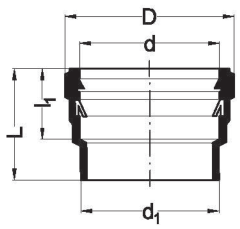
Expansion sockets of type A are equipped with an anchor point chamber of 30 mm which encloses the wall bracket and fixates it.

Connecting fittings

Snap socket
with protection plug

HDPE

SBR seal



d_1	Code		D	d	L	l_1
110	**40 11 40**	1)	130	111	55	45

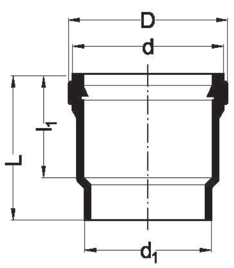
1) *butt-weld only*

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

HDPE

SBR seal



d_1	Code	D	d	L	l_1
40	**42 04 50**	53	41	93	54
50	**42 05 50**	67	51	89	54
56	**42 56 50**	72	57	89	54
63	**42 06 50**	84	64	104	69
75	**42 07 50**	96	76	109	69
90	**42 09 50**	110	91	109	69
110	**42 11 50**	128	119	101	60
125	**42 12 50**	150	126	114	70
160	**42 16 50**	190	162	151	105

Connecting fittings

Screw coupler short

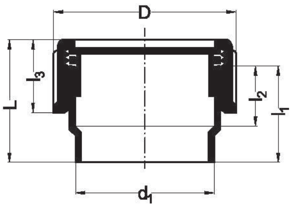
complete with threaded piece, nut, pressure ring and sealing ring

HDPE

EPDM seal

d_1	Code		D	L	l_1	l_2	l_3
40	**43 04 30**	1)	66	71	56	32	33
50	**43 05 30**	1)	76	71	56	32	33
56	**43 56 30**	1)	82	71	56	32	35
63	**43 06 30**	1)	89	76	61	37	42
75	**43 07 30**	1)	103	81	65	37	44
90	**43 09 30**	1)	122	92	75	45	48
110	**43 11 30**	1)	148	97	80	49	62

1) *butt-weld only*

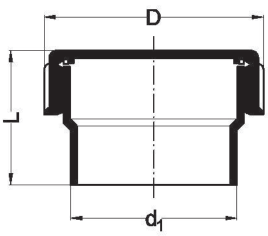


Inspection screw lock long

HDPE

EPDM seal

d_1	Code	D	L
40	**66 04 40**	66	85
50	**66 05 40**	76	85
56	**66 56 40**	82	85
63	**66 06 40**	89	90
75	**66 07 40**	103	91
90	**66 09 40**	122	102
110	**66 11 40**	148	107

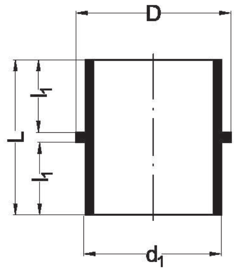


Connecting fittings

Flange bushing for screw coupler

HDPE

d_1	Code	D	L	l_1
40	**43 04 05**	45	58	27
50	**43 05 05**	56	66	31
56	**43 56 05**	63	64	30
63	**43 06 05**	69	73	34
75	**43 07 05**	84	81	38
90	**43 09 05**	99	101	48
110	**43 11 05**	119	112	53



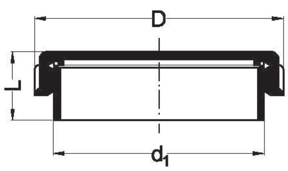
Inspection screw lock short

HDPE

EPDM seal

d_1	Code		D	L
75	**66 07 00**	1)	91	48
110	**66 11 20**	1)	133	53

1) *butt-weld only*



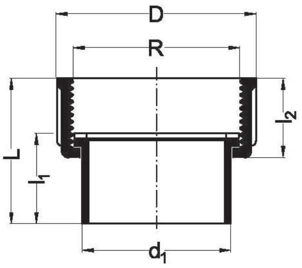
Waste connector
with nut and seal

HDPE

SBR seal

d_1	Code		R	L	l_1	l_2	D
32	**98 03 81**	1)	1 ¼"	35	21	21	54
40	**98 04 82**	1)	1 ½"	38	25	21	59
50	**98 05 83**	1)	2"	44	30	21	72

1) *butt-weld only*

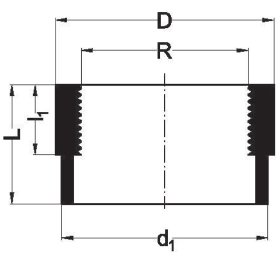


Female thread adaptor short

HDPE

d_1	Code		R	L	l_1	D
40	**91 04 78**	1)	½"	38	30	40
40	**91 04 79**	1)	¾"	38	30	40
40	**91 04 80**	1)	1"	38	30	45
40	**91 04 81**	1)	1 ¼"	38	30	55
50	**91 05 80**	1)	1"	38	30	50
50	**91 05 81**	1)	1 ¼"	38	30	55
50	**91 05 82**	1)	1 ½"	38	30	63
63	**91 06 82**	1)	1 ½"	38	30	63
63	**91 06 83**	1)	2"	38	30	75

1) *butt-weld only*



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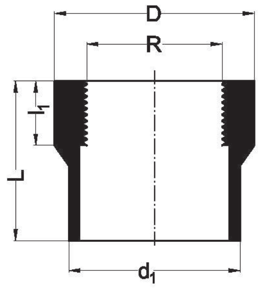
Connecting fittings

Female thread adaptor long

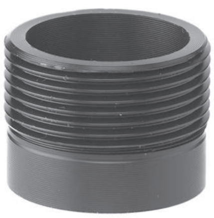
HDPE

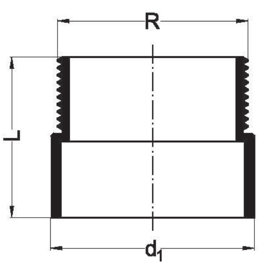


d_1	Code	R	L	l_1	D
40	**92 04 78**	½"	55	30	40
40	**92 04 79**	¾"	70	30	40
40	**92 04 80**	1"	70	30	45
40	**92 04 81**	1 ¼"	70	30	55
50	**92 05 78**	½"	60	30	50
50	**92 05 79**	¾"	60	30	40
50	**92 05 80**	1"	70	30	50
50	**92 05 81**	1 ¼"	70	30	55
50	**92 05 82**	1 ½"	70	30	63
50	**92 05 83**	2"	70	30	75
56	**92 56 83**	2"	70	30	75
63	**92 06 82**	1 ½"	70	30	63
63	**92 06 83**	2"	70	30	75
75	**92 07 84**	2 ½"	70	30	90

Male thread adaptor short

HDPE



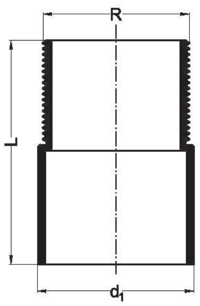


d_1	Code		R	L
40	**96 04 78**	[1]	½"	30
40	**96 04 79**	[1]	¾"	30
40	**96 04 80**	[1]	1"	30
40	**96 04 81**	[1]	1 ¼"	30
50	**96 05 80**	[1]	1"	35
50	**96 05 81**	[1]	1 ¼"	35
50	**96 05 82**	[1]	1 ½"	35
63	**96 06 82**	[1]	1 ½"	40
63	**96 06 83**	[1]	2"	40

[1] *butt-weld only*

Male thread adaptor long

HDPE



d_1	Code	R	L
40	97 04 78	½"	60
40	97 04 79	¾"	60
40	97 04 80	1"	60
40	97 04 81	1 ¼"	60
50	97 05 80	1"	65
50	97 05 81	1 ¼"	65
50	97 05 82	1 ½"	65
56	97 56 83	2"	65
63	97 06 82	1 ½"	70
63	97 06 83	2"	70
75	97 07 84	2 ½"	70

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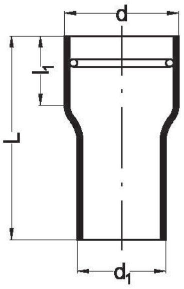
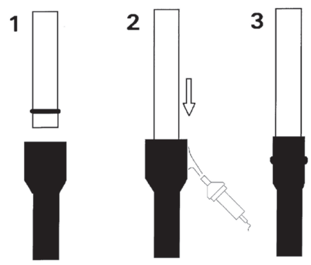
Connecting fittings

Contraction socket HDPE
with O-ring

NBR



d_1/d	Code	L	l_1	d_x
40/50	**55 04 01**	210	65	41-44
40/70	**55 04 02**	210	65	57-64
50/70	**55 05 03**	210	65	57-64
50/80	**55 05 04**	210	60	67-74
56/75	**55 56 01**	210	70	62-69
63/75	**55 06 01**	210	70	62-69
63/85	**55 06 03**	210	70	75-79
75/90	**55 07 01**	210	75	80-84
75/100	**55 07 02**	210	75	90-94
90/110	**55 09 02**	210	75	94-98
110/125	**55 11 02**	210	100	102-111
110/135	**55 11 03**	210	100	110-120
110/150	**55 11 04**	210	90	115-136
125/155	**55 12 01**	210	85	120-140
125/170	**55 12 02**	210	85	135-155
160/180	**55 16 02**	220	90	155-165
160/195	**55 16 04**	220	90	160-180
200/225	**55 20 01**	300	150	185-207
250/280	**55 25 01**	300	150	236-260

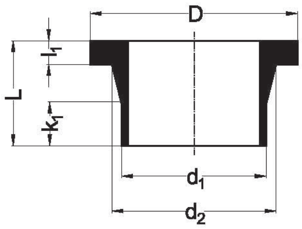


d_x = connecting range

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

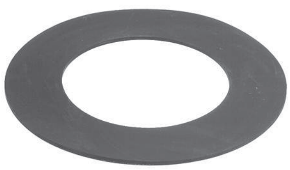


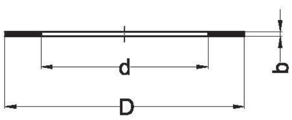
d_1	Code		d_2	D	L	l_1	k_1
40	**47 04 02**	1)	50	78	50	10	15
50	**47 05 02**	1)	61	88	50	10	15
56	**47 56 02**	1)	70	102	60	14	15
63	**47 06 02**	1)	75	102	50	14	15
75	**47 07 02**	1)	89	120	50	16	15
90	**47 09 02**		105	136	80	17	30
110	**47 11 02**		125	158	80	18	30
125	**47 12 02**		132	158	80	18	30
160	**47 16 02**		175	210	80	18	30
200	**47 20 02**	1)	232	268	100	18	40
250	**47 25 02**	1)	285	320	100	20	40
315	**47 31 02**	1)	335	370	100	20	40

1) *butt-weld only*

Gasket flat

EPDM

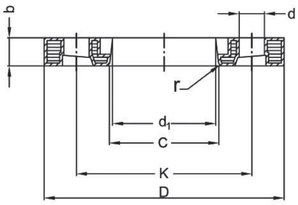




d_1	Code	d	D	b
40/32	**47 04 13 910**	34	82	3
50/40	**47 05 13 910**	42	92	3
56/50	**47 06 13 810**	58	107	3
63/50	**47 06 13 810**	58	107	3
75/65	**47 07 13 810**	69	127	3
90/80	**47 09 13 810**	84	142	3
110/100	**47 11 13 810**	100	162	3
125/100	**47 12 13 810**	114	162	3
160/150	**47 16 13 810**	146	218	3
200/200	**47 20 13 810**	181	273	3
250/250	**47 25 13 810**	226	328	3
315/300	**47 31 13 810**	283	378	3

Connecting fittings

Profile backing ring PP with ductile iron core



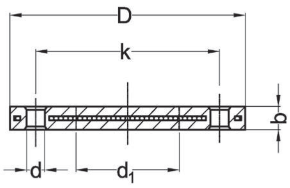
d_1/DN	Code	C	D	K*	b	d*	n*	M	r
40/32	**47 04 09 010**	51	142	100	17	18	4	M16	3
50/40	**47 05 09 010**	62	156	110	19	18	4	M16	3
56/50	**47 06 09 010**	78	171	125	20	18	4	M16	3
63/50	**47 06 09 010**	78	171	125	20	18	4	M16	3
75/65	**47 07 09 010**	92	191	145	21	18	4	M16	3
90/80	**47 09 09 010**	108	206	160	21	18	8	M16	3
110/100	**47 11 09 010**	128	226	180	22	18	8	M16	3
125/100	**47 12 09 010**	135	226	180	23	18	8	M16	3
160/150	**47 16 09 010**	178	296	240	28	22	8	M20	3
200/200	**47 20 09 010**	235	350	295	32	22	8	M20	4
250/250	**47 25 09 010**	288	412	350	36	22	12	M20	4
315/300	**47 31 09 010**	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	**47 04 85 010**	140	100	16	18	4	M16
50/40	**47 05 85 010**	150	110	18	18	4	M16
56/50	**47 06 85 010**	165	125	18	18	4	M16
63/50	**47 06 85 010**	165	125	18	18	4	M16
75/65	**47 07 85 010**	185	145	18	18	4	M16
90/80	**47 09 85 010**	200	160	18	18	8	M16
110/100	**47 11 85 010**	220	180	18	18	8	M16
125/100	**47 11 85 010**	220	180	18	18	8	M16
160/150	**47 16 85 010**	285	240	24	22	8	M20
200/200	**47 20 85 010**	340	295	24	22	8	M20
250/250	**47 25 85 010**	400	350	30	22	12	M20
315/300	**47 31 85 010**	463	400	34	22	12	M20

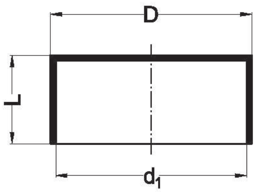
Blind flange PP ductile iron core are suitable for non-pressure applications.

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

Protection cap for pipe

HDPE

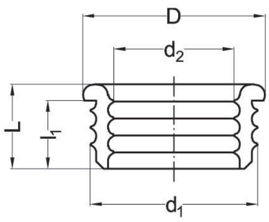
d_1	Code	D	L
40	**40 04 29**	42	35
50	**40 05 29**	52	35
56	**40 56 29**	58	35
63	**40 06 29**	65	35
75	**40 07 29**	78	35
90	**40 09 29**	93	35
110	**40 11 29**	113	40
125	**40 12 29**	129	40
160	**40 16 29**	164	40

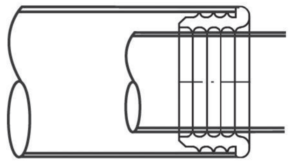


Connecting fittings

Rubber collar for pipe in pipe joints NBR

d_1/d_2	Code	D	L	l_1
50/32	**51 33 01**	54	24	20
50/40	**51 35 01**	54	24	20
56/32	**51 33 03**	56	29	23
56/40	**51 35 03**	56	27	22
63/32	**51 35 02**	63	24	20
63/40	**51 36 02**	63	24	20
63/50	**51 37 02**	63	24	20



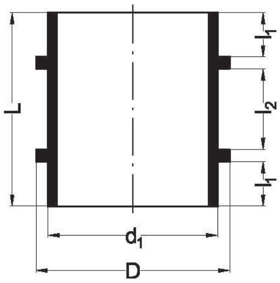


Double-flange bushing

HDPE

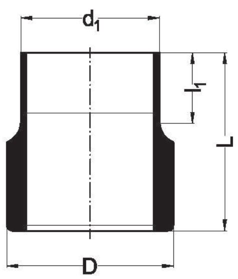
d_1	Code	D	L	l_1	l_2
110	**43 11 15**	118	80	17	31
125	**43 12 15**	133	80	17	31
160	**43 16 15**	170	91	25	31
200	**43 20 15**	216	141	35	41
250	**43 25 15**	262	201	60	41
315	**43 31 15**	327	201	60	41

Double-flange bushings are suitable for anchor joints.



Transition to stoneware

d_1	Code	D	L	l_1
110	**56 11 40**	132	130	50
125	**56 12 40**	160	140	50
160	**56 16 40**	187	140	50
200	**56 20 40**	242	200	130
250	**56 25 40**	298	200	130
315	**56 31 40**	352	200	120



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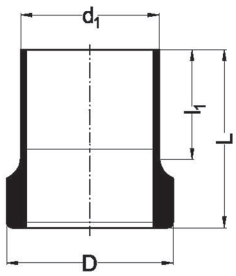
Connecting fittings

Transition to cast iron HDPE



d_1	Code	D	L	l_1
200	**56 20 50**	212	160	80
250	**56 25 50**	274	160	115
315	**56 31 50**	326	160	115

Wall-lavatory bend 90°

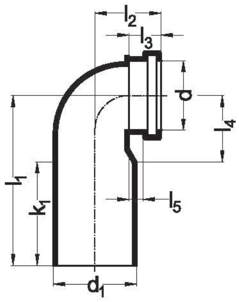
with protection plug

HDPE

SBR seal

d_1/d	Code		l_1	l_2	l_3	l_4	l_5	k_1
90/90	**50 09 84**		225	76	34	83	17	120
110/90	**50 11 85**		225	76	34	95	17	120
110/110	**50 11 82**	1)	225	75	30	92	19	120

1) *NBR O-ring*



Double wall-lavatory bend 90° (vertical)

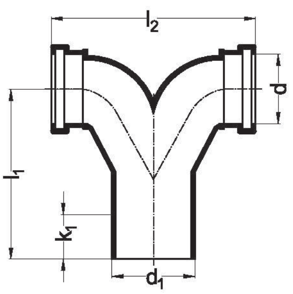
with protection plug

HDPE

d_1/d	Code		l_1	l_2	k_1
110/90	**50 09 34**	1)	225	275	80
110/110	**50 11 34**	2)	185	270	60

1) *EPDM O-ring*

2) *NBR O-ring*



Sanitary fittings

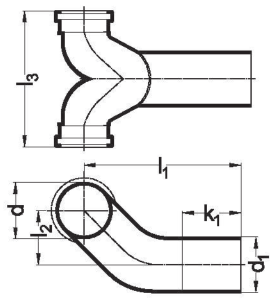
Double wall-lavatory bend 90° (horizontal) HDPE

with protection plug

d_1/d	Code		l_1	l_2	l_3	k_1
110/90	**50 09 35**	1)	360	120	275	200
110/110	**50 11 35**	2)	360	120	270	200

1) *EPDM O-ring*

2) *NBR O-ring*



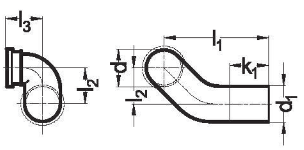
Wall-lavatory bend 90° (horizontal) left HDPE

with protection plug

SBR seal

d_1/d	Code		l_1	l_2	l_3	k_1
90/90	**50 09 32**		300	100	75	140
110/90	**50 10 32**		350	100	75	170
110/110	**50 11 32**	1)	350	100	75	170

1) *NBR O-ring*



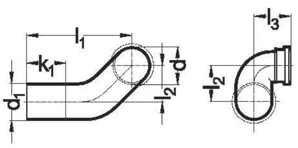
Sanitary fittings

Wall-lavatory bend 90° (horizontal) right — HDPE
with protection plug

SBR seal

d_1/d	Code		l_1	l_2	l_3	k_1
90/90	**50 09 33**		300	100	75	140
110/90	**50 10 33**		350	100	75	170
110/110	**50 11 33**	1)	350	100	75	170

1) *NBR O-ring*

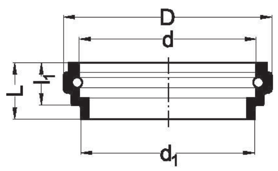


Wall-lavatory socket — HDPE

d_1/d	Code		D	L	l_1
90/90	**50 09 51**	1)	113	49	38
110/110	**50 11 71**	1)	130	45	28

1) *butt-weld only*

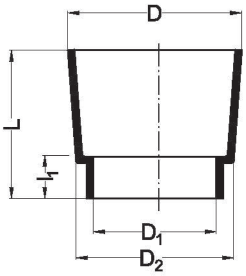
Code 501171 = NBR O-ring.



Sanitary fittings

Protection plug HDPE

d_1	Code	D	D_1	D_2	L	l_1
90	**43 09 19**	109	90	103	98	27,0
110	**43 11 19**	130	105	119	98	23,5

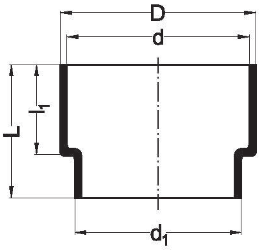


Floor-lavatory socket

HDPE

d_1	Code		d	D	L	l_1
90	**50 09 01**	1)	120	129	85	55
110	**50 11 01**	1)	120	129	88	60

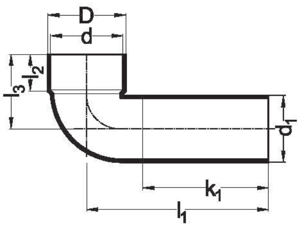
1) *butt-weld only*



Floor-lavatory bend 90°

HDPE

d_1	Code	d	D	l_1	l_2	l_3	k_1
90	**50 09 11**	120	129	270	65	123	175
110	**50 11 11**	120	129	300	60	140	215



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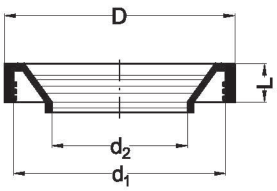
Sanitary fittings

Rubber seal for floor-lavatory socket/bend

d_1	Code	D	d_2	L
129	**50 11 13**	135	102	25

d_2 = connecting size.



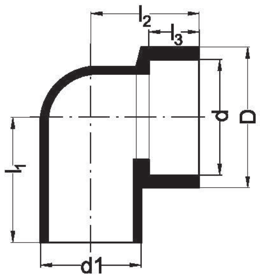
Trap connection 90° bend

HDPE

d_1	Code		d	D	l_1	l_2	l_3
40	**51 04 11**	1)	46	56	50	44	20
50	**51 05 11**	1)	46	53	45	46	18
56	**51 56 11**	1)	46	56	60	60	35
50	**51 05 12**	1)	58	65	50	45	20
56	**51 56 12**	1)	58	65	70	60	28

1) *butt-weld only*

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



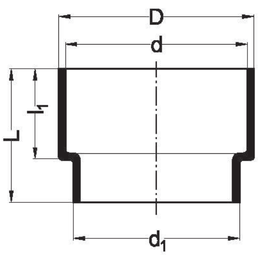
Trap connection socket

HDPE

d_1	Code		d	D	L	l_1
32	**51 03 01**	1)	46	53	31	23
40	**51 04 01**	1)	46	53	30	24
50	**51 05 01**	1)	46	54	38	27
56	**51 56 01**	1)	46	53	38	25
50	**51 05 02**	1)	58	66	50	39
56	**51 56 02**	1)	58	64	46	32

1) *butt-weld only*

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

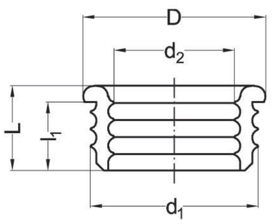


Sanitary fittings

Rubber collar for trap connection bend/socket

NBR

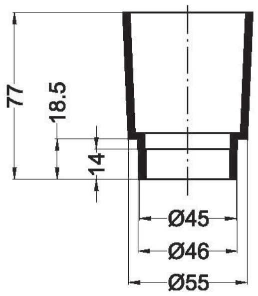
d_1	Code	d	D	L	l_1
46	**51 33 01**	1 ¼" (32)	54	24	20
46	**51 35 01**	1 ½" (40)	54	24	20
58	**51 35 02**	1 ¼" (32)	63	24	20
58	**51 36 02**	1 ½" (40)	63	24	20
58	**51 37 02**	2" (50)	63	24	20



Universal protection plug

for all trap connection bends/sockets

Code
43 46 19



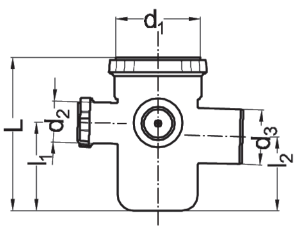
Floor waste gully push-fit

HDPE

SBR seal

$d_1/d_2/d_3$	Code	L	L_1	L_2
110/50/75	**46 11 05**	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

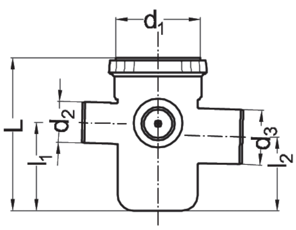


Floor waste gully electrofusable

HDPE

$d_1/d_2/d_3$	Code	L	l_1	l_2
110/56/75	**46 11 56**	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



Traps

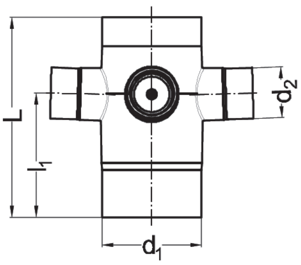
Four way riser electrofusable

HDPE

d_1/d_2	Code	L	l_1
110/56	**46 11 11**	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 11 11 09.

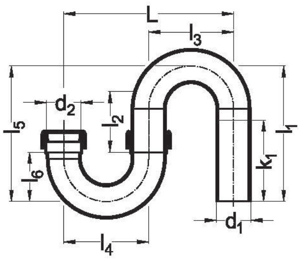


S-trap

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	**04 04 01**	160	182	95	80	80	162	67	100
50/40	**04 05 01**	160	192	100	80	80	172	67	140
50/50	**05 05 01**	200	213	110	100	100	188	73	140
56/50	**05 56 01**	200	238	135	100	100	213	73	90
63/50	**05 06 01**	200	213	110	100	100	188	73	110
56/56	**56 56 01**	210	230	130	110	110	205	70	145
63/63	**06 06 01**	260	254	130	130	130	224	89	170
75/75	**07 07 01**	300	289	130	150	150	254	99	180



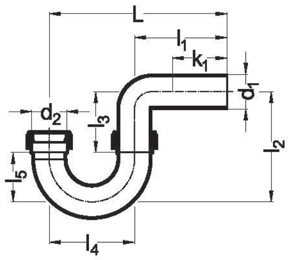
Traps

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	**04 04 02**	172	92	162	95	80	67	45
50/40	**04 05 02**	184	104	172	100	80	67	45
50/50	**05 05 02**	204	104	203	120	100	73	45
63/50	**05 06 02**	218	118	198	120	100	73	55
56/56	**56 56 02**	232	132	213	135	100	70	60
63/63	**06 06 02**	262	132	224	130	130	89	60

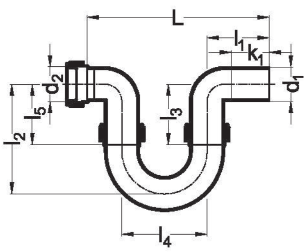


Running trap

HDPE

SBR seal

d_1/d_2	Code	L	l_1	l_2	l_3	l_4	l_5	k_1
40/40	**04 04 03**	241	92	162	95	80	95	45
50/50	**05 05 03**	281	104	193	115	100	115	45
56/56	**56 56 03**	306	132	210	135	100	135	60
63/63	**06 06 03**	351	132	224	130	130	130	60

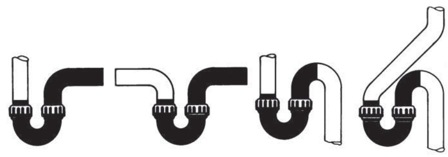


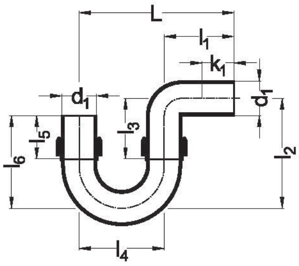
Traps

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	**06 06 09**	255	130	214	140	125	73	149	60
75	**07 07 09**	293	143	258	155	150	81	184	60
90	**09 09 09**	445	270	250	150	175	101	203	175
110	**11 11 09**	520	300	323	165	220	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

d1	Code	A	B	C
40	**40 04 13**	42 04 50	40 04 20	40 04 10
50	**40 05 13**	42 05 50	40 05 20	40 05 10
56	**40 56 13**	42 56 50	40 56 20	
63	**40 06 13**	42 06 50	40 06 20	40 06 10
75	**40 07 13**	42 07 50		40 07 10
75	**42 07 23**		42 07 20	
90	**40 09 13**	42 09 50		40 09 10
90	**42 09 23**		42 09 20	
110	**40 11 13**	42 11 50		40 11 10
110	**42 11 23**		42 11 20	
125	**40 12 13**	42 12 50		40 12 10
125	**42 12 23**		42 12 20	
160	**40 16 13**	42 16 50		40 16 10
160	**42 16 23**		42 16 20	
200	**40 20 13**			40 20 10
200	**40 20 23**		40 20 20	
250	**40 25 23**		40 25 20	
315	**40 31 23**		40 31 20	

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

d1	Code	A	B	C
40	**40 04 19**	42 04 50	40 04 20	40 04 10
50	**40 05 19**	42 05 50	40 05 20	40 05 10
56	**40 56 19**	42 56 50	40 56 20	40 56 10
63	**40 06 19**	42 06 50	40 06 20	40 06 10
75	**40 07 19**	42 07 50	42 07 20	40 07 10
90	**40 09 19**	42 09 50	42 09 20	40 09 10
110	**40 11 19**	42 11 50	42 11 20	40 11 10
125	**40 12 19**	42 12 50	42 12 20	40 12 10
160	**40 16 19**	42 16 50	42 16 20	40 16 10
200	**40 20 19**			40 20 10

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

Spare parts

Protection plug for trap connection socket/bend

HDPE

d_1	Code	A	B
46	**40 46 19**	51 xx 01	51 xx 11
58	**40 58 19**	51 xx 02	51 xx 12

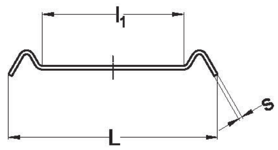
A = trap connection socket
B = trap connection bend

Fixing material

Clamp liners
2 identical metal clamp liners per set

Stainless steel

d_1	Code	L	l_1	s
40	**70 04 15**	40	30	1
50	**70 05 15**	40	30	1
56	**70 56 15**	40	30	1
63	**70 06 15**	40	30	1
75	**70 07 15**	40	30	1
90	**70 09 15**	40	30	1
110	**70 11 15**	40	30	1
125	**70 12 15**	40	30	1
160	**70 16 15**	40	30	1
200	**70 20 15**	50	38	1



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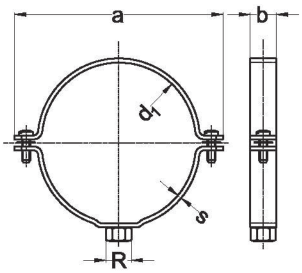
Fixing material

Anchor bracket
for fixing to wall

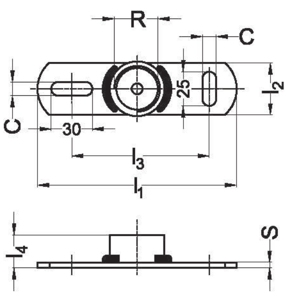
Steel galvanised



d_1	Code	a	b	s	R
40	**70 04 78**	93	30	2,5	½"
50	**70 05 78**	104	30	2,5	½"
56	**70 56 78**	113	30	2,5	½"
63	**70 06 78**	113	30	2,5	½"
75	**70 07 78**	126	30	2,5	½"
90	**70 09 78**	143	30	2,5	½"
110	**70 11 78**	161	30	2,5	½"
125	**70 12 78**	178	30	2,5	½"
160	**70 16 78**	215	30	2,5	½"
200	**70 20 80**	283	40	4	1"
250	**70 25 80**	333	40	4	1"
315	**70 31 80**	398	40	4	1"

Mounting plate for anchor bracket
for fixing to wall

Steel galvanised

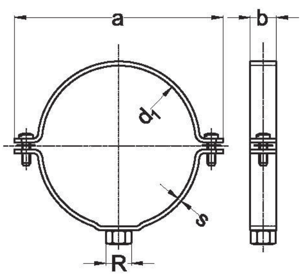


	Code	R	l_1	l_2	l_3	l_4	S	C
40-160	**70 94 78**	½"	145	38	90	25	4	8,5
200-315	**70 94 80**	1"	145	38	90	25	4	8,5

Fixing material

Guide bracket
for fixing to wall

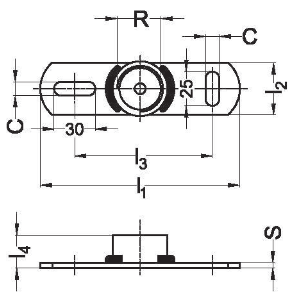
Steel galvanised



d_1	Code	a	b	s	R
40	**70 04 10**	93	30	2,5	M10
50	**70 05 10**	104	30	2,5	M10
56	**70 56 10**	113	30	2,5	M10
63	**70 06 10**	113	30	2,5	M10
75	**70 07 10**	126	30	2,5	M10
90	**70 09 10**	143	30	2,5	M10
110	**70 11 10**	161	30	2,5	M10
125	**70 12 10**	178	30	2,5	M10
160	**70 16 10**	215	30	2,5	M10
200	**70 20 80**	283	40	4	1 "
250	**70 25 80**	333	40	4	1 "
315	**70 31 80**	398	40	4	1 "

Mounting plate for guide bracket
for fixing to wall

Steel galvanised



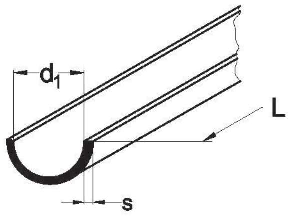
	Code	R	l_1	l_2	l_3	l_4	S	C
40-160	**70 94 10**	M10	145	38	90	14	4	8,5
200-315	**70 94 80**	1 "	145	38	90	25	4	8,5

Fixing material

Support shell galvanised Steel galvanised

Shell length = 3 m

d_1	Code	s	L
40	**90 04 00**	0,63	3000
50	**90 05 00**	0,63	3000
56	**90 56 00**	0,63	3000
63	**90 06 00**	0,63	3000
75	**90 07 00**	0,63	3000
90	**90 09 00**	0,63	3000
110	**90 11 00**	0,63	3000
125	**90 12 00**	0,63	3000
160	**90 16 00**	0,63	3000



Minimum order quantity is 30 m.

Electrofusion control box CB160

d$_1$	Code	Dim.	V~	Hz	kg	A max	W max
40-160	**41 98 10**	200x100x70	230	50/60	1,4	5	1150

The Akatherm CB160 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	**41 99 10**	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 standard supplied with control box Code 419910.

Output leads for control box CB315-U

d$_1$	Code	System	Colour
40-160	**41 99 71**	5A/80s	yellow
200-315	**41 99 72**	220V/420s	blue

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Tools

Weld extension cable

d_1	Code
40-315	41 99 75

Connection cable USB

	Code
	41 99 77

Scraper Spider

Code		L	B	H	kg
41 98 60	1)	105	80	60	0,460
41 98 65	2)	260	210	80	1,600

1) *excluding Spider accessories*

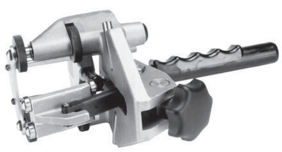
2) *including Spider accessories case, rattle, extension of rattle and blades for replacement*

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

Spider accessories

Code	Accessories
41 98 61	Replacement blades
41 98 62	Roller set 3x
41 98 63	Roller holder
41 98 64	Replacement screw M2, 5x6 for blades
41 98 66	Case

Scraper



Code
61 33 11

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

Tools

Grease pencil

Code
41 96 20

Pipe cutter

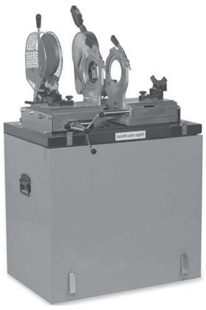
d_1	Code
40-63	49 09 10
50-125	49 10 10
110-160	49 11 10

PE cleaner

Code
60 10 00

Reclosable container with 100 cleaning cloths.

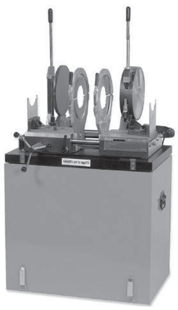
Butt-welding machine 160C



d_1	Code	L	B	H	kg
40-160	**49 20 00**	835	565	760	87

d_1 = 40-50-63-75-90-110-125-160.
Suitable for welding Y-branches 45°.

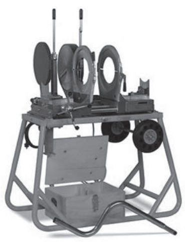
Butt-welding machine 250 C



d_1	Code	L	B	H	kg
75-250	**49 30 00**	835	565	760	160

d_1 = 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	**49 40 00**	1200	680	1045	187

d_1 = 90-110-125-160-200-250-315.
Suitable for welding Y-branches 45°.

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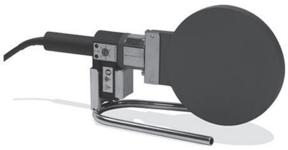
Tools

Manual welding plate



Code
49 00 10

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 pipes systems hardly ever aggressive fluids are drained. When transporting chemical waste waters, the following factors have to be taken in account:
- medium
- 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 l.
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 elastomere 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 much.
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

Appendix A

Component			Concentration	Pipe and fittings			Elastomeric seals			
				HDPE °C			NBR °C	EPDM °C	FPM °C	SBR °C
Name	Formula	Remark		20	40	60	20	20	20	20
Acetaldehyde	CH_3CHO	Aqueous solution	40%	+	+	/	4	2	4	3
Acetaldehyde	CH_3CHO	Technically pure	100%	+	/	/	4	2	4	3
Acetic Acid	CH_3COOH	Aqueous solution	10%	+	+	+	4	3/4	4	4
Acetic Acid	CH_3COOH	Aqueous solution	30%	+	+	+	4	4	4	4
Acetic Acid	CH_3COOH	Aqueous solution	60%	+	+	+	4	4	4	4
Acetic Acid	CH_3COOH	Aqueous solution	80%	/	/	-	4	4	4	4
Acetic Acid	CH_3COOH	Technically pure	100%	+	+	/	4	4	4	4
Acetic Acid Anhydride	$(CH_3CO)_2O$	Technically pure	100%	+	/		4	2	4	2
Acetone	CH_3COCH_3	Aqueous solution	10%	+	+	+	4	1	4	2/3
Acetone	CH_3COCH_3	Technically pure	100%	/	/		4	1	4	2/4
Acetophenone	$CH_3COC_6H_5$	Technically pure	Indetermined	+	+	+	4	1	4	4
Acrylonitrile	CH_2=CH-CN	Technically pure	100%	+	+	+	4	4	4	3
Adipic Acid	$HOOC(CH_2)_4COOH$	Aqueous solution	Saturated	+	+	+	1	1	1	1
Alcohol			40%	+						
Alcoholic Spirits			Comm. Comp.	+	+					
Allyl Alcohol	CH_2=CH-CH_2OH	Aqueous solution	96%	+	+	+				
Alum	$Al_2(SO_4)_3K_2SO_4\,{}_4H_2O$	Aqueous solution	Solution	+	+	+	2	1	1	1
Alum	$Al_2(SO_4)_3K_2SO_4\,{}_4H_2O$	Aqueous solution	Saturated	+	+	+	2	1	1	1
Aluminium Acetate	$(CH_3COO)_3Al$	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_3COONH_4	Aqueous solution	Saturated	+	+	+				
Ammonium Bifluoride	NH_4FHF	Aqueous solution	Saturated	+	+	+				
Ammonium Carbonate	$(NH_4)_2CO_3$	Aqueous solution	100%	+	+	+	2	1	2	2
Ammonium Chloride	NH_4Cl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Ammonium Fluoride	NH_4F	Aqueous solution	25%	+	+	+	1	1	1	1
Ammonium Fosfate	$(NH_4)_3PO_4$ X H_2O		All	+	+	+	1	1	1	1
Ammonium Hydroxide	NH_4OH	Aqueous solution	Solution	+	+	+	4	1	2	4
Ammonium Hydroxide	NH_4OH	Aqueous solution	Saturated	+	+	+	4	1	2	4
Ammonium Nitrate	NH_4NO_3	Aqueous solution	Saturated	+	+	/	2	1	1	1
Ammonium Sulfate	$(NH_4)_2SO_4$	Aqueous solution	All	+	+	+	1	1	1	1
Ammonium Sulfhydrate	$NH_4OH(NH_4)_2SO_4$	Aqueous solution	Solution	+						
Ammonium Sulfhydrate	$NH_4OH(NH_4)_2SO_3$	Aqueous solution	Saturated	+						
Ammonium Sulfide	$(NH_4)_2S$	Aqueous solution	10%	+	+	+	1	1	1	1
Ammonium Sulfide	$(NH_4)_2S$	Aqueous solution	Saturated	+	+	+	1	1	1	1
Amyl Acetate	$CH_3COO(CH_2)_4CH_3$	Technically pure	100%	+	+	+	4	2	4	3
Amyl Alcohol	$CH_3(CH_2)_3CH_2OH$		100%	+	+	/	2	2	2	1
Amyl Chloride	$CH_3(CH_2)_4Cl$	Technically pure	100%	-			4	1	4	4
Aniline	$C_6H_5NH_2$	Technically pure	100%	/			4	2/3	1	3
Aniline Chlorhydrate	$C_6H_5NH_2HCl$	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_3AsO_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
Benzaldehyde	C_6H_5CHO	Aqueous solution	Saturated	+	+	+	4	2	4	3
Benzene	C_6H_6	Technically pure	100%	/	-	-	4	4	3	4
Benzene + Benzine			20/80%	/	-	-	2/3	4	2	4

Appendix A

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
Benzene Sulfonic Acid	$C_6H_5SO_3H$	Aqueous solution	10%	-	4	4	1	4		
Benzine (Free Of Pb And Aromatic)	$C_5H_{12}÷C_{12}H_{26}$		100%	+	+	/	4	4	1	4
Benzoic Acid	C_6H_5COOH	Aqueous solution	Saturated	+	+	+	4	4	1	4
Benzyl Alcohol	$C_6H_5CH_2OH$	Technically pure	100%	+	+	/	4	1	1	4
Bleaching Lye	NaClO+NaCl	12,5%	Cl	/	/		4	1	1	4
Borax	$Na2B_4O_7$	Aqueous solution	All	+	+	+	1	1	1	1
Boric Acid	H_3BO_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	$CH_3CH_2CH_2CH_3$	100%	+	+	+		2	4	2	4
Butanediol	$OHCH_2CH_2CH_2CH_2OH$	Aqueous solution	10%	+	+	+				
Butanediol	$OHCH_2CH_2CH_2CH_2OH$	Aqueous solution	Concentrated	/	-	-				
Butyl Acetate	$CH_3COOCH_2CH_2CH_2CH_3$	Technically pure	100%	/	/	/	4	2	4	4
Butyl Alcohol	$CH_3(CH_2)_3OH$	Technically pure	100%	+	+	+	1	2	1	1
Butyl Ether	$(CH_3(CH_2)_3)2O$	Technically pure	100%	/	-	-	4	3	4	4
Butyl Phenol	$C_4H_9C_6H_4OH$	Technically pure	100%	-			4	4	2	4
Butyl Phthalate	$HOOCC_6H_4COOC_4H_9$	Technically pure	100%	+	/	/				
Butylene	CH_2=CH-CH_2CH_4	Liquid	100%	-			2	4	1	4
Butylene Glycol	$OHCH_2$-CH=CH-CH_2OH	Technically pure	100%	+	+	+	1	1	1	1
Butylene	CH_2=CH-CH_2CH_3	Technically pure	100%	-			2	4	1	4
Butyric Acid	$CH_3CH_2CH_2COOH$	Aqueous solution	20%	+	+	/				
Butyric Acid	$CH_3CH_2CH_2COOH$	Technically pure	100%	+	+	/				
Calcium Acetate	$Ca(CH_3COO)_2$	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_2O	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_2CO_3	Aqueous solution	Saturated	+	+	+				
Chloramine	$C_6H_5SO_2NNaCl$	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_2O	Saturated	/	/						
Chloro Benzene	C_6H_5Cl	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_2O	Aqueous solution	10%	/	-	-	4	2/3	1	4
Chromic Acid	CrO_3+H_2O	Aqueous solution	30%	/	-	-	4	2/3	1	4
Chromic Acid	CrO_3+H_2O	Aqueous solution	50%	/	-	-	4	2/3	1	4
Citric Acid	$C_3H_4(OH)(COOH)_3$	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

Appendix A

Component			Concentration	Pipe and fittings			Elastomeric seals			
				HDPE			NBR	EPDM	FPM	SBR
Name	Formula	Remark		°C			°C	°C	°C	°C
				20	40	60	20	20	20	20
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	$CH_3C_6H_4OH$	Aqueous solution	>=90%	+	+	/				
Cresol	$CH_3C_6H_4OH$	Aqueous solution	Solution	+	+	/				
Croton Aldehyde	CH_3-CH=CH-CHO	Technically pure	100%	/						
Cryolite	Na_3AlF_6	Aqueous solution	Saturated	/	/	-				
Cyclohexane	C_6H12	Technically pure	100%	+	+	+	2	4	1	4
Cyclohexanol	C_6H11OH	Technically pure	100%	+	/	/	2	4	2	3
Cyclohexanone	$C_6H_{10}O$	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	$C_6H_{12}O_6$	Aqueous solution	All	+	+	+				
Dextrose	$C_6H_{12}O_6$	Aqueous solution	Saturated	+	+	+				
Dextrose	$C_6H_{12}O_6$	Aqueous solution	All	+	+	+	1	1	1	1
Dibutyl Phthalate	$C_6H_4(COOC_4H_9)_2$	Technically pure	100%	-			4	2	2	4
Dibutyl Sebacate	$C_8H_{16}(COOC_4H_9)_2$	Technically pure	100%	+			4	2	2	4
Dichloro Benzene	$C_6H_4Cl_2$	Technically pure	100%	/			4	4	2	4
Dichloroacetic Acid	$Cl_2CHCOOH$	Aqueous solution	50%	+	+	+	2	2	2	2
Dichloroacetic Acid	$Cl_2CHCOOH$	Technically pure	100%	+	+	/	3	2	3	3
Dichloroacetic Acid Methyl Ester	$Cl_2CHCOOH_3$	Technically pure	100%	+	+	+				
Dichloroethylene	CHCl=CHCl	Technically pure	100%	-				2	2	4
Diesel Oil			100%	+	/	/	1	4	1	4
Diethylether	$C_2H_5OC_2H_5$	Technically pure	100%	-	-		4	4	4	4
Diglycolic Acid	$HOOCCH_2OCH_2COOH$	Aqueous solution	Saturated	+						
Di-Isobutyl Ketone	$(CH_3)_2CHCH_2COCH_2CH(CH_3)_2$	Technically pure	100%	+	/	-	4	2	4	2/3
Dimethyl Amine	$(CH_3)_2NH$	Technically pure	100%	/	-					
Dimethyl Formamide	$HCON(CH_3)_2$	Technically pure	100%	+	+	/	4	2	4	3
Dioctyl Phthalate	$C_6H_4(COOC_8H_{17})_2$	Technically pure	100%	+	/	/	4	2	2	4
Dioxane	$(CH_2)_4O2$	Technically pure	100%	+	+	+	4	2/3	4	4
Ethyl Acetate	$CH_3COOCH_2CH_3$	Technically pure	100%	+	/	-	4	2/3	4	4
Ethyl Alcohol	CH_3CH_2OH	Aqueous solution	96%	+	+	/	2	1	2	1
Ethyl Benzene	$C_6H_5C_2H_5$	Technically pure	100%	/	/	/	4	4	2	4
Ethyl Chloride	CH_3CH_2Cl	Technically pure	100%	/	-	2/3	4	2	4	
Ethyl Ether	$CH_3CH_2OCH_2CH_3$	Technically pure	100%	/	3	3	4	4		
Ethylene Chlorohydrin	$ClCH_2CH_2OH$	Technically pure	100%	+	+	/	4	2	2	2
Ethylene Diamina	$NH_2CH_2CH_2NH_2$	Technically pure	100%	-	-	-	2	1	4	2
Ethylene Dichloride	CH_2ClCH_2Cl	Technically pure	100%	/	/	4	4	2/3	4	
Ethylene Glycol	$HOCH_2$-CH_2OH	Technically pure	100%	+	+	+	1	1	1	1
Ethylene Oxide	C_2H_4O	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	+	+	+				
Fluoboric Acid	HBF_4	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.	+						

Appendix A

Component				Pipe and fittings			Elastomeric seals			
				HDPE °C			NBR °C	EPDM °C	FPM °C	SBR °C
Name	Formula	Remark	Concentration	20	40	60	20	20	20	20
Furfuryl Alcohol	$C_5H_6O_2$	Technically pure	100%	+	+	/	4	2		4
Gelatine			100%	+	+	+	1	1	1	1
Glycerine	$C_3H_5(OH)_3$	Aqueous solution	All	+	+	+	1	1	2	1
Glycocoll	NH_2CH_2COOH	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	NO, NO_2, $N2O_3$, NOx	Gas	< 0,1%	+	+	+				
- Nitrous Vapours	NO, NO_2, $N2O_3$, NOx	Gas	5%	+	+	+				
- Oleum	$H_2SO_4 + SO_3$	Gas	< 0,1%	-	-	-				
- Oleum	$H_2SO_4 + SO_3$	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	NH_2-NH_2 H_2O	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	$C_6H_4O_2$	Aqueous solution	Saturated	+	+	+	3	4	2	4
Hydroxylamine Sulphate	$(NH_2OH)_2$-H_2SO_4	Aqueous solution	All	+	+	+				
Iodine Dry And Wet	I2		3%	/	-		1	2	1	1
Iso-Octane	C_8H_{18}		100%	/	/	-	1	4	1	4
Isopropyl Alcohol	$(CH_3)_2CHOH$	Technically pure	100%	+	+	+	2	1	1	2
Isopropyl Ether	$(CH_3)_2CHOCH(CH_3)_2$	Technically pure	100%	/	-	-	2/3	3	4	4
Lactic Acid	$CH_3CHOHCOOH$	Aqueous solution	<=28%	+	+	+	2	1	1	3
Lanoline			Comm. Comp.	+	+	+	1	4	1	4
Lard Oil			Comm. Comp.	+						
Lead Acetate	$Pb(CH_3COO)_2$	Aqueous solution	Saturated	+	+	+	1	1	4	4
Lead Chloride	$PbCl_2$	Aqueous solution	Saturated	+	+					
Lead Nitrate	$Pb(NO_3)_2$	Aqueous solution	Saturated	+			1	1	1	1
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	$HOOCCH_2CHOHCOOH$	Aqueous solution	Saturated	+			1	4	1	2

Appendix A

Component			Concentration	Pipe and fittings			Elastomeric seals			
					HDPE °C		NBR °C	EPDM °C	FPM °C	SBR °C
Name	Formula	Remark		20	40	60	20	20	20	20
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_2CO_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_2CrO_4	Aqueous solution	Solution	+						
Sodium Cyanide	NaCN	Aqueous solution	All	+	+	+	2	1	1	1
Sodium Disulphite	$Na_2S_2O_5$	Aqueous solution	All	+			1	1	1	2
Sodium Ferrocyanide	Na_4FeCN_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_2SiO_3	Aqueous solution	<5%	+	+	+				
Sodium Metasilicate	Na_2SiO_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	$Na_2C_2O_4$	Aqueous solution	Saturated	+						
Sodium Perborate	$NaBO_3$	Aqueous solution	All	+			2	1	1	2
Sodium Perchlorate	$NaClO_4$	Aqueous solution	Indetermined	+						
Sodium Peroxide	Na_2O_2		Solution	+			2	1	1	2
Sodium Persulphate	$Na_2S_2O_8$	Aqueous solution	Saturated	+	+	+				
Sodium Phosphate	Na_3PO_4	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Phosphate Monoacid	Na_2HPO_4	Aqueous solution	Saturated	+	+	1	1	1		
Sodium Sulfate	Na_2SO_4	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Sulfide	Na_2S	Aqueous solution	Solution	+	+	+	2	1	1	3
Sodium Sulfide	Na_2S	Aqueous solution	Saturated	+	+	+	2	1	1	3
Sodium Sulfite	Na_2SO_3	Aqueous solution	Saturated	+	+	+				
Sodium Thiocyanate	NaSCN	Aqueous solution	Indetermined	+	+	+				
Sodium Thiosulphate	$Na_2S_2O_3$	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	$C_6H_5CH=CH_2$		100%	/	-	-	4	4	1	4
Sugar Syrup			Saturated	+	+	+	1	1	1	1
Sulfamic Acid	HSO_3NH_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%	-						
Sulphuric Acid	$H2SO_4$	Aqueous solution	10%	+	+	+	2	1	2	2
Sulphuric Acid	$H2SO_4$	Aqueous solution	50%	+	+	+	4	1	2	4
Sulphuric Acid	$H2SO_4$	Aqueous solution	80%	+	+	/	4	2	2	4
Sulphuric Acid	$H2SO_4$	Aqueous solution	90%	/	/	-				
Sulphuric Acid	$H2SO_4$	Aqueous solution	96%	-	-	-	4	4	2	4
Sulphuric Acid	$H2SO_4$	Aqueous solution indetermined	98%	-	-	-				
Sulphuric Acid	$H2SO_4$	Technically pure	100%	-	-	-				
Sulphurous Acid	$H2SO_3$	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	$COOH(CHOH)_2COOH$	Aqueous solution	All	+	+	+				
Tetrachloroethane	$CHCl_2CHCl_2$	100%	/	-			4	4	1	4
Tetrachloroethylene	$Cl_2C=CCl_2$	100%	/	-			4	4	2	4
Tetraethyl Lead	$Pb(C_2H_5)_4$	Technically pure	100%	+			2	4	1	4

Appendix A

Component			Concentration	Pipe and fittings			Elastomeric seals			
				HDPE °C			NBR °C	EPDM °C	FPM °C	SBR °C
Name	Formula	Remark		20	40	60	20	20	20	20
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_4H_8S	100%	/	/	/		4	4	4	4
Toluene	$C_6H_5CH_3$	Technically pure	100%	/	-	-	4	4	2	4
Toluic Acid	$CH_3C_6H_4COOH$		50%	/						
Transformer Oil			Comm. Comp.	+	/	/		4	2	4
Tributylphosphate	$(C_4H_9)_3PO_4$	Technically pure	100%	+	+	+	4	2	3	4
Trichlorethylene	$ClCH{=}CCl_2$	Technically pure	100%	-	-	-	4	4	2	4
Trichloroacetic Acid	CCl_3COOH	Aqueous solution	50%	+	/	/	2	2	4	4
Trichloroacetic Acid	CCl_3COOH	Technically pure	100%	+	/	-	2	2	4	4
Trichloroethane	CH_3CCl_3	Technically pure	100%	/			4	4	1	4
Tricresylphosphate	$(CH_3C_6H_4O)_3PO_4$	Technically pure	100%	+	+	+	4	2	2	4
Triethanolamine	$N(CH_2CH_2OH)_3$	Technically pure	100%	+	+	/	3	1	4	2
Trioctylphosphate	$(C_8H_{17})_3PO_4$	Technically pure	100%	/			4	1	2	4
Turpentine Oil		Technically pure	100%	/	-	-	2	4	1	4
Urea	NH_2CONH_2	Aqueous solution	<=10%	+	+	+	1	1	1	1
Urea	NH_2CONH_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_2O		100%	+	+	+	1	1	1	1
Water	H_2O		100%	+	+	+	1	1	1	1
Water	H_2O		100%	+	+	+	1	1	1	1
Water	H_2O		100%	+	+	+	2	1	2	2
Water	H_2O		100%	+	+	+	2	1	2	2
Water, Rain	H_2O		100%	+	+	+	1	1	1	1
Water, Salt	$H_2O+NaCl$		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	$C_6H_4(CH_3)_2$		100%	-	4	4	2	4		
Zinc Acetate	$Zn(CH_3COO)_2$		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 A

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Articlelist

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akatherm

Articlelist

Notes

Notes

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