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Specialist Drainage Systems

Soil & Waste systems

Specification manual

2012

Preface

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.

This specification manual is produced with extreme care. Akatherm BV does not accept any liability for damage caused by not or incorrect mentioned data in this manual.

Preface 1

Table of contents 3

1 Applications and design guidelines

1.1 Soil and waste systems for high-rise 7
1.2 Waste water systems 13

2 Material properties

2.1 Physical characteristics of HDPE 17
2.2 Chemical resistance 19
2.3 Noise and condensation insulation 27
2.4 Fire hazard 28

3 Standards and quality

3.1 Standards and approvals 31
3.2 Quality management ISO 9001 31
3.3 Environmental management ISO 14001 31
3.4 Warranty 31
3.5 Aliaxis 31

4 Product range

4.1 Dimensions 33
4.2 Pipe 33
4.3 Electrofusion 33
4.4 Butt-welding and the k-dimension 33
4.5 Abbreviations 33
4.6 Handling and storage 33

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Table of contents

HDPE drainage

Pipes
Pipes ... 35

Fittings
Reducers ... 36
Bends ... 39
Elbows ... 42
Branches ... 45
End caps ... 55

Connecting fittings
Electrofusion joints Akafusion ... 56
Plug-in joints ... 57
Screw couplers ... 60
Contraction socket joints ... 65
Flanged joints ... 66
Pipe in pipe joints ... 69
Transition to other material ... 70

Sanitary fittings
Wall-lavatory ... 71
Floor-lavatory ... 75
Trap connections ... 77

Traps
Traps ... 79
Traps with flange bushings ... 81

Spare parts
Spare parts ... 82

Fixing material
Clamp liners ... 84
Anchor point joints ... 85
Guide bracket joints ... 86
Support shells ... 87

Tools

Tools
Control boxes Akafusion ... 88
Scrapers ... 89
Tools miscellaneous ... 90
Butt-welding machines ... 91

5 Jointing methods

5.1 Pull-tight and not pull-tight jointing 93
5.2 Butt-weld joint 93
5.3 Electrofusion joint 97
5.4 Plug-in joint 100
5.5 Snap joint 100
5.6 Screw-threaded joint 101
5.7 Flange joint 101
5.8 Contraction sleeve joint 101
5.9 Metal coupling 102
5.10 Pipe-in-pipe joint 102

6 Prefabrication

6.1 Choosing to prefabricate 103
6.2 HDPE as a material 103
6.3 Pipe and fittings 103
6.4 CAD software 104

7 Soil and waste pipe installation methods

7.1 Choice of pipe installation methods 105
7.2 Bracket assembly methods 105
7.3 General bracket distance at different temperatures 106
7.4 Guide bracket system with expansion sockets 107
7.5 Guide bracket system with deflection leg 109
7.6 Anchor point bracket system 112
7.7 Embedding HDPE in concrete 115
7.8 Underground installation of HDPE 116

Alphabetical index 119

Index of article numbers 123

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Table of contents

1 Applications and design guidelines

More and more specialist drainage systems are called upon to drain rainwater, soil and waste or industrial waste water in a cost-effective way. In this chapter we elaborate on the benefits, design parameters for soil and waste systems.

1.1 Soil and waste systems for high-rise

Because skyscrapers are designed evermore extreme, a single stack soil and waste system offers you the possibility to aim higher.
Today, whether a consultant or installer, you need drainage solutions capable of responding to the commercial challenges faced by your clients.

1.1.1 Advantages of the Akavent system

Akatherm soil and waste systems for high-rise offer the following advantages:

- Saving space that can be used for other installations or as usable space for the occupants of the building
- Higher flow capacity of the stack
- Less installed cost by a welded plastic (HDPE) pipe system with low weight
- Reduced hydraulic pressure
- Full peace of mind from a sophisticated risk management system

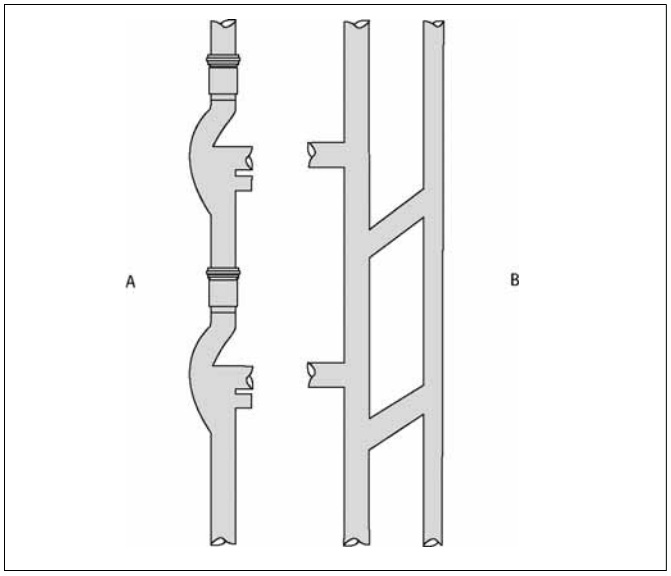


Illustration 1.1

Akatherm system with Akavent aerator (A)

- Single stack system
- No limits in height
- One diameter and limited number of fittings
- Multiple connections per floor*
- Low speed

Traditional stack with vent pipe (B)

- Two stacks
- Limited in height
- More dimensions and fittings
- One connection per floor
- High speed

* *The Akavent aerator has 3 connections d_1 = 110 mm and connections d_1 = 75 mm.*

Elements of the system

The Akatherm soil and waste system for high-rise consists of the following elements:

1. Akavent aerators on each floor with the 3 horizontal aerators d_1 = 110 mm and 3 horizontal aerators d_1 = 75 mm.
2. A stack made of standard Akatherm pipe and fittings sized by fixture unit load.
3. A de-aerator assembly at the bottom of the stack to make a transition to the general sewerage drain possible.
4. Relief vent where the stack is offset over a distance greater than 45°.

Akatherm soil and waste systems for high-rise buildings have no height limitation, and sizing is determined solely on the number and type of fixtures connected.

1.1.2 The Akavent aerator working principle

The high velocity in the down pipe of a tall building creates a 'hydraulic prop'. Due to air resistance (larger at high velocities), the water closes off the entire diameter of the down pipe. This causes a substantial pressure difference in both a positive and a negative sense. The pressure difference causes the evacuating force or pull in the siphon. In an Akatherm soil and waste system for high-rise buildings, velocity is limited by breaking the fall on each storey.
This enables greater air flow by pressing the waste water to the side of the pipe and, consequently, making room for an open connection in the middle of the pipe. The pressure difference remains far within +/- 30 mm WK (see illustration 1.2). The down pipe remains in a single line.

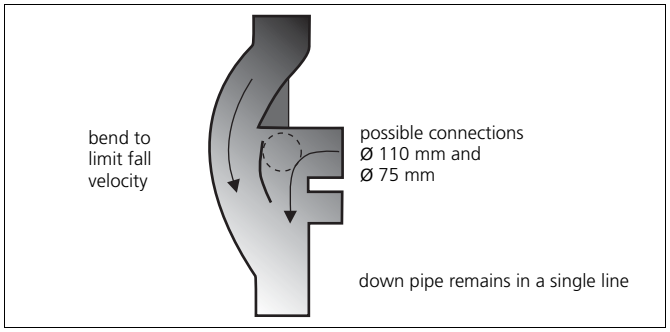


Illustration 1.2

With a standard connection on a down pipe, the incoming waste water flow from the storey and the flow in the down pipe affect or even block each other. In the Akatherm soil and waste system for high-rise, the waste water from the storey is channelled through a separate 'compartment' in the Akavent aerator before flowing into the down pipe. The merging with the waste water from above-lying storeys occurs in a gradual manner. The continuously open connection to the down pipe keeps the pressure in balance and the pipe for the storey can extend over a greater length without any secondary pressure-relief vents. For the dimensions of the Akavent aerator, see the 'Product range' chapter.

Application and design guidelines

1.1.3 Connection to the Akavent aerator

The connection to the Akavent can best be made by using Akatherm snap sockets. This unique push-fit socket joint with additional snap ring has the following advantages:

- Firm tensile joint if a snap groove exists in the pipe to be connected.
- The pipe is centred in the seal, offsetting any extra load on this seal as a result of the weight of the pipe.
- Prevention of any soiling of the seal due to 'scraping' it over the pipe.

A top joint can best be accomplished with an expansion socket in order to compensate for any expansion of the down pipe (see illustration 1.3).

Illustration 1.3

A side joint is made using the standard snap socket (see illustration 1.4).

Illustration 1.4

1.1.4 Designing the Akavent system

An Akatherm soil and waste system for high-rise doesn't have any height restrictions: the dimensions are only determined by the number and types of drain fixtures that are connected to it. The Akavent system is preferably always equipped with one Akavent for each floor.

Follow the guidelines in this chapter in order to design the Akatherm system for high-rise. Detailed calculations and examples of such designs can be found in paragraph 1.1.7.

The basic Akatherm system for high-rise consists of the following elements:

- Akavent aerator on every floor
- A down pipe with standard Akatherm pipes and fittings
- A vent pipe through the roof of the same diameter as the down pipe
- A vent pipe on the first floor

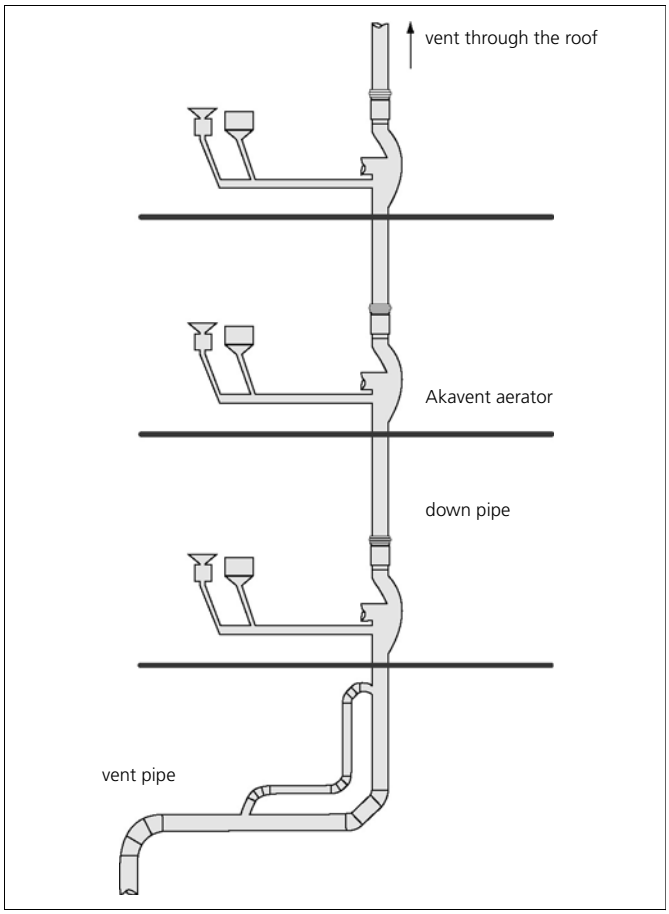


Illustration 1.5

Applications and design guidelines

Akavent aerator in the down pipe

An Akavent down pipe aerator fitting must be installed on each storey with a waste water connection. When the distance between two Akavent down pipe aerators is larger than 6 m, a double offset must be placed in the down pipe (see illustration 1.6).

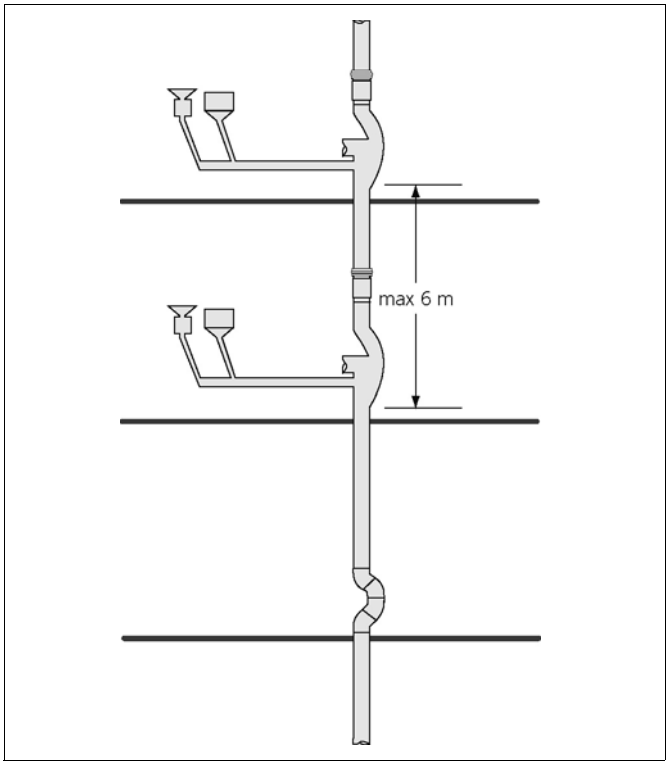


Illustration 1.6

Zone division for each Akavent down pipe

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 Akavent down pipes.

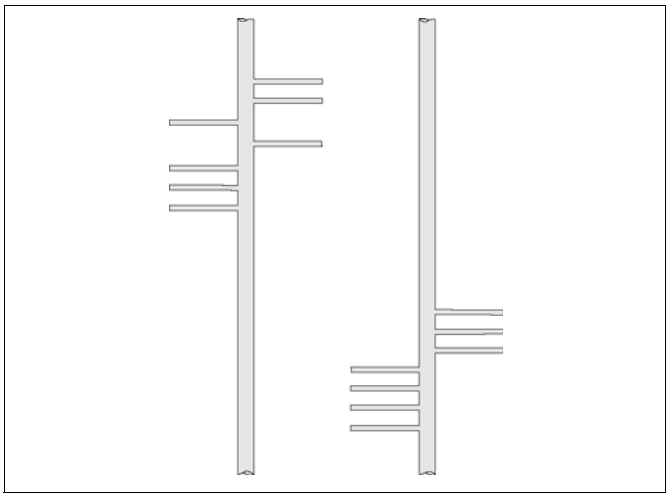
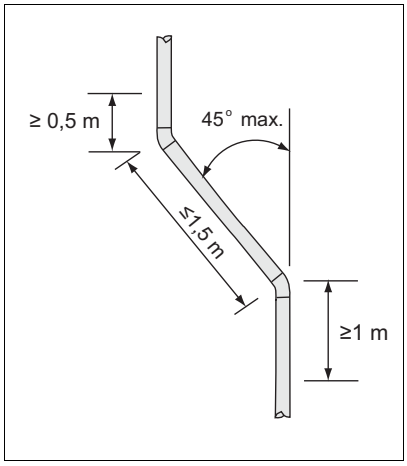


Illustration 1.7

Deflecting the Akavent down pipe



The axis of an Akavent down pipe can be deflected without use of an equalisation pipe if the transition is constructed as shown in illustration 1.8.

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

Illustration 1.8

If the axis of the Akavent down pipe can't be deflected in accordance with the illustration 1.8, the offset must be equipped with an equalisation line, to be designed in accordance with illustration 1.9.

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 1.9. The equalisation or diverter pipe must have the same diameter as the down pipe.

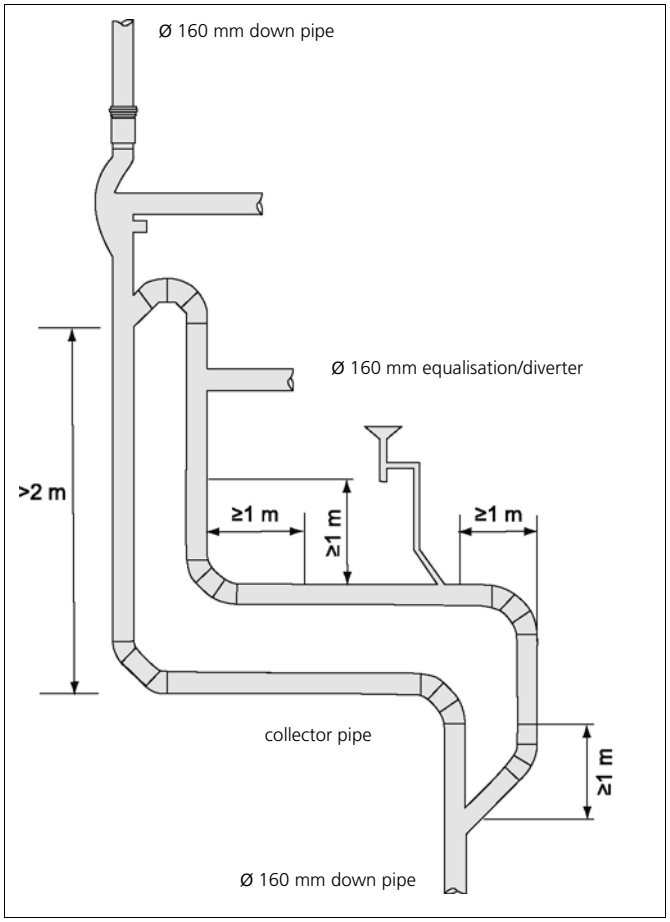


Illustration 1.9

Application and design guidelines

Floor connectors
The maximum length for an unvented floor connector (or collector pipe) is 4 m at an incline of at least 1,0% (1:100) with no more than three 90° bends. The floor connector must be sized in accordance to national standards and guidelines.
Floor connectors that exceed these limits must have connections to the down pipe involving secondary pressure-relief pipes (vents). The joint of the relief pipe to the down pipe must be slanted downward at 45°, as shown in illustration 1.10.

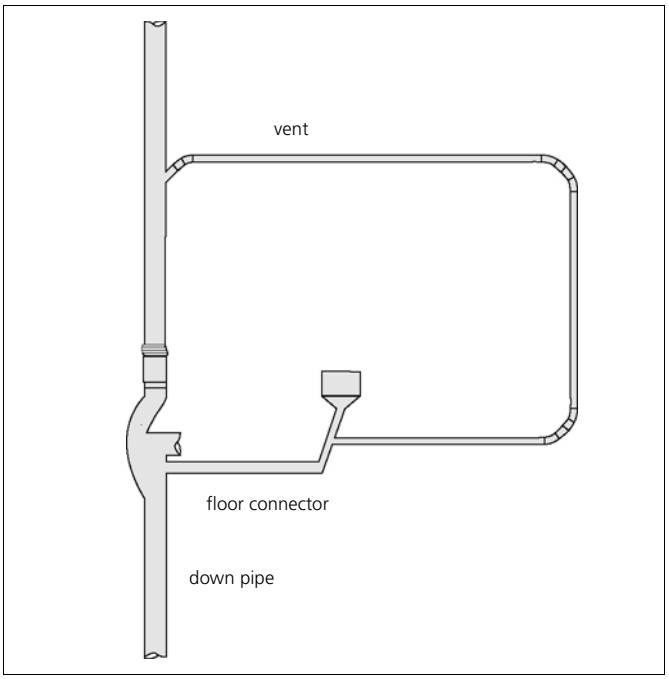


Illustration 1.10

Connectors are pipes that link a single drain fixture to the floor connector. According to EN 12056-2, the maximum length of an unvented connector is 3,5 m (without any specification of slope or number of 90° bends). If the 3,5 m is exceeded, the connector must be provided with secondary pressure relief as illustrated in illustration 1.10.

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

Details about maximum total and per-storey drainage flows that may be handled by an Akavent down pipe can be found in paragraph 1.1.7 'Akavent system calculation'.

End of the Akavent down pipe
At the bottom of the Akavent down pipe, there must be an equalisation line in order to release all the built-up pressure. Fixtures can be attached to the equalisation line outside the joint-free zones. This equalisation pipe must be designed in accordance with illustration 1.11.

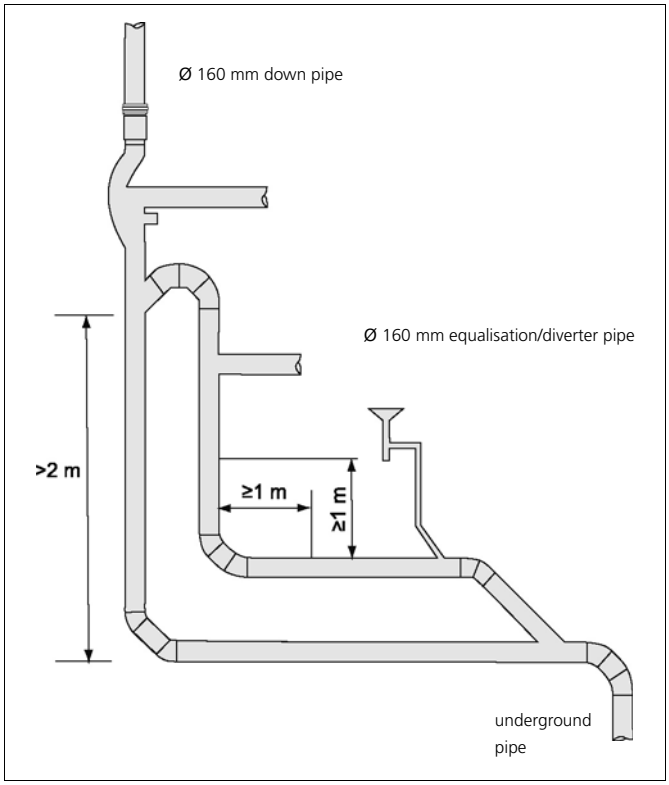


Illustration 1.11 End of the Akavent down pipe

Venting the Akavent down pipe
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 8 x 110 mm or 3 x 160 mm, as long as the combined pressure-relief pipe has a diameter as specified in table 1.1. Illustration 1.12 provides an example of 4 down pipes ø 110 mm with combined vent pipes.

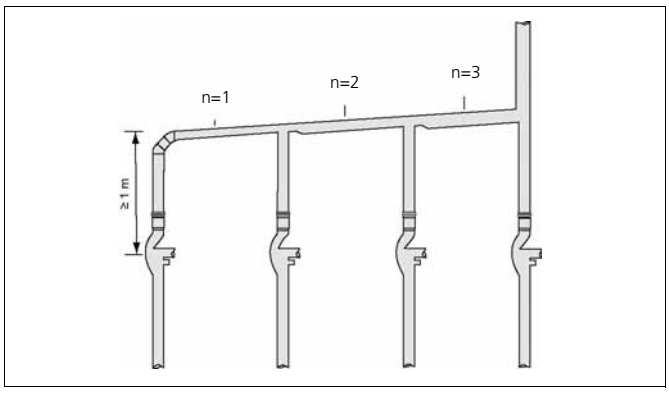


Illustration 1.12

Down pipe (n)	Minimum ø of combined pressure-relief pipe Akavent 110 mm	Akavent 160 mm
1	110	160
2	160	250
3	200	315
4	250	
5	250	
6	315	
7	315	
8	315	

Table 1.1

The flow opening must be at least equal to the surface area of the connected pressure-relief pipe. 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.

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

1.1.5 Fixing system

For fixing the Akatherm soil and waste system for high-rise to the building structure the standard guidelines for fixing apply. The Akavent aerator needs to be fixed to the building on the top and bottom with an anchor bracket.

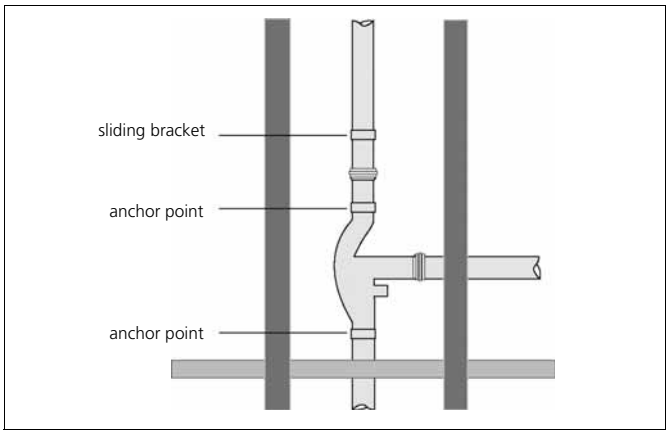


Illustration 1.13

1.1.6 Duct size

The minimal duct size that is needed for an Akatherm system can be found in table 1.2. The aerator possibilities 1 and 3 are not to be used simultaneously for connecting soil and waste systems (see illustration 1.14).

		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 1.2

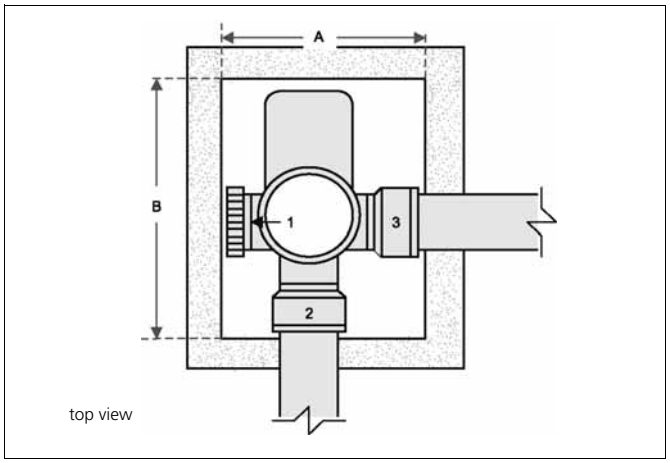


Illustration 1.14

1.1.7 Akavent system calculation

The basic calculation for an Akatherm system 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 Akavent 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 1.3 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 1.3 Q_i according to EN 12056

Simultaneity coefficient
Not every drain fixture will be used at the same time and, therefore, the simultaneity coefficient p exists to take this factor into account. This coefficient will differ for each type of building (see table 1.4).

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 1.4 Simultaneity coefficient

The simultaneity coefficient is employed in equation 1.1 to combine the drainage from all drain fixtures into a comparable drainage flow.

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

Equation 1.1 Combined drainage equation (l/s)

Q_a = *Combined simultaneous drainage (l/s)*
p = *Simultaneity coefficient as indicated in table 1.5 ((l/s)$^{0.5}$)*
n = *Number of drain fixtures (-)*
Q_i = *Basic drainage unit for drain fixture i as stated in table 1.4 (l/s)*

Application and design guidelines

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

Akavent capacity

This combined simultaneous drainage (Q_a) must be handled by one or more Akavent down pipes. Every down pipe incorporating the Akavent aerator has a maximum capacity based on diameter. Table 1.5 provides a summary of this.

Akavent aerator type	110 mm	160 mm
Design diameter standard (DN)	100 mm	150 mm
Maximum simultaneous drainage for Akavent	7,6 l/s	19,6 l/s
Number of basic drainage units (Q_i)*	231 l/s	1537 l/s

Table 1.5 Akavent aerator capacity

* *The last row in table 1.5 shows the permitted number of basic drainage units for the down pipe. The number is calculated by re-writing equation 1.1 and by inserting the maximum capacity of the Akavent aerator from table 1.5 as Q_a.*

A residential building (p = 0,5) with a single Akavent aerator 110 mm down pipe can have drain fixtures with a total capacity of 231 l/s connected (see equation 1.2 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 1.2 Re-written combined drainage equation (l/s)

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

Conditions affecting Akavent capacity

Table 1.6 describes conditions concerning the maximum drainage flow of the collectors that may be connected to an Akavent down pipe in detail.

Max. capacities of one Akavent down pipe (l/s)	110 mm (l/s)	Q_i	Toilets	160 mm (l/s)	Q_i	Toilets
Total drainage from all floors	7,6	231	-	19,6	1537	-
Toilet drainage from all floors	4,7	85	42	11,8	562	281
Total drainage from one floor	4,5	81	-	11,6	537	-
Toilet drainage from one floor	2,0	16	8	5,2	106	53

Table 1.6 Connection conditions

Sample calculation

Example of a residential building with 100 storeys and 4 flats on each storey. Each flat has drain fixtures with basic drainage units (Q_i), which you can find in table 1.7.

Drain fixture	Q_i
Kitchen	1,0
Bathroom	2,5
Toilet (6 l)	2,0
Total per flat	5,5
Total per storey	22,0
Total for building	2,200

Table 1.7

In this building, the $\sum_{i=1}^{n} Q_i$ is 2.200 l/s and the simultaneity coefficient 0,5. The total flow Q_a is therefore:
$Q_a = 0,5.\sqrt{2200} = 23,45$ l/s.

The maximum capacity for a 110 mm Akavent down pipe is 7,6 l/s. 4 x 110 mm Akavent down pipes are required or 2 x 160 mm Akavent down pipes having a maximum capacity of 19,6 l/s, if the conditions of the standard are to be met.

Logically, the choice will be made for 2 x 160 mm, as a result of which 100 x 2 = 200 toilets can be connected to each Akavent down pipe. The maximum number of toilets connected to a 160 mm Akavent down pipe is 281, and therefore the basic condition is satisfied.

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 1.15 illustrates a situation in which the 2 down pipes in the above sample calculation are connected to a single underground pipe with a 2% incline (1:50).

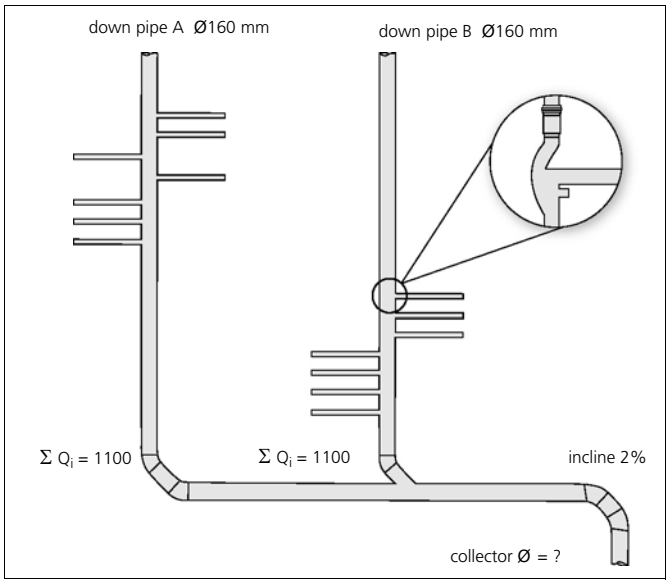


Illustration 1.15

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

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

Equation 1.3

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 1.8

The 23,45 l/s can be found in the 2% column between 20,1 and 38,1. Take the highest value of these and the pipe diameter associated with it. In this case, the underground pipe must have a diameter of 250 mm.

1.2 Waste water systems

1.2.1 Soil and waste system

Waste water systems encompass the system of drainage and pressure-relief pipes within a building and terminate 0,5 m outside the external wall. Waste water systems are based on the primary pressure-relief system in which water and air-flow occurs in the same pipe. The waste water system must be separated from the roof drainage system.

1.2.2 Pipe system and flow conditions

For a properly functioning interior sewer system, the flow conditions of the various types of pipe must be known so that they can be taken into account in the design. In the pipework for a soil and waste system, the following pipes are defined as indicated in illustration 1.16.

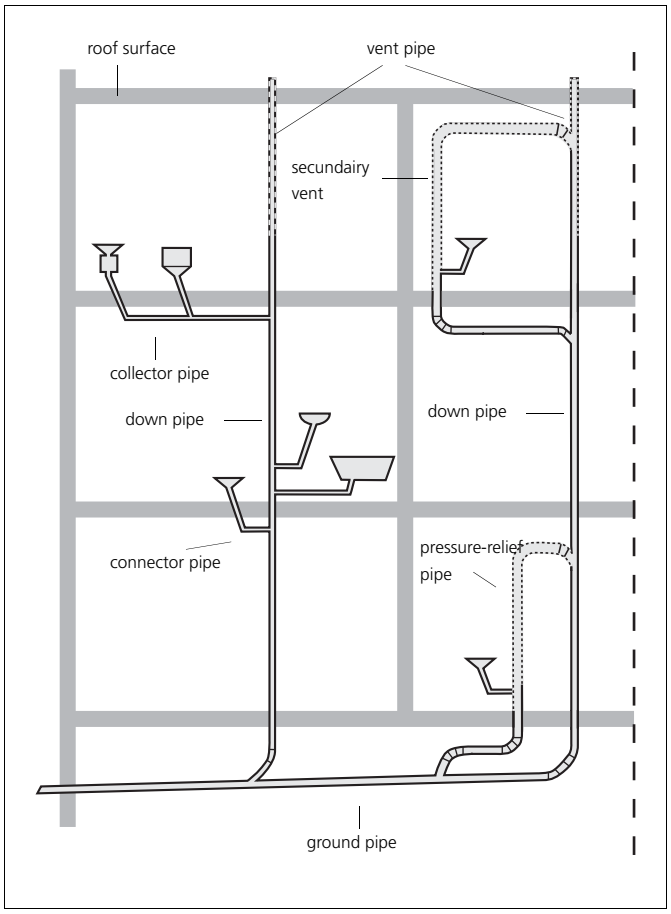


Illustration 1.16

Connectors

A connector links a drain fixture to the collector, down or underground pipe. Only one drain fixture is to be connected to a connector. In an internal sewer, a connector can be both horizontal and vertical and may, in contrast to collectors, become completely full. To prevent stench traps from being siphoned empty, certain parameters are normally imposed on connectors. These parameters relate to:

- minimum pipe diameter
- maximum pipe length
- maximum height difference

Collectors

A collector is a horizontal pipe that links connectors to down pipes.

Down pipes

A down pipe is a drain pipe that deviates no more than 45° from vertical. A down pipe connects a collector to a ground pipe and is outfitted with a pressure-relief pipe.

In a soil and waste system, the design must focus on preventing large pressure difference in down pipes. Pressure differences in a down pipe can be reduced by implementing joint-free zones, appropriate types of joints for connectors and the proper sizing of the down pipe.
Underpressure arises in a down pipe as a result of a connector draining waste water into the down pipe. Depending on the flow volume, the drainage water will gradually spread over the entire pipe wall. Due to gravity and pipe friction, the drainage water will reach a maximum velocity and carry the air in the core along with it. This creates a pressure difference that transmits up the pipe to a point above the input of the drainage flow.

Overpressure is created at the base of the down pipe where the drainage flow is forced to slow down substantially in transitioning to the horizontal collector or underground pipe. The air in the horizontal pipe can only escape to a limited extent, causing the air at the base of the down pipe to be pressed together, giving rise to overpressure.
The transition to a collector or underground pipe must therefore occur using 2 x 45° bends so that the air in the horizontal pipe can flow away.

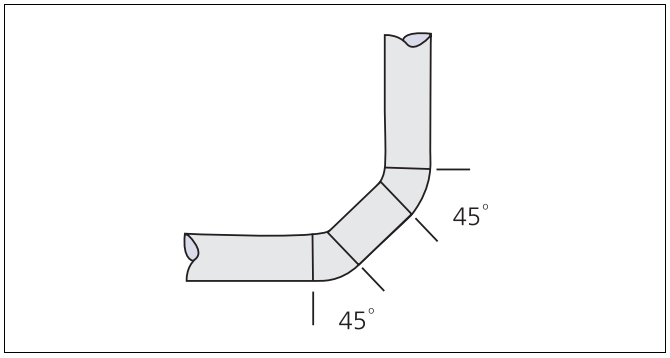


Illustration 1.17

Pressure-relief pipes

A pressure-relief pipe must ensure proper air intake and venting of the internal sewer. The pressure-relief is the part of the down pipe that extends above the highest collector joint and is open to the air above the roof surface. This is the principle of primary pressure-relief, and it is associated with pressure differences as described in the chapter on down pipes. In some cases, secondary pressure-relief pipes are required to prevent large pressure differences from occurring. Such secondary pressure-relief pipes are directly or indirectly connected to the primary pressure-relief pipes.

Ground pipes

A ground pipe is a horizontal pipe that collects drainage flows from connectors, collectors and down pipes and discharges them into the external sewer. The ground pipe remains inside the 0,5 m boundary of the internal sewer.

Flow conditions in horizontal pipes

Flow conditions in horizontal pipes depend on the nature of the individual discharges that can, in turn, partly or fully coincide. In practice, draining occurs in waves that quickly reach their maximum level of drainage and subsequently subside to nil due to the friction of the pipes and fittings. Flow calculations are therefore extremely complex but are simplified into a system with 70% water filling of the pipe during the maximum expected flow volume. The remaining 30% of air is unrestrictedly in contact with the pressure-relief pipe so that no large positive or negative pressure differences arise.

Application and design guidelines

Pressure differences can be created in the pipe system if the drain flow hydraulically seals the pipe, causing the system to become completely full. Pressure differences can seriously disrupt the system, causing an odour problem due to the emptying of siphons. It is also possible that a noise nuisance can arise due to the enclosed air and air that is pressed through the stench traps.

A completely full system is more likely to occur when there is large incline because the high flow velocity tends to cause build up in the bends. The standard limits the incline to 1:50 (20 mm/m). A risk of hydraulic sealing also may occur where pipes join together, both in the case of two horizontal pipes and in the transition to a stand pipe. The standard therefore specifies requirements for the installation of drain pipes.

1.2.3 Drain fixtures and connectors

Drain fixtures and stench traps
All drain fixtures are connected to the soil and waste system with a siphon, such as a stench trap. The height of the siphon must be at least 50 mm, so it offers good resistance to the pressure differences in the pipe system and will not be drained empty.

Connectors
Only one drain fixture can be connected to one connector. The total length of a connector (horizontal and vertical together) may not exceed 3,5 m, without any restrictions on the number of bends. There is no specific incline because the horizontal portion may become completely full. Some incline is recommended.

If the design cannot satisfy this requirement, a secondary pressure reliever needs to be installed directly behind the stench trap. The total horizontal length of the connector and the collector is also subject to regulations.

1.2.4 Horizontal pipes

Connecting to a horizontal pipe
The connection of a connector to a horizontal pipe must occur by means of a 45° aerator in which the diameter of the stem is equal to the diameter of the aerator. Three types of joints can be distinguished.

- Side joint
If the joint has a smaller diameter, an eccentric route must be used so that the bottoms of all pipes are at the same level.

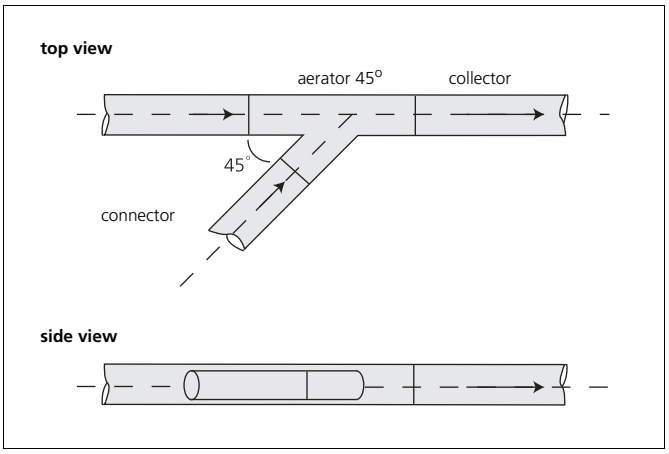


Illustration 1.18 Side joint

- Inclined joint
The diameter of the aerator fitting may be equal to the diameter of the joint if the joint lies between 30° and 45° above horizontal.

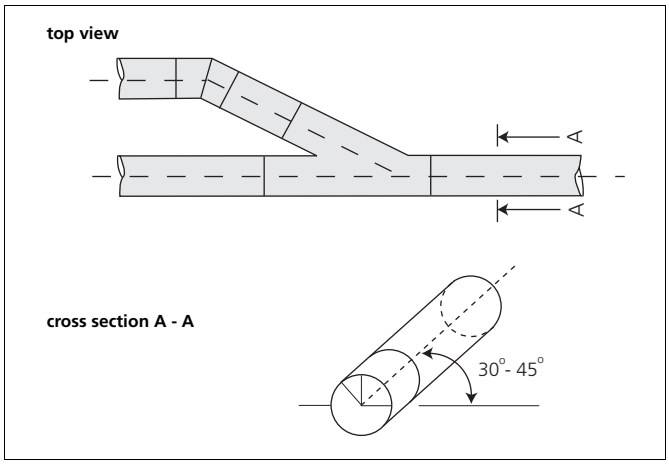


Illustration 1.19 Inclined joint

- Top joint
A top joint is only permitted if the design diameter of the collector or underground pipe is at least 100 mm and the drainage from the pipe being connected is not larger than 1 l/s.

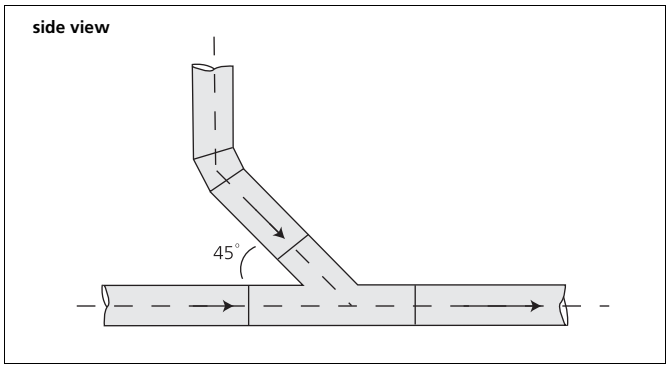


Illustration 1.20 Top joint

Minimum distance between joints on a horizontal pipe
Minimum distances are necessary because the joint alters the flow pattern in the pipe. The flow after a joint is restored in the space of the minimum distance.

General minimum distances
The minimum distance between two joints on a horizontal pipe is 5 times the inside diameter of the collector or underground pipe. The minimum distance may be twice the inside diameter if the collector or underground pipe has an inside diameter > 100 mm or if the highest joint has drainage of no more than 0,75 l/s.

Minimum distances for shower connections
No toilet, dishwasher or washing machine may be connected within 1 m upstream of a shower connection.

Minimum distances for toilet connections
Joints can only be made upstream from a toilet connection if there is also a pressure-relief pipe connected upstream. No drain fixture may be connected within 1 m downstream of a toilet connection.

Joint-free zones
In the zone of the transition from a down pipe to a horizontal pipe, there are joint-free zones as specified in illustration 1.21. In low-rise construction in which the height h is less than 10 m, both l_a and l_b remain at least 1 m.

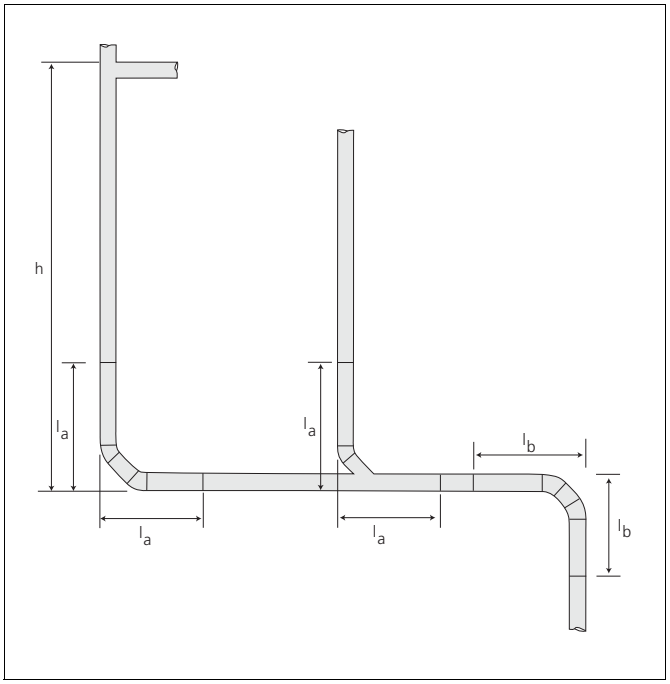


Illustration 1.21

1.2.5 Collectors and underground pipes

Incline
The incline of collectors and underground pipes must be at least 1:200 (5 mm/m) in order to prevent blockage resulting from too low flow velocity. The incline may not exceed 1:50 (20 mm/m) in order to prevent excessive flow speed that would cause a hydraulic seal.

Maximum pipe lengths
The length of a horizontal pipe depends on the connected drain fixture and incline of the pipe. In addition, there are maximum changes of direction prescribed for combinations of various connected drain fixtures. Toilets have a large influence on the length of the pipe because these must be conceived a manner to enable the waste materials travel down a given incline and reach the down pipe with one flush. Pipe length is to be understood to encompass the entire length of the connector and collector. National standards and guidelines typically provide a complete overview of the maximum pipe lengths for given diameters and pipe inclines.

The previously described connection requirements for horizontal pipes also apply to:
- the manner of connecting collectors and underground pipes together
- the manner of connecting collectors to down pipes
- the minimum distances between connector joints on collectors, underground pipes and down pipes
- the joint-free zone in the transitions from horizontal pipes to down pipes and down pipes to horizontal pipes

Reductions
In collectors and underground pipes, there are to be no reductions in the direction of draining.

1.2.6 Down pipes

How to connect to a down pipe
The connection to a down pipe must occur at an angle of between 87,5° and 90°. This prevents a hydraulic seal from being created. Improved inflow can be achieved by providing the inflow aerator with a radius.

Minimum distance between joints on a down pipe
If the angle between connectors is smaller than or equal to 90°, there are no restrictions placed on the height differences between the connections on the down pipe. A minimum 0,5 m height difference must exist if the angle is greater than 90°.

Offset in a down pipe

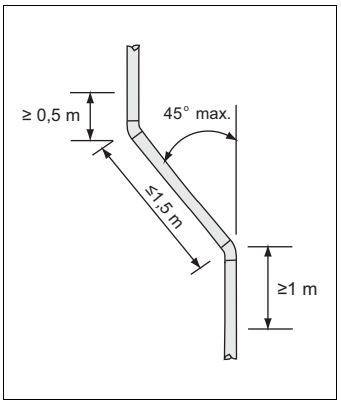


Illustration 1.22

A down pipe may be offset without an equalisation pipe if the following conditions are met:
- the length of the offset must not exceed 1,5 m.
- the angle may not exceed 45°.
- no joints in this segment may be installed in a zone ranging from 0,5 m above the offset to 1 m below the offset.

If the offset cannot satisfy these conditions, the resulting pressure differences can be alleviated by means of good air transport using an equalisation line.

Connecting a down pipe to a collector or ground pipe
The down pipe base must be constructed from two 45° bends between which a straight 250 mm segment is placed. This causes the deceleration to be less abrupt, the transported air can escape more easily and the under pressure remains limited.

A diversion pipe must be installed if the down pipe continues as a down pipe after a horizontal section and the highest joint on the down pipe is 20 m above the horizontal segment.

Each down pipe must be connected to a (combined) pressure-relief or equaliser pipe. The equaliser line connecting two parts of an offset down pipe must be constructed so that:
- No connection less than or equal to 1 m above and below the transition from down pipe to horizontal pipe and the inverse.
- The equaliser line must be connected to the down pipe by means of a 45° downward angle.
- Joint-free zones according to national standards.

1.2.7 Pressure-relief pipes
An internal sewer system must always be in contact with the outside air by means of a pressure-relief pipe. Each down pipe must also be connected to a (combined) pressure-relief pipe. No more than 10 down pipes may be connected to a combined pressure-relief pipe. A primary pressure-relief system is based on water and air transport in the same pipe without any parallel venting.

In situations in which the internal sewer design does not allow any primary pressure-relief, it is possible to resort to secondary pressure-relief, which prevents hydraulic sealing and is downstream from the last drain fixture connected to the horizontal pipe. The secondary pressure-relief line is at least 1 m above the floor connected to the down pipe at a downward 45° angle.

National standards and guidelines further describe requirements on the outlet of the pressure-relief pipe.

Application and design guidelines

2 Material 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/cm^3)
MDPE (Density 0,93-0,94 g/cm^3)
HDPE (Density 0,94-0,97 g/cm^3)

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 table 2.2 the properties and benefits of the Akatherm HDPE are highlighted.

Table 2.2 See following page

2.1 Physical characteristics of HDPE

	Unit	Test method	Value
Density at 23°C	g/cm^3	ISO 1183	0,954
Elasticity modulus	N/mm^2	ISO 527	850
Bending creep modulus	N/mm^2	DIN 54852-Z4	1000
Tensile strength at 23°C	N/mm^2	ISO 527	22
Elongation at break	%	ISO R 527	300
Linear expansion coefficient	mm/mK	DIN 53752	0,13 - 0,19
Indentation hardness	N/mm^2	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 - +100
Melt Flow Rate MFR 190/5	g/10 min	ISO 1133	0,43

Table 2.1

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Material properties

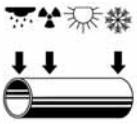
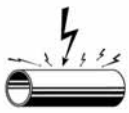
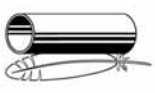
	Properties HDPE	Benefits
	Impact-resistant and tough	Unbreakable temperatures > 5°C
	Elastic	Suitable for underground pipes through adjustment to local ground movement
	Thermal resistant	Application possible between -40°C and 100°C
	Smooth internal wall	Low blockage risk due to low deposit/residue effects
	Wear resistant	Lower costs due to relatively long life
	Weather resistant/UV resistant	Application in open air unrestricted through colouring with carbon black
	Chemical resistant	Suitable for transport of polluted waste water
	Poor heat conductivity	No condensation during short periods of cooling
	Recyclable	Environmentally friendly
	Insulating	Non-conductive
	Highly suitable for welding	Easy installation using butt-welding and electrofusion techniques
	Homogeneous welded joints	End load resistant and leak proof
	Prefabrication	Reduces on-site installation time
	Light in weight	Cost-saving in transport and handling

Table 2.2

2.2 Chemical resistance

In table 2.3 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 in laboratories and the chemical industry the following factors have to be taken in account:

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

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

Used symbols

HDPE pipe and fittings:

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

Elastomeric seals:

1	Little or no effect, volume change <10%. In heavy conditions this elastomere can show a small increase in volume and /or loss of physical properties.
2	Possible change of physical properties, volume change 10%-20%, the 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 to great.
Empty field	No data available.

Abbreviations:

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

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Material properties

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
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
Aniline	$C_6H_5NH_2$	Technically pure	100%	/			4	2/3	1	3
Aniline Chlorhydrate	$C_6H_5NH2HCl$	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	BaCl2	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

Material properties

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
Benzene Sulfonic Acid	$C_6H_5SO_3H$	Aqueous solution	10%	-			4	4	1	4
Benzine (Free Of Pb And Aromatic)	$C_5H_{12}÷C_{12}H_{26}$	Technically pure	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
Copper Nitrate	$Cu(NO_3)_2$	Aqueous solution	Indetermined	+	+	+	2	1	1	1

Material properties

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 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 (Decahydronaf-talene)	$C_{10}H_{18}$	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	$C8H_{16}(COOC_4H_9)_2$	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	$Cl_2CHCOOCH_3$	Technically pure	100%	+	+	+				
Dichloroethylene	CHCl=CHCl	Technically pure	100%	-			2		2	4
Diesel Oil			100%	+	/	/	1	4	1	4
Diethylether	$C_2H_5OC2H_5$	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	$NH_2CH_2CH2NH_2$	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	H2SiF6	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.	+						

Material properties

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
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	I_2		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

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Material properties

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
Mercuric Chloride	$HgCl_2$	Aqueous solution	Saturated	+	+	+	1	1	1	1
Mercuric Cyanide	$Hg(CN)_2$	Aqueous solution	All	+	+	+				
Mercuric Sulfate	$HgSO_4$	Aqueous solution	Saturated	+	+	+				
Mercurous Nitrate	$HgNO_3$	Aqueous solution	Saturated	+	+	+				
Mercury	Hg	Technically pure	100%	+	+	+	1	1	1	1
Methane	CH_4		100%	+			1	3	1	3
Methanesulfonic Acid	CH_3SO_3H	Aqueous solution	50%	/	/					
Methanesulfonic Acid	CH_3SO_3H	Technically pure	100%	-	-					
Methyl Acetate	CH_3COOCH_3	Technically pure	100%	+			4	2	4	4
Methyl Alcohol	CH_3OH	Technically pure	100%	+	+	+				
Methyl Amine	CH_3NH_2	Aqueous solution	32%	/			4	1	4	2
Methyl Bromide	CH_3Br	Technically pure	100%	/			4	4	1	4
Methyl Chloride	CH2Cl	Technically pure	100%	/			4	3	1	4
Methyl Ethyl Ketone	$CH_3COCH2CH_3$		100%	+	/	-	4	2	4	4
Methylene Chloride	CH_2Cl_2		100%	/			4	4	3	4
Milk			100%	+	+	+	1	1	1	1
Mineral oil			Comm. Comp.	/	/	-	1	4	1	4
Mixed Acids (Chromic, Sulphuric)	$H_2CrO_4/H_2SO_4/H_2O$		50/15/35%	-						
Mixed Acids (Sulphuric, Nitric)	$H_2SO_4/HNO_3/H_2O$		10/20/70%	/	/	/				
Mixed Acids (Sulphuric, Nitric)	$H_2SO_4/HNO_3/H_2O$		48/49/3	-	-	-				
Mixed Acids (Sulphuric, Nitric)	$H_2SO_4/HNO_3/H_2O$		50/50%	-	-	-				
Mixed Acids (Sulphuric, Phosphoric)	$H_2SO_4/H_3PO_4/H_2O$		30/60/10%	+	/					
Molasses			Comm. Comp.	+	/	/	1	1	1	1
Monochloracetic Acid	$ClCH_2COOH$	Aqueous solution	50%	+	/	/	4	2		4
Monochloroacetic Acid Ethyl Ester	$ClCH_2COOCH_2CH_3$	Technically pure	100%	+	+	+				
Naphthalene	C10H8	Technically pure	100%	+	/	/				
Nickel Chloride	$NiCl_2$	Aqueous solution	All	+	+	+	1	1	1	1
Nickel Nitrate	$Ni(NO_3)_2$	Aqueous solution	Saturated	+	+	+				
Nickel Sulfate	$NiSO_4$	Aqueous solution	Solution	+	+	/	1	1	1	1
Nickel Sulfate	NiSO4	Aqueous solution	Saturated	+	+	+	1	1	1	1
Nicotine	$C_{10}H1_4N_2$		Indetermined	+	+	+				
Nitric Acid	HNO_3	Aqueous solution	20%	+	/	/	4	4	2/3	4
Nitric Acid	HNO_3	Aqueous solution	40%	/	-	-	4	4	2/3	4
Nitric Acid	HNO_3	Aqueous solution	70%	-	-	-	4	4	2/3	4
Nitric Acid	HNO_3	Technically pure	100%	-			4	4	2/3	4
Nitrobenzene	$C_6H_5NO_2$		100%	+	/	/				
Nitroethane	$CH_3CH_2NO_2$	Technically pure	100%	+	/	/	4	2	4	2
Nitromethane	CH_3NO_2	Technically pure	100%	+	/	/	4	2	4	2
Nitrotoluene	$CH_3C_6H_4NO_2$	Technically pure	100%	+	+	/				
Nitrous Gases	NOx	Anhydrous	Solution	+	+	+	1	1	1	1
Oleic Acid	$C_{17}H_{33}COOH$	Technically pure	100%	+	+	/	2	3	1	4
Oleum	$H_2SO_4+SO_3$		10%	-			4	4	1	4
Oleum	$H_2SO_4+SO_3$		High	-			4	4	1	4
Oleum	$H_2SO_4+SO_3$		Traces	-			4	4	1	4
Olive Oil			Comm. Comp.	+	+	/	1	4	1	4
Oxalic Acid	HOOCCOOH	Aqueous solution	10%	+	+	+	1	1	1	1
Oxalic Acid	HOOCCOOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Oxygen	O_2		All	+	+	/	2	1	1	4
Ozone Gas	O_3	Aqueous solution	Saturated	/	-		4	1	1	4
Ozone Gas	O_3		>2%	/	-		4	1	1	4
Palmitic Acid	$CH_3(CH_2)1_4COOH$		70%	/	-	-				
Paraffin Emulsion		Water-emulsie	Comm. Comp.	/	/	/	1	4	1	4
Paraffin Oil			Comm. Comp.	+	+	+	1	4	1	4
Peanut Oil			Comm. Comp.	+			1	3	1	4
Perchloric Acid	$HClO_4$	Aqueous solution	10%	+	+	+	4	1	1	4
Perchloric Acid	$HClO_4$	Aqueous solution	70%	+	/	-	4	1	1	4

Material properties

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
Perchloric Acid	$HClO_4$	Aqueous solution	10%	+	+		4	1	2	4
Petroleum		Technically pure	100%	+	+	/	1	4	1	4
Petroleum Ether		Technically pure	100%	+	/	/	1	4	1	4
Phenol	C_6H_5OH	Aqueous solution	1%	+	/		4	4	2	4
Phenol	C_6H_5OH	Aqueous solution	90%	+	+		4	4	1	4
Phenylhydrazine	$C_6H_5NHNH_2$	Technically pure	100%	/	/	/	3	3	2	4
Phenylhydrazine Hydrochloride	$C_6H_5NHNH_2HCl$	Aqueous solution	Saturated	+						
Phosphoric Acid	H_3PO_4	Aqueous solution	25%	+	+	+	1	1	1	1
Phosphoric Acid	H_3PO_4	Aqueous solution	50%	+	+	+	1	1	1	1
Phosphoric Acid	H_3PO_4	Aqueous solution	85%	+	+	/	1	1	1	1
Phosphorous Penta-Trichloride	PCl_5-PCl_3	Technically pure	100%	+	/	/				
Phosphorous Pentoxide	P_2O_5	Technically pure	100%	+	+	+				
Photographic Developer			Comm. Comp.	+			1	2	1	2
Photographic Emulsion			Comm. Comp.	+	+					
Phthalic Acid	$C_6H_4(COOH)_2$	Aqueous solution	50%	+	+	+				
Picric Acid	$C_6H_2(OH)(NO_2)_3$	Aqueous solution	1%	+	+	/	2	1	1	2
Potassium Acetate	CH_3COOK	Aqueous solution	Saturated	+	+	+	1	1	2	4
Potassium Bicarbonate	$KHCO_3$	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Bichromate	$K_2Cr_2O_7$	Aqueous solution	Saturated	+	+		2	1	1	2
Potassium Bisulfate	$KHSO_4$	Aqueous solution	Indetermined	+	+	+	1	1	1	1
Potassium Borate	K_3BO_3	Aqueous solution	Saturated	+	+	+				
Potassium Bromate	$KBrO_3$	Aqueous solution	Saturated	+	+	/	1	1	1	1
Potassium Bromide	KBr	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Carbonate	K_2CO_3	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Chlorate	$KClO_3$	Aqueous solution	Saturated	+	+	+	4	1	1	2
Potassium Chloride	KCl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Chromate	K_2CrO_4	Aqueous solution	Saturated	+	+		2	1	1	2
Potassium Cyanide	KCN	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Ferricyanide	$K_4Fe(CN)_{63}H_2O$	Aqueous solution	Saturated	+	+	+				
Potassium Fluoride	KF	Aqueous solution	Saturated	+	+	+				
Potassium Hydroxide	KOH	Aqueous solution	<=60%	+	+	+	2	1	2/3	1
Potassium Hypochlorite	KClO	Aqueous solution	Indetermined	+	/	/				
Potassium Iodide	KI	Aqueous solution	Saturated	+	+	+				
Potassium Nitrate	KNO_3	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Perborate	KBO_3	Aqueous solution	Indetermined	+	+	+				
Potassium Perchlorate	$KClO_4$	Aqueous solution	Saturated	+	+	+	3	1	1	3
Potassium Permanganate	$KMnO_4$	Aqueous solution	10%	+	+	+				
Potassium Permanganate	$KMnO_4$	Aqueous solution	Saturated	+	+	/				
Potassium Persulfate	K_2S_2O8	Aqueous solution	Saturated	+	+	+				
Potassium Phosphates Acids	K_2HPO_4 KH_2PO_4	Aqueous solution	All	+	+	+				
Potassium Sulfate	K_2SO_4	Aqueous solution	Saturated	+	+	+	1	1	1	1
Propane Gas	$CH_3CH_2CH_3$		100%	+			1	4	1	4
Propane Gas	$CH_3CH_2CH_3$		100%	+			1	4	1	4
Propionic Acid	CH_3CH_2COOH	Aqueous solution	50%	+	+	+	2	4	1	4
Propyl Alcohol	C_3H_7OH	Aqueous solution	97%	+	+	+				
Propylene Glycol	$CH_3CHOHCH_2OH$	Technically pure	100%	+	+	+	2	1	1	1
Propylene Oxid		Technically pure	100%	+			4	1	4	4
Pyridine	C_5H_5N	Technically pure	100%	+	/	/	4	4	4	4
Silicic Acid	H_2SiO_3	Aqueous solution	All	+	+	+				
Silicone Oil			Comm. Comp.	+	+	/	1	1	1	1
Silver Cyanide	AgCN	Aqueous solution	All	+	+	+				
Silver Nitrate	$AgNO_3$	Aqueous solution	Saturated	+	+	+	1	1	1	1
Silver Sulfate	Ag_2SO_4	Aqueous solution	Saturated	+	+	+				
Soap		Aqueous solution	All	+	+	+	1	1	1	2
Sodium Acetate	CH_3COONa	Aqueous solution	Saturated	+	+	+	2	1	4	4
Sodium Alum	$NaAl(SO_4)_2$	Aqueous solution	Saturated	+	+	+				
Sodium Benzoate	C_6H_5COONa		Saturated	+	+	+				

akatherm

Material properties

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
Sodium Bicarbonate	$NaHCO_3$	Aqueous solution	Saturated	+	+	+	2	1	1	1
Sodium Bichromate	Na_2Cr_2O7	Aqueous solution	Saturated	+	+	+				
Sodium Bisulfate	$NaHSO_4$	Aqueous solution	10%	+	+	+	1	1	1	2
Sodium Bisulfite	$NaHSO_3$	Aqueous solution	100%	+	+	+	1	1	1	2
Sodium Bromate	$NaBrO_3$	Aqueous solution	All	+	/					
Sodium Bromide	NaBr	Aqueous solution	Saturated	+	+	+				
Sodium Carbonate (Soda)	Na_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_2O8	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	H_2SO_4	Aqueous solution	10%	+	+	+	2	1	2	2
Sulphuric Acid	H_2SO_4	Aqueous solution	50%	+	+	+	4	1	2	4
Sulphuric Acid	H_2SO_4	Aqueous solution	80%	+	+	/	4	2	2	4
Sulphuric Acid	H_2SO_4	Aqueous solution	90%	/	/	-				
Sulphuric Acid	H_2SO_4	Aqueous solution	96%	-	-	-	4	4	2	4
Sulphuric Acid	H_2SO_4	Aqueous solution indetermined	98%	-	-	-				
Sulphuric Acid	H_2SO_4	Technically pure	100%	-	-	-				
Sulphurous Acid	H_2SO_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

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
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
Tetrahydrofurane	$(CH_2)_4O$		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	$C6H_5CH_3$	Technically pure	100%	/	-	-	4	4	2	4
Toluic Acid	CH_3C6H_4COOH		50%	/						
Transformer Oil			Comm. Comp.	+	/	/	2	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	$(CH_3C6H_4O)_3PO_4$	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	H2O		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

Table 2.3 Chemical resistance. The data is based on the latest knowledge. When in doubt please contact our Technical Support department.

2.3 Noise and condensation insulation

2.3.1 Noise insulation

What is noise?

Noise is a variance in air pressure that spreads like a wave. If quick changes in pressure occur between 20 and 20.000 times a second (frequency 20 Hz and 20kHz), they are audible to humans. The loudness of noise is determined by the amplitude of the wave, which is measured in decibels (dB).

A decibel is not a unit of measurement but provides a comparison between a reference point and the measured value. The human ear is most sensitive to frequencies between 1 kHz and 4 kHz, and to a lesser extent, to other frequencies. To make a good comparison, these differences in sensitivity must be corrected by means of the so-called A-filter, which yields the measurement dB(A). Values measured in dB(A) are not corrected at 1000 Hz, which stands for 0 dB(A).

How noise is created

Noise can be created in various ways. For instance, 'airborne noise' comes from a source that causes the air to vibrate, such as a roof drainage system. 'Contact noise' is created by mechanical contact passing on vibrations to a structure through brackets, for example. Both types of noise must be taken into account. Airborne noise can be well insulated by working with absorbent material. Contact noise can be reduced by using soft material to acoustically uncouple the mechanical contact.

Material properties

Noise according to standards
The Netherlands Building Decree (Bouwbesluit) imposes the following requirements concerning the shielding of installations in residences and residential buildings from noise:
1. As defined in NEN 5077, the characteristic noise level of a flush toilet located in a residence may not, according to the standard, exceed 30 dB(A) in a residential area outside the residence in question in order to limit noise nuisance.
2. The noise level of a flush toilet located in a residential building but outside any of the residences comprising it may not exceed 30 dB(A) in a living area of a residence or other building.

According to the standard, the values also apply to the residential areas of buildings not intended to be residential, such as:
- office and bank buildings
- hotel and restaurant buildings
- buildings involved in health care (hospitals, psychiatric institutions)

A noise level of 35 dB(A) applies to lodging houses and hotels.

In measuring noise, a distinction is made between transient and protracted noise. Noise measurements must measure the maximum noise level throughout a complete operational cycle with the noise meter at the S(low) setting. At noise levels of 35 to 45 dB(A), the chance of noise nuisance is relatively large, and noise nuisance is to be expected at levels exceeding 45 dB(A).

What causes internal sewer noise
The noise level resulting from internal sewers depends on such factors as:
- type of (drain) pipe
- type of bracketing used
- insulation
- fall height
- drainage capacity and diameter

The standard individually describes the noise levels to be expected from each source.

Down pipes that incorporate Akavent aerators have proven in practice to produce less noise that traditional down pipes, in which fall velocities are higher. Akavent aerators reduce fall velocities at each storey, reducing the noise created in an Akavent system to a level below that occurring in a traditional system.
A proper choice of materials and appropriate construction measures enable the noise produced to be well within the standard.

Measures against noise nuisance
Measures to be taken against noise nuisance can be divided into:
- Design measures
- Construction measures

Measures during design relate to the proper location of the drain pipes. In locating shafts in a multi-storey residential building, an effort should be made to avoid residential areas as much as possible. In non-residential construction, rooms such as storage, toilets and pantries have the preference over offices and meeting rooms.

Construction measures refer to the installation of architectural structures around pipes involving insulating provisions for both airborne and contact noise.

An insulating measure against airborne noise in residential construction involves encasing the pipes in concrete. The encasement of pipes in concrete floors is common practice in residential construction when the drain pipes have a design 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). Shafts in a multi-storied residential building are insulated by the shaft wall, for which the applicable standard describes some constructions in which appropriate noise insulation is provided. Additional noise-reducing measures are necessary if the shaft wall is not adequately insulated.

A measure against airborne noise in non-residential construction, in which pipes mostly run through ceilings, involves the installation of mineral wool ceilings, which result in a reduction of approximately 5 dB(A): mineral fibre can obtain a reduction of around 10 dB(A).

The production of contact noise is mostly 15 dB(A) to 20 dB(A) lower than airborne noise. Once airborne noise has been sufficiently limited, a determination can then be made of the extent to which contact noise must be reduced in order to obtain a sufficiently low overall noise level. Additionally, a role is played by the fastening technique used and the mass of the wall to which a pipe is attached. For this reason, the choice should be made to attach the pipes to the heaviest wall.

The standard identifies other insulation measures, including a list of acoustic effects in dB(A) for various noise insulation measures with regard to HDPE pipes.

2.3.2 Condensation insulation
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 temperature falls, 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 is therefore dependent on a number of factors:
- room temperature (the warmer a room, the more water vapour can be contained in the air)
- relative humidity of the air
- temperature of the pipe surface

With the aid of the h-x (Mollier) diagram and a detailed calculation, a determination can be made of when and with which material a pipe needs to be insulated. Polyethylene has a relatively good thermal coefficient. No condensation will therefore occur during short periods of transporting 'cold' fluids.

There are, however, a number of rules of thumb:
Always insulate
- Pipes in wall cavities
- Pipes in drop ceilings
- Pipes in concrete
- Pipes in poorly conditioned industrial buildings (without proper circulation, for example: no heaters, fans, etc.)
- Pipes in paper storerooms (not properly conditioned areas)

Do not insulate
- Pipes in a properly conditioned industrial building (having sufficient air circulation due to heaters, fans, etc.) unless the contracting party or consultant deems this desirable.

If the choice is made to insulate, the entire pipe network must be insulated. An insulated circuit must always be a closed circuit.

2.4 Fire hazard

HDPE burns, but is not classified as flammable. Principal toxicant in the smoke is carbon monoxide. The ignition temperature of HDPE lies above 300°C. In designing new buildings a lot of attention goes to compartmenting the building. This is to prevent the fire from spreading to a neighboring room. The solution for the wall and ceiling penetrations is the use of a fire collar. Installed around the Akatherm pipe they squeeze off the pipe when a certain temperature is reached and close the penetration hermetic.

Depending on local regulations all wall and ceiling penetrations have to be safeguarded in this way above a certain diameter of pipe.

Safety data sheet
The safety data sheets are available on request.


Borstar® ME3440

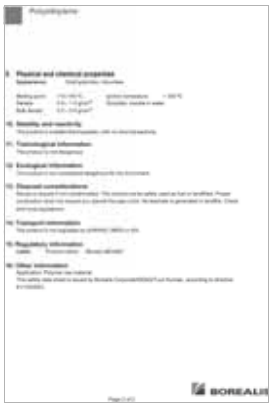


Illustration 2.1

Material properties

3 Standards and quality

Akatherm specialist drainage systems are developed and manufactured within an ISO 9001 Quality Assurance system and comply with the EN 1519 and other relevant international standards as well as meeting numerous other national approved standards.

3.1 Standards and approvals

The Akatherm PE system has the appropriate national approval for most countries. All these approvals are based on the international EN 1519 standard or any other national equivalent. These approvals ensure a pipe system of the highest quality standards.

Country	Certificate of approval	Standard
The Netherlands	KOMO	NEN-EN 1519
Belgium	BENOR	NBN EN 1519
Germany		DIN EN 1519 DIN EN 12666
Denmark		NKB Product Rules No. 8
Sweden		NKB Product Rules No. 8
Italy	IIP 242 UNI	UNI EN 1519
Australia		AS/NZS 4401 AS/NZS 5065
Austria		ÖNORM EN 1519
France	CSTBat	NF-EN 1519
Switzerland	Swiss Quality	EN 1519 EN 12666
Finland	STF	NKB Product Rules No. 8

Table 3.1

3.2 Quality management ISO 9001

Akatherm has a quality management system in accordance with ISO 9001.

It comprises all business processes within Akatherm, ranging from development and production to marketing and supply of plastic pipe systems. It emphasises on quality care and continuous improvements in customer satisfaction.

Akatherm is a leading brand of specialist drainage systems which is also reflected in our management systems certified by Lloyd's Register Quality Assurance.

Illustration 3.1 ISO 9001

3.3 Environmental management ISO 14001

Akatherm has integrated the ISO 14001 environmental management system into our quality management.

The ISO 14001 environmental management system is a standard which controls and improves our overall environmental performance. The system structurally focuses our attention to the environment during everyday operation. Two of the most important starting points are to make permanent environmental improvements and conformity with all rules and regulations.

Illustration 3.2 ISO 14001

3.4 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 15 years. Details are available on request.

3.5 Aliaxis

Akatherm has build a network of connected organisations and institutes which all contribute to the guaranteed quality of the systems and service which Akatherm offers.

Akatherm is a part of Aliaxis which is the largest producer of plastic pipe systems in the world. The Aliaxis group has 15.000 employees and comprises of more than 100 companies with subsidiaries in 40 countries. All companies operate under their own brand and are specialized in specific solutions for building, industrial and utility applications.
Akatherm is the brand within Aliaxis focusing on specialist drainage systems in the commercial and industrial building sector.

Standards and quality

4 Product range

On the following pages you will find the complete Akatherm product range for specialist drainage systems. The product range is divided into a general section and a section tools.

4.1 Dimensions

The dimensions of the pipe and fittings in the product tables are all in mm unless stated differently. The standard wall thickness of the fittings is not included in the tables but can be found in the table below, any deviation is mentioned in the product table.

diameter d_1	wall thickness e
32	3,0
40	3,0
50	3,0
56	3,0
63	3,0
75	3,0
90	3,5
110	4,2
125	4,8
160	6,2
200	6,2
250	7,7
315	9,7

Table 4.1 Wall thickness pipe fittings

4.2 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.

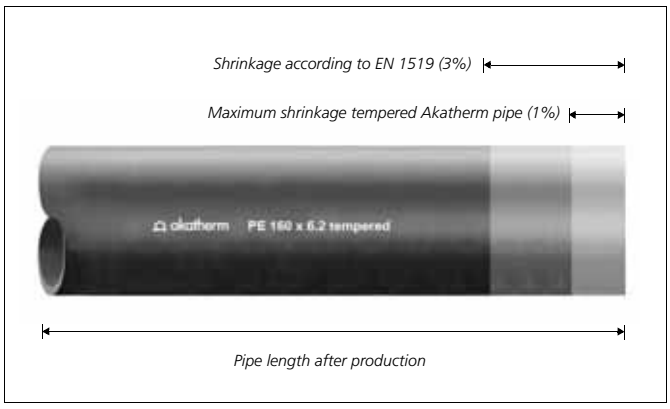


Illustration 4.1

4.3 Electrofusion

The Akatherm products can be welded by electrofusion unless stated differently in the product table. Electrofusion is the preferred method of on-site jointing.

4.4 Butt-welding and the k-dimension

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 on a standard butt-welding machine.

4.5 Abbreviations

Abbreviation	
A	Cross section area flow
AG	Article group
Art. Nr.	Article number
D	External dimension fitting part
d_1, d_2 ...	External dimension fitting/pipe
DN	Nominal size
e	Wall thickness
k_1,k_2 ...	Maximum length for shortening fittings
L	Total length fitting
l_1,l_2 ...	Partial length of fitting
q	Packing quantity
s	Pipe class according to ISO-S (SDR-1)/2
SDR	Ratio diameter/wall thickness d_1/e

Table 4.2

4.6 Handling and storage

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

Lengths
Pipe lengths stored individually should be stacked in a pyramid not more that 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).

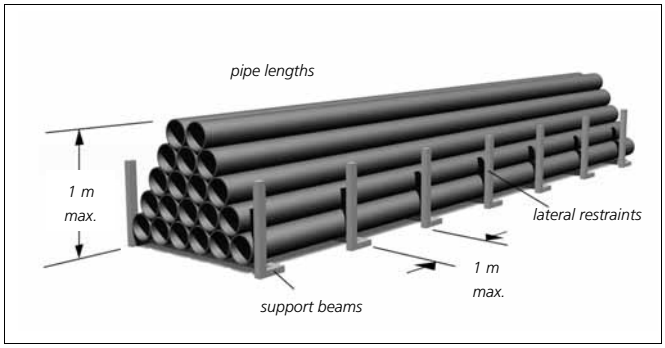


Illustration 4.2 Storage of loose pipes

Product range

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

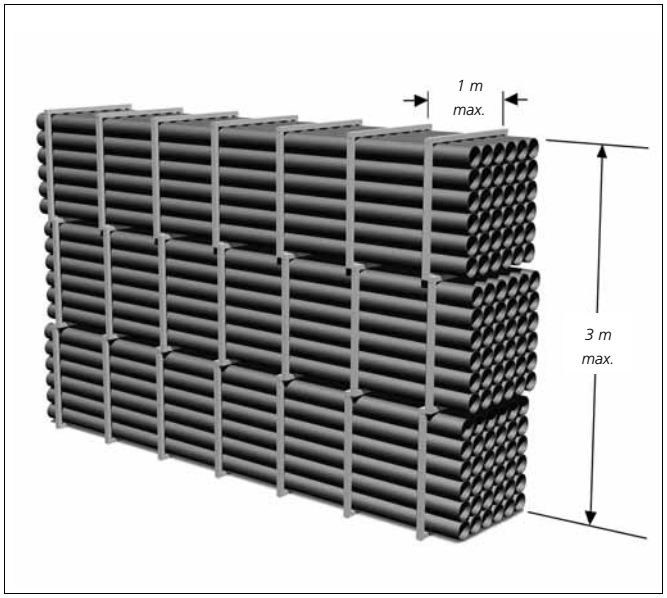


Illustration 4.3

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 required for use.

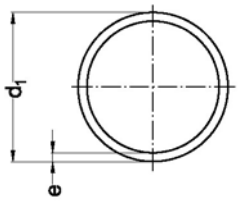
Tools
All tools, especially electrical, must be protected against moisture, dust and should not be dropped.

Recycling residual waist
According to regulations, residual waist materials should be recycled:

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

Pipe tempered HDPE

Pipe length = 5 m

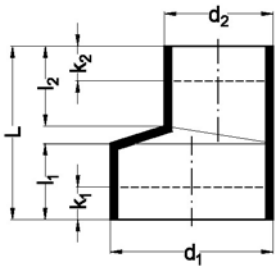


d_1	Art. Nr.	S	e	A (cm^2)	kg/m
40	**10 04 00**	12,5	3,0	9,10	0,36
50	**10 05 00**	12,5	3,0	15,20	0,45
56	**10 56 00**	12,5	3,0	19,60	0,51
63	**10 06 00**	12,5	3,0	25,50	0,58
75	**10 07 00**	12,5	3,0	37,40	0,70
90	**10 09 00**	12,5	3,5	54,10	0,98
110	**10 11 00**	12,5	4,2	80,70	1,43
125	**10 12 00**	12,5	4,8	104,20	1,85
160	**10 16 00**	12,5	6,2	171,10	3,04
200	**10 20 10**	12,5	7,7	267,64	4,69
250	**10 25 10**	12,5	9,6	418,37	7,30
315	**10 31 10**	12,5	12,1	664,17	11,60
200	**10 20 00**	16	6,2	276,41	3,84
250	**10 25 00**	16	7,7	431,52	5,99
315	**10 31 00**	16	9,7	685,35	9,45

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

HDPE drainage

Reducer eccentric HDPE



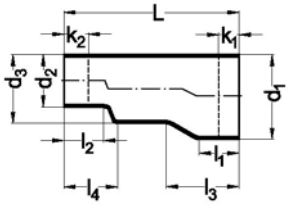
d_1/d_2	Art. Nr.	L	l_1	l_2	k_1	k_2
50/40	**16 05 04**	80	35	37	20	20
56/40	**16 56 04**	80	35	37	20	20
56/50	**16 56 05**	80	35	37	20	20
63/40	**16 06 04**	80	35	37	20	20
63/50	**16 06 05**	80	35	37	20	20
63/56	**16 06 56**	80	35	37	20	20
75/40	**16 07 04**	80	35	30	20	20
75/50	**16 07 05**	80	35	37	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

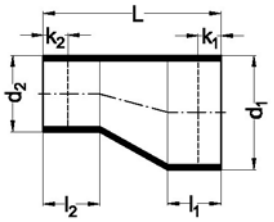
HDPE

d_1/d_2	Art. Nr.	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

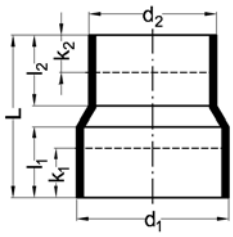


B



HDPE drainage

Reducer concentric HDPE



d_1/d_2	Art. Nr.		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**	*	149	50	40	40	30
250/160	**15 25 16**	*	194	60	40	50	30
250/200	**15 25 20**	*	182	60	50	50	40
315/200	**15 31 20**	*	230	90	80	80	70
315/250	**15 31 25**	*	230	90	90	80	80

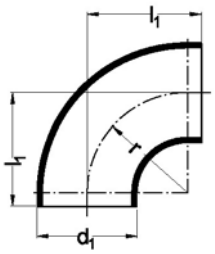
* *butt-weld only*

Bend 90°

HDPE

d_1	Art. Nr.		l_1	r
160	**11 16 91**	*	160	160
200	**11 20 91**	*	205	200
250	**11 25 91**	*	290	265
315	**11 31 91**	*	340	300

* *butt-weld only*

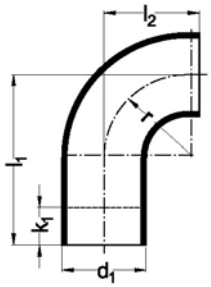


Bend 90° with long side

HDPE

d_1	Art. Nr.		l_1	l_2	r	k_1
40	**11 04 92**	*	93	43	40	45
50	**11 05 92**	*	103	53	50	45
56	**11 56 92**	*	120	59	56	55
63	**11 06 92**	*	130	66	65	60
75	**11 07 92**	*	140	78	75	60
90	**11 09 92**	*	155	93	90	60
110	**11 11 92**	*	180	113	110	60
125	**11 12 92**	*	190	128	125	60

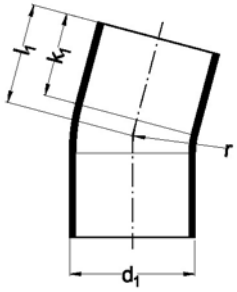
* *electrofusable at one side*



HDPE drainage

Bend 15° HDPE

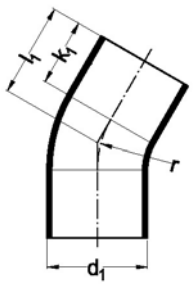
fabricated



d_1	Art. Nr.	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

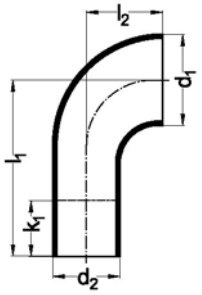
fabricated



d_1	Art. Nr.	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

Bend 90° reduced

HDPE

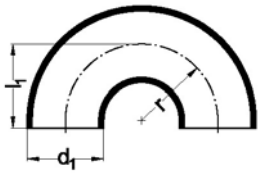


d_1/d_2	Art. Nr.		l_1	l_2	k_1
50/40	**17 05 04**	*	90	40	40
63/50	**17 06 05**	*	119	50	50

* *electrofusable at one side*

Bend 180°

HDPE



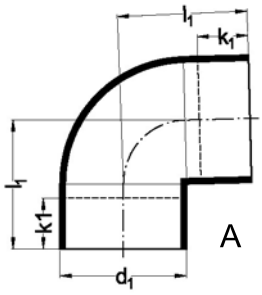
d_1	Art. Nr.		l_1	r
40	**11 04 99**	*	38	40
50	**11 05 99**	*	55	50
56	**11 56 99**	*	47	49
63	**11 06 99**	*	60	64

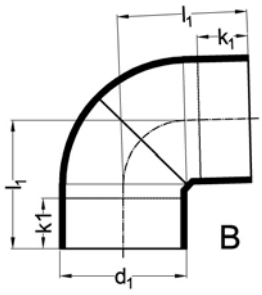
* *butt-weld only*

Bends 180° are suitable for the fabrication of traps.

HDPE drainage

Elbow 88,5° HDPE





d_1	Art. Nr.		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**	*	B	290	60
250	**12 25 88**	**	B	350	60
315	**12 31 88**	**	B	360	60

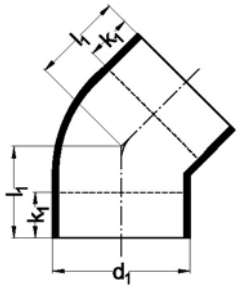
* *fabricated*

** *fabricated*
wall thickness e according to S12,5

HDPE drainage

Elbow 45°

HDPE

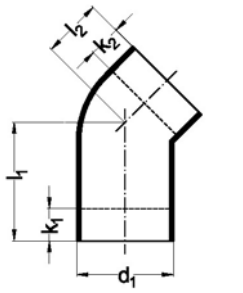


d_1	Art. Nr.		l_1	k_1
40	**12 04 45**		40	20
50	**12 05 45**		45	20
56	**12 56 45**		45	20
63	**12 06 45**		50	20
75	**12 07 45**		50	20
90	**12 09 45**		55	20
110	**12 11 45**		60	25
125	**12 12 45**		65	25
160	**12 16 45**		69	20
200	**12 20 45**		173	60
250	**12 25 45**	*	182	60
315	**12 31 45**	*	195	60

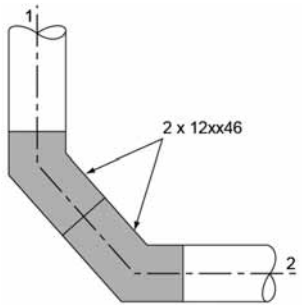
* *wall thickness e according to S12,5*

Elbow 45° with long side

HDPE



d_1	Art. Nr.	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



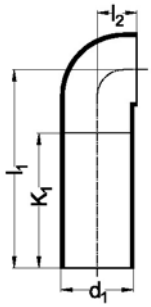
Elbows 45° with long side are applied for making the transition from stack to building drain acc. to EN 12056 (see drawing).

1 stack
2 building drain

HDPE drainage

Elbow 90° with long side

HDPE



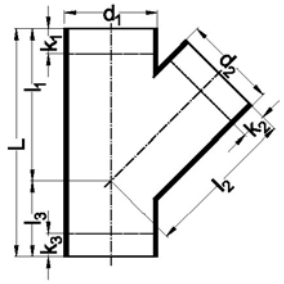
d_1	Art. Nr.		l_1	l_2	k_1
90	**12 09 93**	*	270	50	175
110	**12 11 93**	*	300	60	220

* *electrofusable at one side*

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

Y-branch 45°

HDPE



d_1/d_2	Art. Nr.		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**	*	375	250	125	120	115	65
160/56	**30 16 56**	*	375	250	125	120	115	65
160/63	**30 16 06**	*	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**	*	540	360	180	95	15	175
200/56	**30 20 56**	*	540	360	180	95	15	175
200/63	**30 20 06**	*	540	360	180	95	15	175
200/75	**30 20 07**	**	540	360	180	95	160	175
200/90	**30 20 09**	**	540	360	180	80	150	165
200/110	**30 20 11**	**	540	360	180	65	140	150
200/125	**30 20 12**	**	540	360	180	55	130	140
200/160	**30 20 16**	**	540	360	180	35	85	115
200/200	**30 20 20**	**	555	375	180	0	0	95
250/75	**30 25 07**	***	660	440	270	170	205	235
250/90	**30 25 09**	***	660	440	220	160	195	225
250/110	**30 25 11**	***	660	440	220	150	185	215

-- to be continued --

HDPE drainage

Y-branch 45° - continuation -

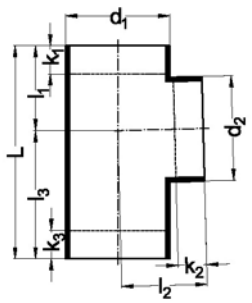
d_1/d_2	Art. Nr.		L	l_1/l_2	l_3	k_1	k_2	k_3
250/125	**30 25 12**	***	660	440	220	140	175	205
250/160	**30 25 16**	***	660	440	220	120	130	180
250/200	**30 25 20**	***	660	440	220	90	50	150
250/250	**30 25 25**	***	900	600	300	160	160	250
315/75	**30 31 07**	***	840	560	280	255	280	325
315/90	**30 31 09**	***	840	560	280	245	270	315
315/110	**30 31 11**	***	840	560	280	235	260	305
315/125	**30 31 12**	***	840	560	280	220	250	290
315/160	**30 31 16**	***	840	560	280	200	205	270
315/200	**30 31 20**	***	840	560	280	175	125	240
315/250	**30 31 25**	***	840	560	280	140	130	205
315/315	**30 31 31**	***	950	610	340	170	170	280

* *fabricated from branch xxx/75 mm with concentric reducer*

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

*** *fabricated*

Branch 88,5° HDPE



d_1/d_2	Art. Nr.		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**	*	250	100	150	60	25	110
125/56	**20 12 56**	*	250	100	150	55	25	105
125/63	**20 12 06**	*	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**	*	350	140	210	75	30	145
160/56	**20 16 56**	*	350	140	210	75	30	145
160/63	**20 16 06**	*	350	140	210	65	30	140

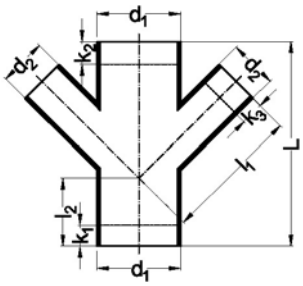
-- to be continued --

Branch 88,5° - continuation -

d_1/d_2	Art. Nr.		L	l_1/l_2	l_3	k_1	k_2	k_3
160/75	**20 16 07**	*	350	140	210	80	45	150
160/90	**20 16 09**	*	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**	*	360	180	180	90	60	90
200/90	**20 20 09**	*	360	180	180	80	60	80
200/110	**20 20 11**	*	360	180	180	70	60	70
200/125	**20 20 12**	*	360	180	180	65	60	65
200/160	**20 20 16**	*	360	180	180	45	60	45
200/200	**20 20 20**	*	360	180	180	25	60	25
250/110	**20 25 11**	*	440	220	220	110	70	110
250/125	**20 25 12**	*	440	220	220	105	70	105
250/160	**20 25 16**	*	440	220	220	85	70	85
250/200	**20 25 20**	*	480	240	240	65	40	65
250/250	**20 25 25**	*	480	240	240	40	40	40
315/110	**20 31 11**	*	560	280	280	170	90	170
315/125	**20 31 12**	*	560	280	280	165	90	165
315/160	**20 31 16**	*	560	280	280	145	90	145
315/200	**20 31 20**	*	560	280	280	120	65	120
315/250	**20 31 25**	*	560	280	280	95	65	95
315/315	**20 31 31**	*	560	280	280	70	65	70

* *fabricated*

Double branch 45° HDPE

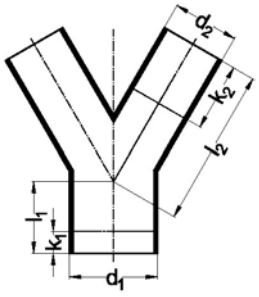


d_1/d_2	Art. Nr.	L	l_1	l_2	k_1	k_2	k_3
110/40	**36 11 04**	270	180	100	110	65	45
110/50	**36 11 05**	270	180	100	100	65	45
110/110	**36 11 11**	270	180	100	65	20	20

HDPE drainage

Y-piece 60°

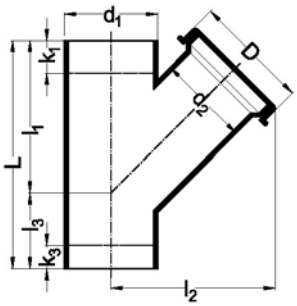
HDPE



d_1/d_2	Art. Nr.	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

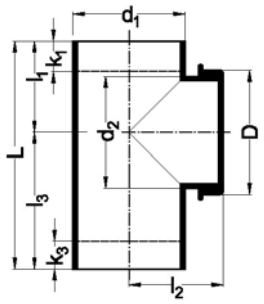


d_1/d_2	Art. Nr.	D	L	l_1	l_2	l_3	k_1	k_3
110/110	**33 11 00**	140	270	180	195	90	20	55
125/110	**33 12 00**	140	300	200	200	100	25	25
160/110	**33 16 00**	140	375	250	220	125	45	45

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

Clean out branch 90°

HDPE



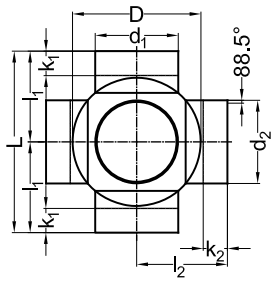
d_1/d_2	Art. Nr.	D	L	l_1	l_2	l_3	k_1	k_3
40/40	**23 04 00**	64	130	55	80	75	25	45
50/50	**23 05 00**	72	150	60	72	90	25	55
56/56	**23 56 00**	83	175	70	100	105	30	65
63/63	**23 06 00**	87	175	70	100	105	30	60
75/75	**23 07 00**	91	175	70	100	105	25	55
90/90	**23 09 00**	118	200	80	100	120	25	70
110/110	**23 11 20**	135	225	90	100	135	20	65
125/110	**23 12 00**	140	250	100	123	150	20	80
160/110	**23 16 00**	140	350	140	140	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.

HDPE drainage

Ball Branches - General dimensions

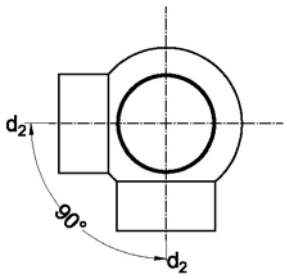
HDPE



Double ball branch 88,5°

HDPE

fabricated - 90°



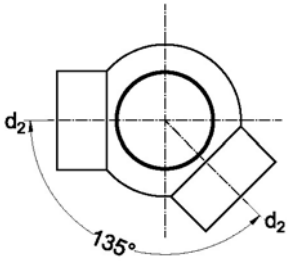
d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 14**	275	135	140	170	30	15
110/56	**24 11 15**	275	135	140	170	30	15
110/63	**24 11 16**	275	135	140	170	30	15
110/75	**24 11 17**	275	135	140	170	30	15
110/90	**24 11 19**	275	135	140	170	30	15
110/110	**24 11 01**	275	135	140	170	30	30
125/50	**24 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°

HDPE

fabricated - 135°



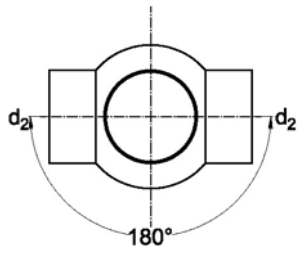
d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 24**	275	135	140	170	30	15
110/56	**24 11 25**	275	135	140	170	30	15
110/63	**24 11 26**	275	135	140	170	30	15
110/75	**24 11 27**	275	135	140	170	30	15
110/90	**24 11 29**	275	135	140	170	30	15
110/110	**24 11 02**	275	135	140	170	30	30
125/50	**24 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°

HDPE

fabricated - 180°



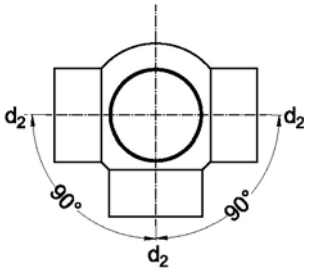
d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**24 11 34**	275	135	140	170	30	15
110/56	**24 11 35**	275	135	140	170	30	15
110/63	**24 11 36**	275	135	140	170	30	15
110/75	**24 11 37**	275	135	140	170	30	15
110/90	**24 11 39**	275	135	140	170	30	15
110/110	**24 11 03**	275	135	140	170	30	30
125/50	**24 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.

HDPE drainage

Triple ball branch 88,5° HDPE

fabricated - 90°

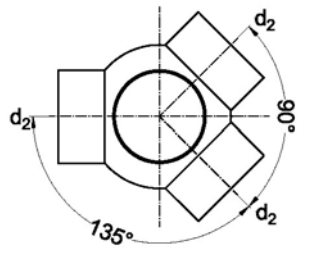


d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**34 11 14**	275	135	140	170	30	15
110/56	**34 11 15**	275	135	140	170	30	15
110/63	**34 11 16**	275	135	140	170	30	15
110/75	**34 11 17**	275	135	140	170	30	15
110/90	**34 11 19**	275	135	140	170	30	15
110/110	**34 11 01**	275	135	140	170	30	30
125/50	**34 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.

Triple ball branch 88,5° HDPE

fabricated - 135°



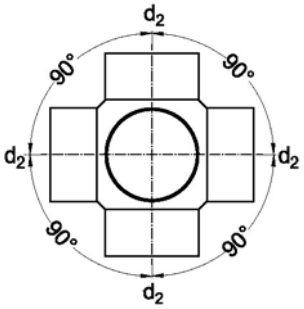
d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**34 11 24**	275	135	140	170	30	15
110/56	**34 11 25**	275	135	140	170	30	15
110/63	**34 11 26**	275	135	140	170	30	15
110/75	**34 11 27**	275	135	140	170	30	15
110/90	**34 11 29**	275	135	140	170	30	15
110/110	**34 11 02**	275	135	140	170	30	30
125/50	**34 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°

HDPE

fabricated - 90°

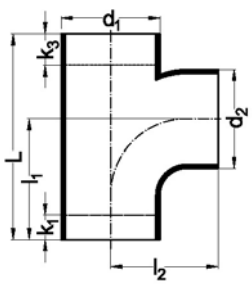


d_1/d_2	Art. Nr.	L	l_1	l_2	D	k_1	k_2
110/50	**44 11 14**	275	135	140	170	30	15
110/56	**44 11 15**	275	135	140	170	30	15
110/63	**44 11 16**	275	135	140	170	30	15
110/75	**44 11 17**	275	135	140	170	30	15
110/90	**44 11 19**	275	135	140	170	30	15
110/110	**44 11 01**	275	135	140	170	30	30
125/50	**44 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.

Branch 88,5° swept entry

HDPE

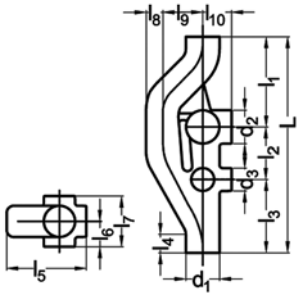


d_1/d_2	Art. Nr.	L	l_1	l_2	k_1	k_3
110/110	**25 11 11**	230	140	120	90	20

HDPE drainage

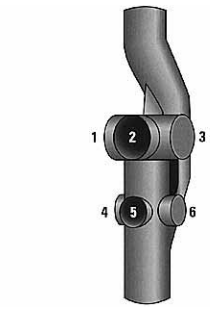
Akavent aerator

HDPE



d_1/d_2	Art. Nr.		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**	*	75	705	295	170	240	60	279	89	178	55	130	94
160/110	**60 16 17**	*	75	750	330	170	250	60	339	114	228	80	140	119

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



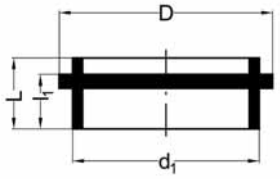
The Akavent aerator interrupts the fall of the waste water on every floor resulting in a reduction of the speed. The vent pipe is obsolete and the unique design increases the capacity of the riser.
The Akavent aerator will be delivered with closed caps. After removing the caps, the required branches can be butt-welded to the aerator. When the connection will be made with snap socket Art. Nr. 40xx10 a tight-fit plug-in connection is created. Then a transition to other material is also possible.

End cap

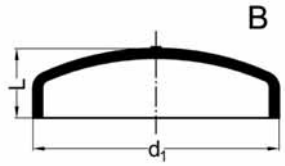
HDPE

d_1	Art. Nr.		Type	L	D	l_1
40	**67 04 07**	*	A	15	46	11
50	**67 05 07**	*	A	16	57	12
56	**67 56 07**	*	A	16	64	12
63	**67 06 07**	*	A	18	71	14
75	**67 07 07**	*	A	21	85	16
90	**67 09 07**	*	A	19	100	19
110	**67 11 07**	*	A	19	120	19
125	**67 12 09**	*	B	35		
160	**67 16 09**	*	B	45		
200	**67 20 09**	*	B	55		
250	**67 25 09**	*	B	30		
315	**67 31 09**	*	B	30		

A



B

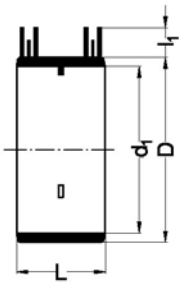


* *butt-weld only*

HDPE drainage

Electrofusion coupler Akafusion

HDPE
Akafusion



d_1	Art. Nr.	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**	122	58	22	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 Akafusion 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 Akafusion control box and other suitable control boxes.

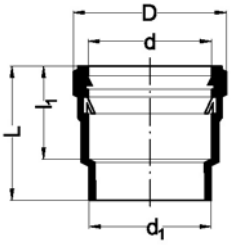
Snap socket
with protection plug

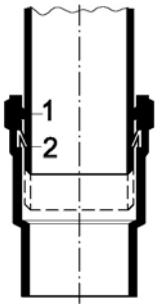
HDPE

SBR seal

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

* *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.

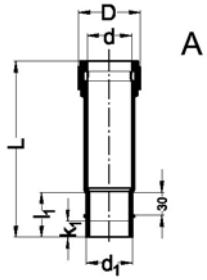
1 sealing ring
2 snap ring

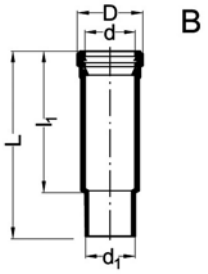
HDPE drainage

Expansion socket with anchor point
with protection plug

HDPE

SBR seal

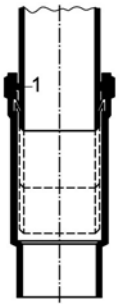




d_1	Art. Nr.		Type	D	d	L	l_1	k_1
40	**40 04 20**		B	58	41	172	13	
50	**40 05 20**		B	68	51	172	135	
56	**40 56 20**		B	74	57	172	135	
63	**40 06 20**	*	B	78	64	155	135	
75	**42 07 20**		A	100	76	256	75	35
90	**42 09 20**		A	116	91	256	75	35
110	**42 11 20**		A	137	112	256	75	35
125	**42 12 20**		A	153	127	256	75	35
160	**42 16 20**		A	189	162	265	75	35
200	**40 20 60**	**	B	230	202	310	230	
250	**40 25 60**	**	B	300	253	330	250	
315	**40 31 60**	**	B	370	319	360	270	

* *butt-weld only*

** *butt-weld only without protection plug*



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.

1 sealing ring

Snap socket short
with protection plug

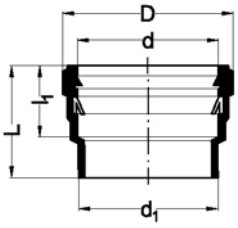
HDPE

SBR seal

d_1	Art. Nr.		D	d	L	l_1
110	**40 11 40**	*	130	111	55	45

* *butt-weld only*

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



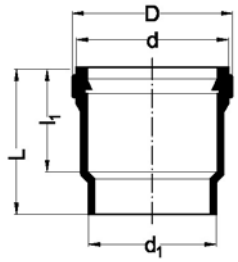
Plug-in socket
with protection plug

HDPE

SBR seal

d_1	Art. Nr.		D	d	L	l_1
40	**42 04 50**	*	53	41	73	54
50	**42 05 50**		67	51	75	54
56	**42 56 50**		72	57	80	54
63	**42 06 50**	*	84	64	93	69
75	**42 07 50**		96	76	95	69
90	**42 09 50**	*	110	91	95	69
110	**42 11 50**		131	111	95	69
125	**42 12 50**	*	150	126	94	70
160	**42 16 50**		190	162	130	105

* *butt-weld only*



HDPE drainage

Screw coupler short

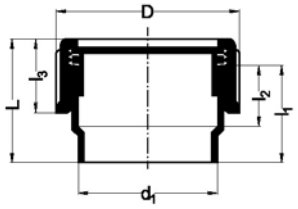
HDPE

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

EPDM seal

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

* *butt-weld only*

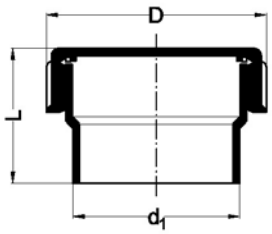


Inspection screw lock long

HDPE

EPDM seal

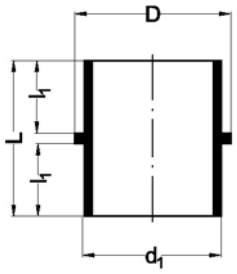
d_1	Art. Nr.	D	L
40	**66 04 40**	66	85
50	**66 05 40**	76	85
56	**66 56 40**	82	85
63	**66 06 40**	89	90
75	**66 07 40**	103	91
90	**66 09 40**	122	102
110	**66 11 40**	148	107



Flange bushing for screw coupler

HDPE

d_1	Art. Nr.	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



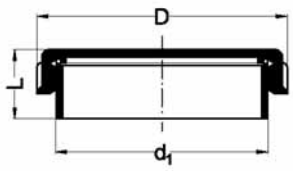
Inspection screw lock short

HDPE

EPDM seal

d_1	Art. Nr.		D	L
75	**66 07 00**	*	91	48
110	**66 11 20**	*	133	53

* *butt-weld only*

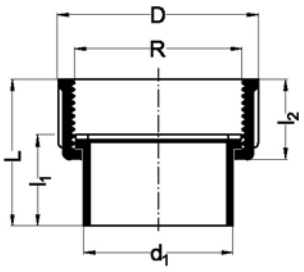


HDPE drainage

Waste connector
with nut and seal

HDPE

SBR seal

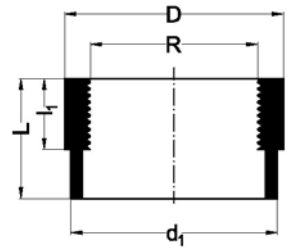


d_1	Art. Nr.		R	L	l_1	l_2	D
32	**98 03 81**	*	1 ¼"	35	21	21	54
40	**98 04 82**	*	1 ½"	38	25	21	59
50	**98 05 83**	*	2"	44	30	21	72

* *butt-weld only*

Female thread adaptor short

HDPE

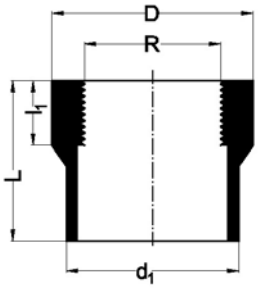


d_1	Art. Nr.		R	L	l_1	D
40	**91 04 78**	*	½"	38	30	40
40	**91 04 79**	*	¾"	38	30	40
40	**91 04 80**	*	1"	38	30	45
40	**91 04 81**	*	1 ¼"	38	30	55
50	**91 05 80**	*	1"	38	30	50
50	**91 05 81**	*	1 ¼"	38	30	55
50	**91 05 82**	*	1 ½"	38	30	63
63	**91 06 82**	*	1 ½"	38	30	63
63	**91 06 83**	*	2"	38	30	75

* *butt-weld only*

Female thread adaptor long

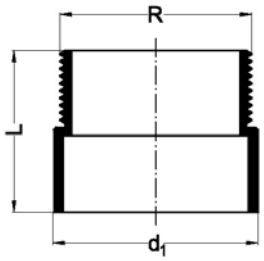
HDPE



d_1	Art. Nr.	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

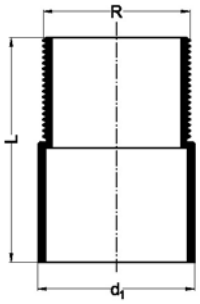


d_1	Art. Nr.		R	L
40	**96 04 78**	*	½"	30
40	**96 04 79**	*	¾"	30
40	**96 04 80**	*	1"	30
40	**96 04 81**	*	1 ¼"	30
50	**96 05 80**	*	1"	35
50	**96 05 81**	*	1 ¼"	35
50	**96 05 82**	*	1 ½"	35
63	**96 06 82**	*	1 ½"	40
63	**96 06 83**	*	2"	40

* *butt-weld only*

HDPE drainage

Male thread adaptor long HDPE

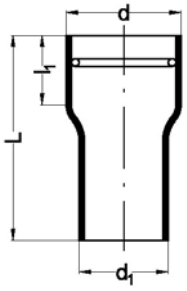


d_1	Art. Nr.	R	L
40	**97 04 78**	½"	60
40	**97 04 79**	¾"	60
40	**97 04 80**	1"	60
40	**97 04 81**	1 ¼"	60
50	**97 05 80**	1"	65
50	**97 05 81**	1 ¼"	65
50	**97 05 82**	1 ½"	65
56	**97 56 83**	2"	65
63	**97 06 82**	1 ½"	70
63	**97 06 83**	2"	70
75	**97 07 84**	2 ½"	70

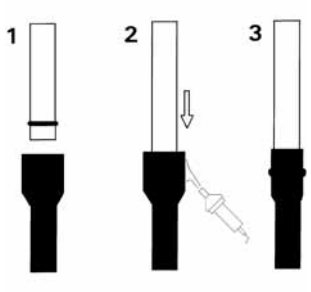
Contraction socket
with O-ring

HDPE

NBR



d_1/d	Art. Nr.	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



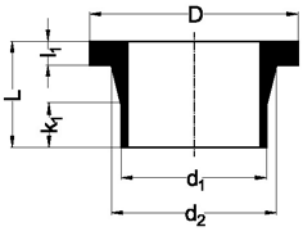
d_x = connecting range

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.

HDPE drainage

Stub flange

HDPE

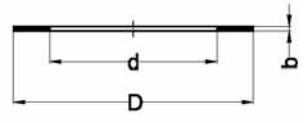


d_1	Art. Nr.		d_2	D	L	l_1	k_1
40	**47 04 02**	*	50	78	50	10	15
50	**47 05 02**	*	61	88	50	10	15
56	**47 56 02**	*	70	102	60	14	15
63	**47 06 02**	*	75	102	50	14	15
75	**47 07 02**	*	89	120	50	16	15
90	**47 09 02**		105	136	80	17	20
110	**47 11 02**		125	158	80	18	30
125	**47 12 02**		132	158	80	18	30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

* *butt-weld only*

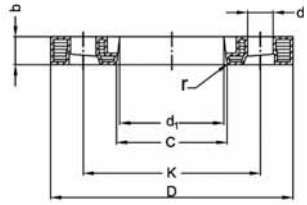
Gasket flat

EPDM



d_1	Art. Nr.	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

Profile backing ring PP with ductile iron core



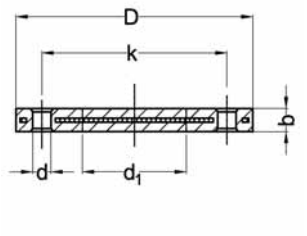
d_1/DN	Art. Nr.	C	D	K*	b	d*	n*	M	r
40/32	**47 04 09 010**	51	142	100	17	18	4	M16	3
50/40	**47 05 09 010**	62	156	110	19	18	4	M16	3
56/50	**47 06 09 010**	78	171	125	20	18	4	M16	3
63/50	**47 06 09 010**	78	171	125	20	18	4	M16	3
75/65	**47 07 09 010**	92	191	145	21	18	4	M16	3
90/80	**47 09 09 010**	108	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	Art. Nr.	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.

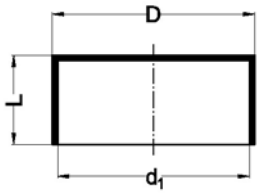
n = number of bolts
M = thread
Reference circle PN10 EN 1092

HDPE drainage

Protection cap for pipe HDPE

orange

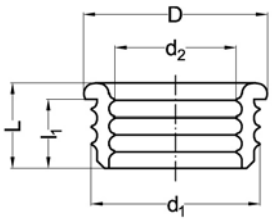
d_1	Art. Nr.	D	L
40	**40 04 29**	42	35
50	**40 05 29**	52	35
56	**40 56 29**	58	35
63	**40 06 29**	65	35
75	**40 07 29**	78	35
90	**40 09 29**	93	35
110	**40 11 29**	113	40
125	**40 12 29**	129	40
160	**40 16 29**	164	40

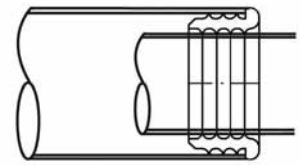


Rubber collar for pipe in pipe joints

NBR

d_1/d_2	Art. Nr.	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



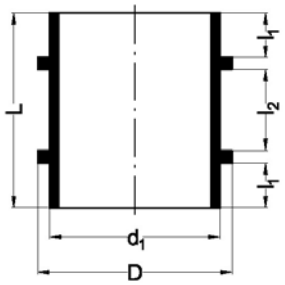


HDPE drainage

Double-flange bushing HDPE

d_1	Art. Nr.	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

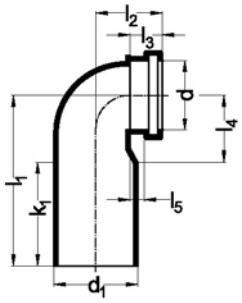
Double-flange bushings are suitable for anchor joints.



Wall-lavatory bend 90°
with protection plug

HDPE

SBR seal

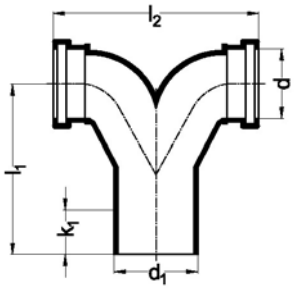


d_1/d	Art. Nr.		l_1	l_2	l_3	l_4	l_5	k_1
90/90	**50 09 84**		225	76	34	83	17	120
110/90	**50 11 85**		225	76	34	95	17	120
110/110	**50 11 82**	*	225	75	30	92	19	120

* *NBR O-ring*

Double wall-lavatory bend 90° (vertical)
with protection plug

HDPE



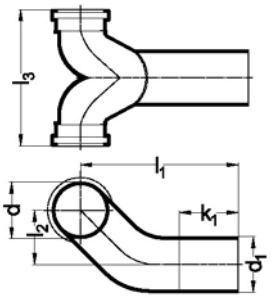
d_1/d	Art. Nr.		l_1	l_2	k_1
110/90	**50 09 34**	*	225	275	80
110/110	**50 11 34**	**	185	270	60

* *EPDM O-ring*

** *NBR O-ring*

HDPE drainage

Double wall-lavatory bend 90° (horizontal) HDPE
with protection plug



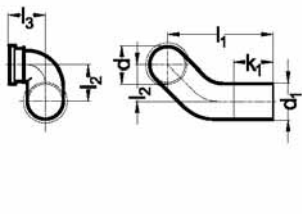
d_1/d	Art. Nr.		l_1	l_2	l_3	k_1
110/90	**50 09 35**	*	360	100	275	200
110/110	**50 11 35**	**	360	100	270	200

* *EPDM O-ring*

** *NBR O-ring*

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

SBR seal



d_1/d	Art. Nr.		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**	*	350	100	75	170

* *NBR O-ring*

Wall-lavatory bend 90° (horizontal) right

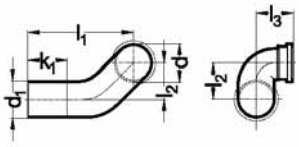
with protection plug

HDPE

SBR seal

d_1/d	Art. Nr.		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**	*	350	100	75	170

* *NBR O-ring*



Wall-lavatory socket

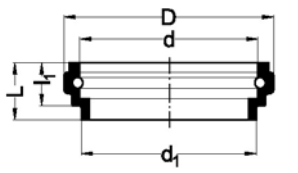
HDPE

SBR seal

d_1/d	Art. Nr.		D	L	l_1
90/90	**50 09 51**	*	113	49	38
110/110	**50 11 71**	*	130	45	28

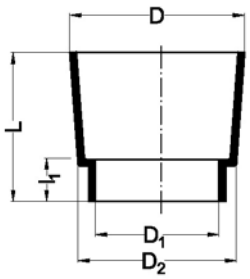
* *butt-weld only*

Art. Nr. 501171 = NBR O-ring.



HDPE drainage

Protection plug HDPE



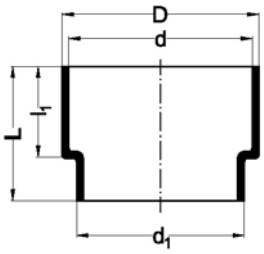
d_1	Art. Nr.	D	D_1	D_2	L	l_1
90	**43 09 19**	109	90	103	98	27,0
110	**43 11 19**	130	105	119	98	23,5

Floor-lavatory socket

HDPE

d_1	Art. Nr.		d	D	L	l_1
90	**50 09 01**	*	120	129	85	55
110	**50 11 01**	*	120	129	88	60

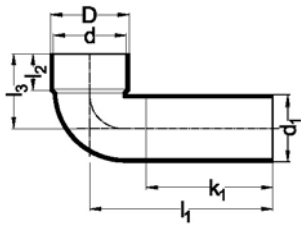
* *butt-weld only*



Floor-lavatory bend 90°

HDPE

d_1	Art. Nr.	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

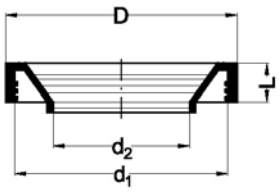


HDPE drainage

Rubber seal for floor-lavatory socket/bend

d_1	Art. Nr.	D	d_2	L
129	**50 11 13**	135	102	25

d_2 = connecting size.



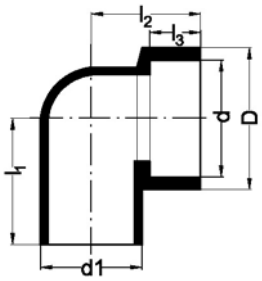
Trap connection bend 90°

HDPE

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

* *butt-weld only*

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



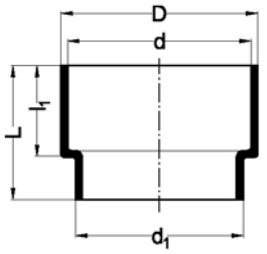
Trap connection socket

HDPE

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

* *butt-weld only*

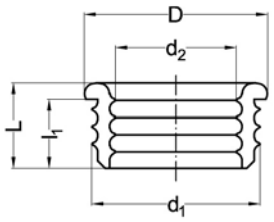
Trap connection socket connect in combination with rubber seal Art. Nr. 51xx01 or 51xx02.



Rubber collar for trap connection bend/socket

NBR

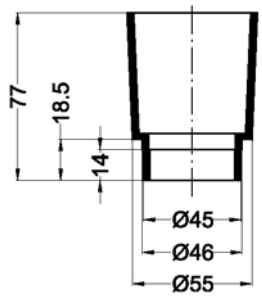
d_1	Art. Nr.	d	D	L	l_1
46	**51 33 01**	1 ¼" (32)	54	24	20
46	**51 35 01**	1 ½" (40)	54	24	20
58	**51 35 02**	1 ¼" (32)	63	24	20
58	**51 36 02**	1 ½" (40)	63	24	20
58	**51 37 02**	2" (50)	63	24	20



Universal protection plug

for all trap connection bends/sockets

Art. Nr.
43 46 19

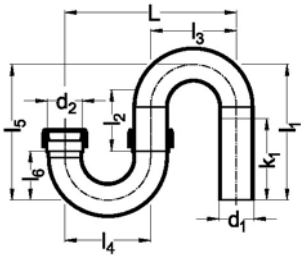


S-trap

HDPE

SBR seal

d_1/d_2	Art. Nr.	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

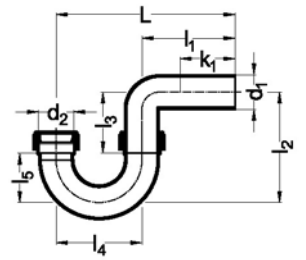


P-trap

HDPE

SBR seal

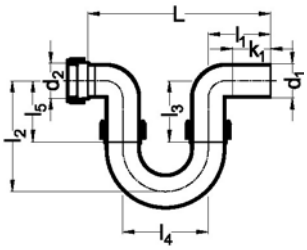
d_1/d_2	Art. Nr.	L	l_1	l_2	l_3	l_4	l_5	k_1
40/40	**04 04 02**	172	92	162	95	80	67	45
50/40	**04 05 02**	184	104	172	100	80	67	45
50/50	**05 05 02**	204	104	203	120	100	73	45
63/50	**05 06 02**	218	118	198	120	100	73	55
56/56	**56 56 02**	232	132	213	135	100	70	60
63/63	**06 06 02**	262	132	224	130	130	89	60



akatherm

Running trap HDPE

SBR seal

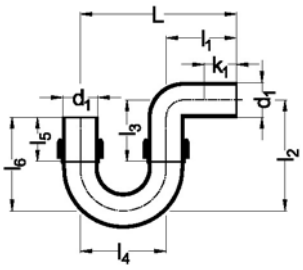


d_1/d_2	Art. Nr.	L	l_1	l_2	l_3	l_4	l_5	k_1
40/40	**04 04 03**	241	92	162	95	80	95	45
50/50	**05 05 03**	281	104	193	115	100	115	45
56/56	**56 56 03**	306	132	210	135	100	135	60
63/63	**06 06 03**	351	132	224	130	130	130	60

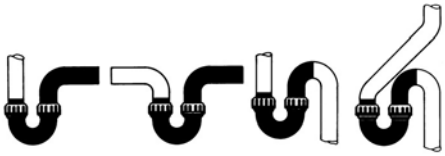
Universal trap with flange bushing

HDPE

SBR seal



d_1	Art. Nr.	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 at the right).

HDPE drainage

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

d_1	Art. Nr.	A	B	C
32	**40 03 13**	42 03 50	40 03 20	40 03 10
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	40 56 10
63	**40 06 13**	42 06 50	40 06 20	40 06 10
75	**40 07 13**	42 07 50	42 07 20	40 07 10
75	**42 07 23**		42 07 20	
90	**40 09 13**	42 09 50	42 09 20	40 09 10
90	**42 09 23**		42 09 20	
110	**40 11 13**	42 11 50	42 11 20	40 11 10
110	**42 11 23**		42 11 20	
125	**40 12 13**	42 12 50	42 12 20	40 12 10
125	**42 12 23**		42 12 20	
160	**40 16 13**	42 16 50	42 16 20	40 16 10
160	**42 16 23**		42 16 20	
200	**40 20 13**			40 20 10
200	**40 20 23**		40 20 60	
250	**40 25 23**		40 25 60	
315	**40 31 23**		40 31 60	

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

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

d_1	Art. Nr.	A	B	C
32	**40 03 19**	42 03 50	40 03 20	40 03 10
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

Protection plug for trap connection socket/bend

HDPE

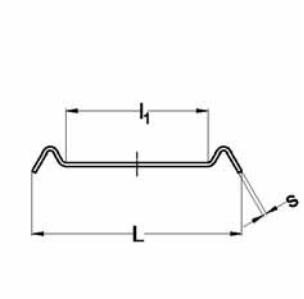
d_1	Art. Nr.	A	B
46	**40 46 19**	51 xx 01	51 xx 11
58	**40 58 19**	51 xx 02	51 xx 12

A = trap connection socket
B = trap connection bend

HDPE drainage

Clamp liners Stainless steel

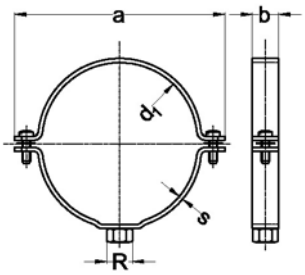
2 identical metal clamp liners per set



d_1	Art. Nr.	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

Anchor bracket
for fixing to wall

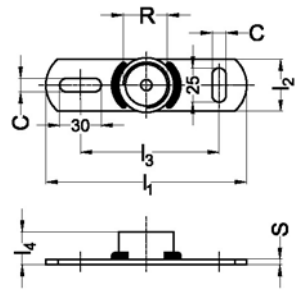
Steel galvanised



d_1	Art. Nr.	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

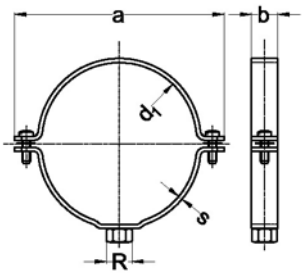


Art. Nr.	R	l_1	l_2	l_3	l_4	S	C
70 94 78	½"	145	38	90	25	4	8,5
70 94 80	1"	145	38	90	25	4	8,5

HDPE drainage

Guide bracket
for fixing to wall

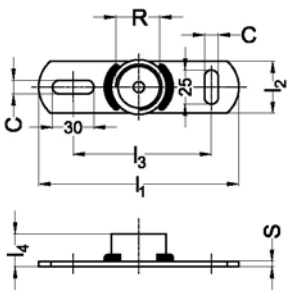
Steel galvanised



d_1	Art. Nr.	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



Art. Nr.	R	l_1	l_2	l_3	l_4	S	C
70 94 10	M10	145	38	90	14	4	8,5
70 94 80	1"	145	38	90	25	4	8,5

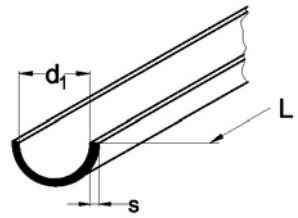
Support shell galvanised

Steel galvanised

Shell length = 3 m

d_1	Art. Nr.	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.



Tools

Control box Akafusion CB160

Akafusion

d_1	Art. Nr.	Dim.	V~	Hz	kg	A max	W max
40-160	**41 98 10**	200x100x70	230	50/60	1,4	5	1150

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

Control box Akafusion CB315-U

Akafusion

d_1	Art. Nr.	Dim.	V~	Hz	kg	A max	W max
40-315	**41 99 10**	440x220x180	230	50/60	5	10,9	2500

The Akafusion 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 Art. Nr. 419910.

Output leads for control box Akafusion CB315-U

Akafusion

d_1	Art. Nr.	System	Colour
40-160	**41 99 71**	5A/80s	yellow
200-315	**41 99 72**	220V/420s	blue

Scraper Spider

Art. Nr.		L	B	H	kg
41 98 60	*	105	80	60	0,460
41 98 65	**	260	210	80	1,600

* *excluding Spider accessories*

** *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

Art. Nr.	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

Art. Nr.
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

Art. Nr.
41 96 20

Pipe cutter

d_1	Art. Nr.
40-63	49 09 10
50-125	49 10 10
110-160	49 11 10

Butt-welding machine 160C

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

d_1 = 40-50-56-63-75-90-110-125-160.
Suitable for welding Y-branches 45°.

Butt-welding machine 250C

d_1	Art. Nr.	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 315C

d_1	Art. Nr.	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°.

Tools

5 Jointing methods

5.1 Pull-tight and not pull-tight jointing

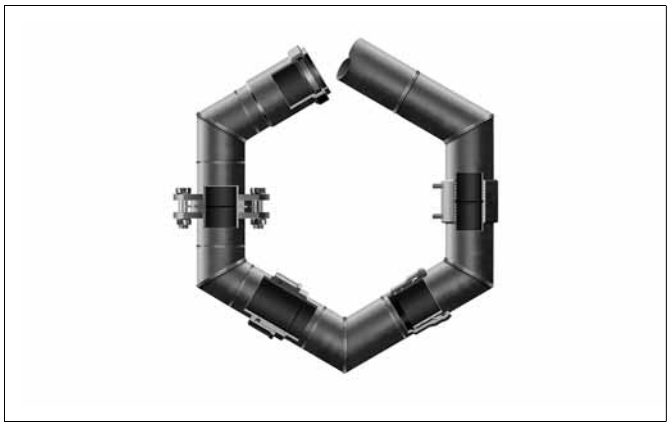


Illustration 5.1

Depending on the application Akatherm HDPE fittings and pipes can be jointed by different methods. These can be divided into pull-tight and not pull-tight jointing methods:

Pull-tight
- Electrofusion
- Butt-welding
- Snap jointing
- Screw-threaded jointing
- Flanged jointing

Not pull-tight
- Plug-in jointing
- Screw-threaded joint without flange bushing
- Contraction sleeve
- Metal Coupling

5.2 Butt-weld joint

Illustration 5.2

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

The following guidelines are of importance when making a proper butt-weld:
- Establish a work space where the jointing can be done without being effected by major weather conditions.
- Check if the equipment functions properly. Welding equipment used on site deserves special attention.
- The fittings and/or pipes need to be aligned in the welding machine to avoid a sagging in the pipe-wall. This sagging may maximally be 10% of the wall thickness.
- Clean the heating element before each jointing operation with a non clotted paper and suitable cleaner (see instructions welding machine).
- Cut the pipe and/or fitting with a pipe cutter to make the end square.
- Make sure that once the pipe and/or fitting ends have been machined, they do not get dirty. Do not touch them with your hands. The surface needs to be clear of oil, grease and dirt.
- Without removing the oxygen layer a weld cannot be guaranteed.
- Put the pipe parts into the welding machine to facilitate a firm hold during the jointing process.
- The temperature of the heating element has to be between 200°C and 220°C. With a thinner wall-thickness the higher temperature is recommended. The maximum deviations can be found in table 5.1. The temperature of the heating element needs to be checked at several spots on the heating element. Check the temperature set at the thermostat using thermal measuring sticks or a thermometer.

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

Table 5.1 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.

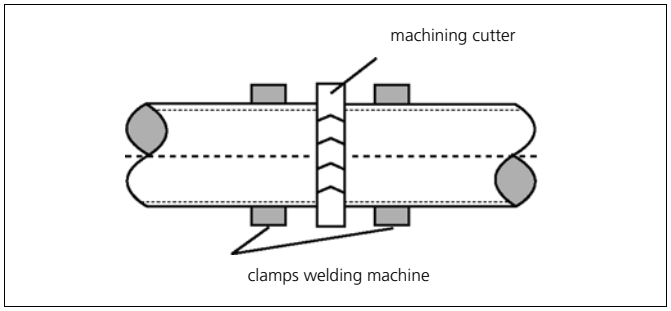


Illustration 5.3 Machining the surface

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 5.2.

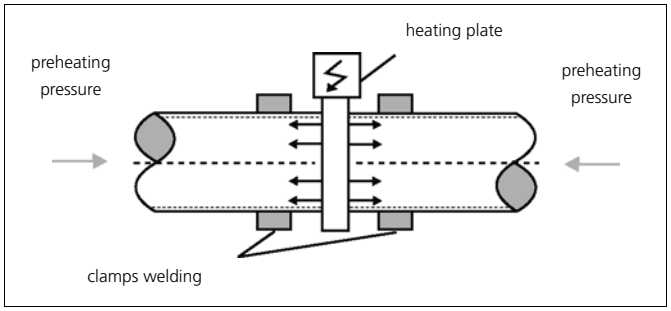


Illustration 5.4 Preheating under pressure

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/mm^2 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 5.2.

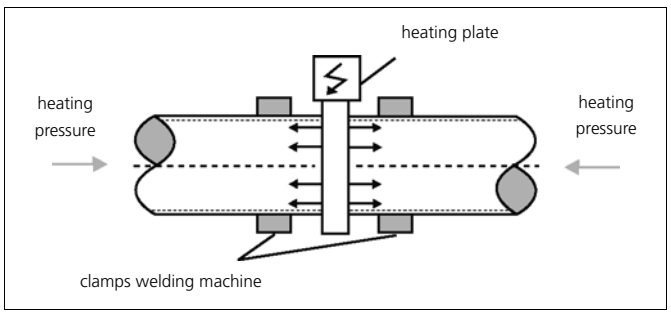


Illustration 5.5 Obtaining the correct heating depth

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 5.2.

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/mm^2. 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.

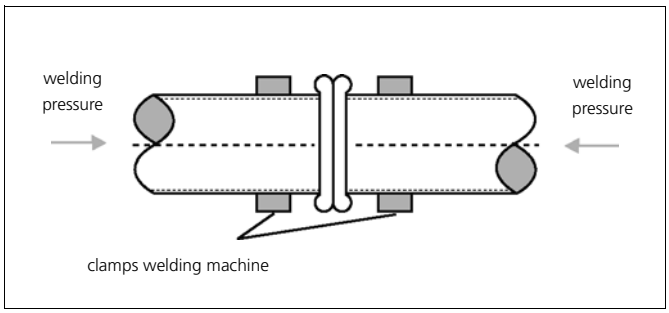
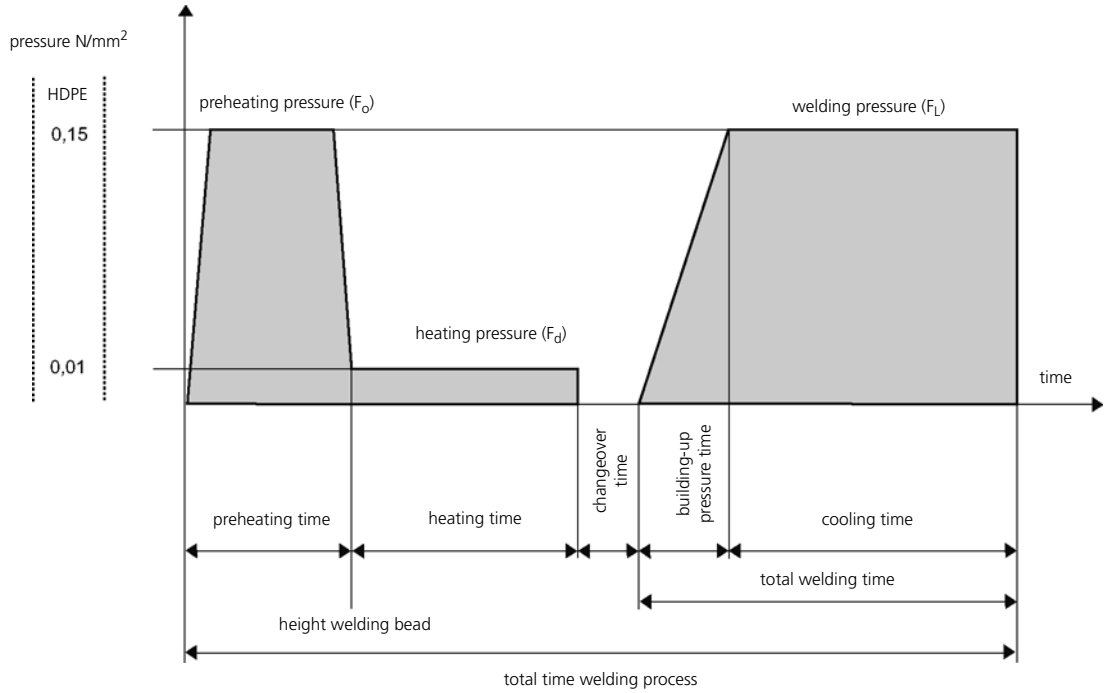


Illustration 5.6 Welding and cooling

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.

Jointing methods



Graphic drawing 5.1

Diameter d_1	Wall thickness e	Preheating pressure / welding pressure (0,15 N/mm²)	Heating pressure (0,01 N/mm²)	Height welding bead	Heating time	Changeover time	Building-up pressure time	Cooling time
mm	mm	F_O/F_L N	F_d N	mm	sec	sec	sec	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 5.2 Welding parameters Akatherm HDPE drainage

In table 5.2 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 5.7 a good weld is shown with a uniform welding bead. At a visual inspection this would be classified as an "acceptable" weld.

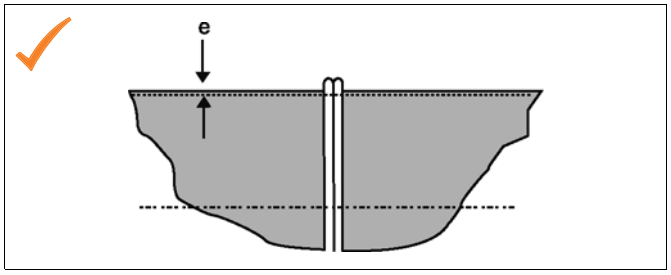


Illustration 5.7 Butt-weld with even welding beads (acceptable)

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 5.8).

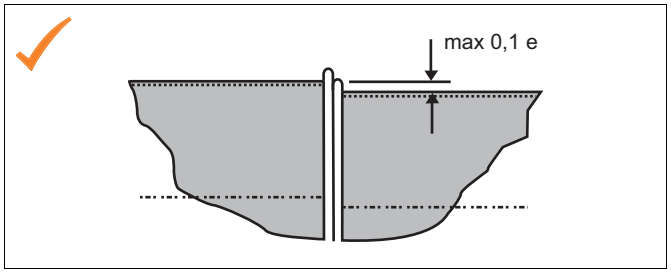


Illustration 5.8 Butt-weld with mis-alignment of pipe (acceptable)

Illustration 5.9 shows a joint with beads that are too big. The uniformity indicates a good joint preparation. Heat supply and jointing pressure settings, however, are too high. A purely visual assessment would still classify the weld as "acceptable".

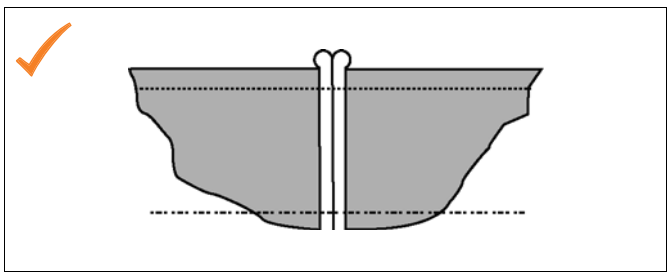


Illustration 5.9 Butt-weld with big welding beads (acceptable)

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".

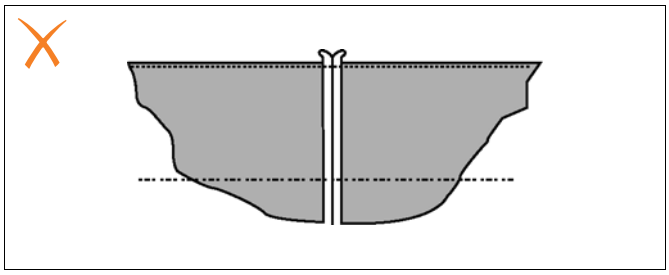


Illustration 5.10 Butt-weld (not acceptable)

In illustration 5.11 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.

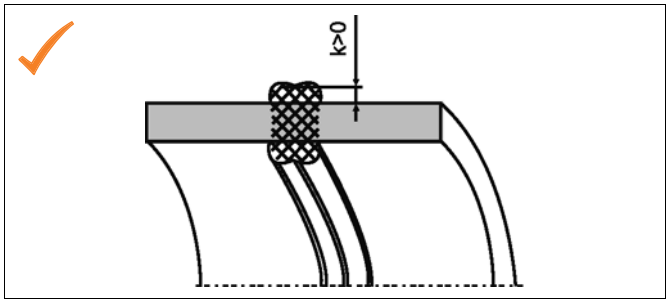


Illustration 5.11 Cross section of a good butt-weld

Welding by hand
In general butt-welds are made using an Akatherm butt-welding machine. However up to the diameter d_1 = 75 mm the weld can be made by hand. At 90 mm and above the welding pressures are to 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 5.2).

Heating up
Hold the pipe/fittings against the heating plate with no pressure (for time see table 5.2).

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.

5.3 Electrofusion joint

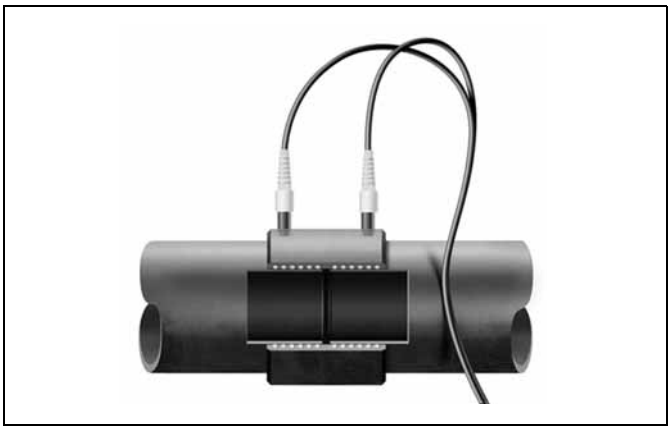


Illustration 5.12

Electrofusion is a rapid and simple way of permanent jointing. Using the Akafusion couplers and equipment, pipes, fittings and prefabricated pipe sections can efficiently be assembled. Most Akatherm products can be welded by electrofusion.

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 Akafusion 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.

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.

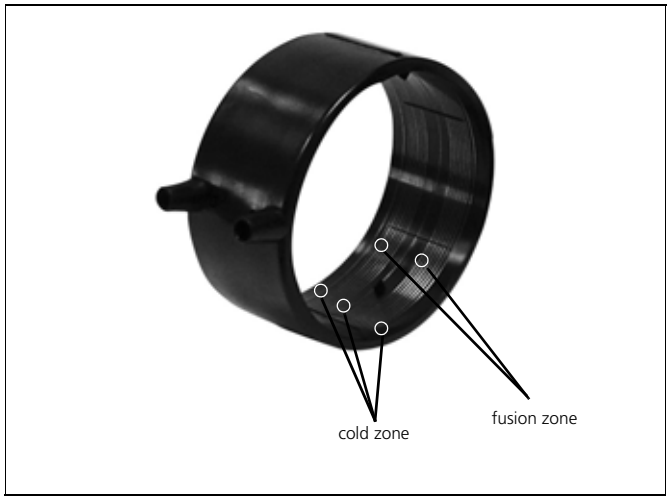


Illustration 5.13 Akafusion coupler with fusion and cold zones

Jointing methods

Welding process

Cut pipe square

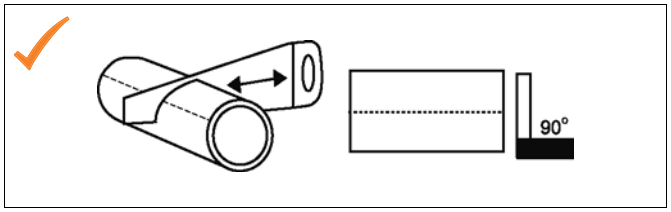


Illustration 5.15

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.

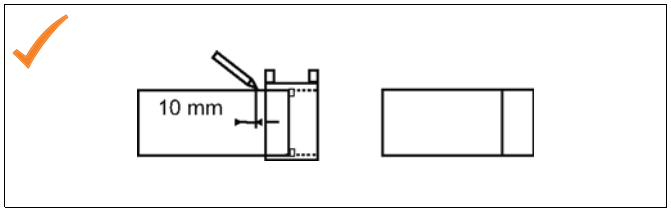


Illustration 5.16

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 'oxi-dation'. The insertion depth should be marked again to safeguard full insertion.

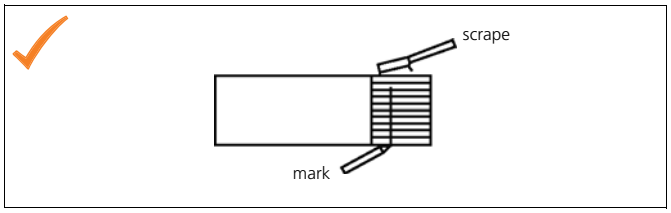


Illustration 5.17

Clean electrofusion coupler

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

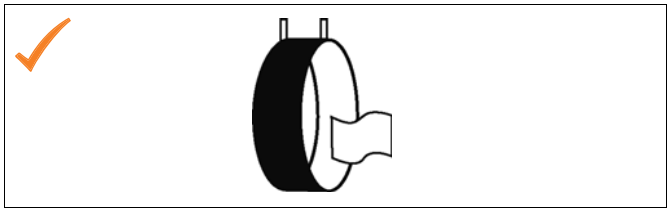


Illustration 5.18

Insert pipe/fitting until marked line

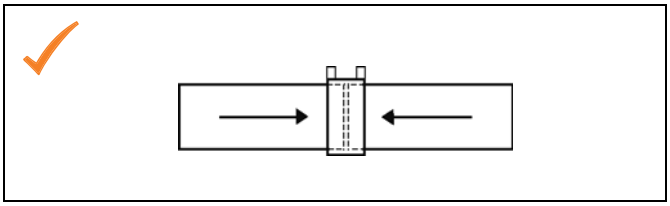


Illustration 5.19

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.

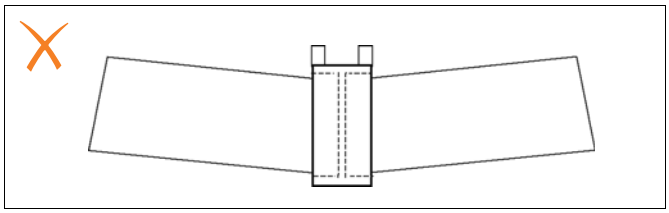


Illustration 5.20

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.

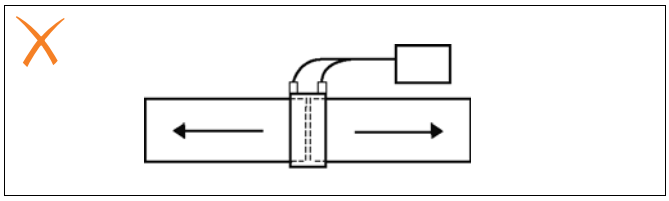
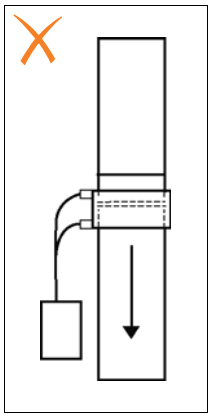


Illustration 5.21

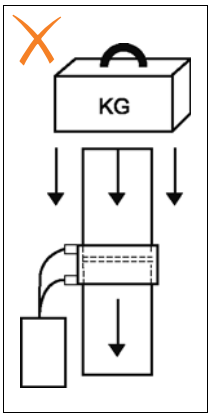
Prevent coupler from sliding down when center stop removed



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

Illustration 5.22

Remove vertical loading during welding



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

Illustration 5.23

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

Table 5.3 Welding parameters Akafusion 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.

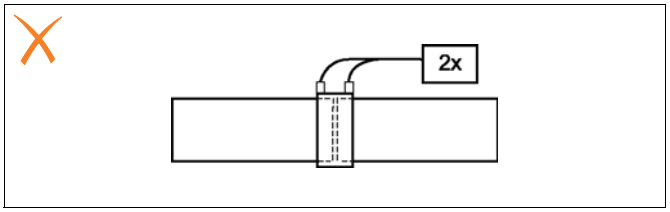


Illustration 5.24

Illustration 5.25

Assessing an electrofusion weld

It is harder to judge an electrofusion weld than a butt-weld. An indication of a good weld is the welding indicator (see illustration 5.25). The pop-outs on the fitting are however only an indication of a weld having been executed. They do not guarantee the integrity of the joint. The amount of movement of the pop-out depends on a number of factors including the size tolerances of the components and any ovality of the pipe/fitting. If all preparations have taken place successfully, like marking the insertion depth, scraping etc. and the pipe assembly wasn't under any additional load during welding and cooling, a joint can me marked OK when the welding indicators are protruded. If a significant quantity of melt exudes from the fitting after welding there may be a misalignment of the components, excessive tolerances or an accidental second welding of the fitting. The integrity of such joints 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 ended.

Deformation

A too big deformation can cause problems during assembly and welding of the components. The maximum allowed deformation is 0,02 x d_1. This results in a maximum difference between the largest and smallest diameter corresponding with table 5.4. The pipe 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 5.4 Deformation pipe

Jointing methods

5.4 Plug-in joint

Illustration 5.26

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

Jointing process:

Cut pipe square and remove burr

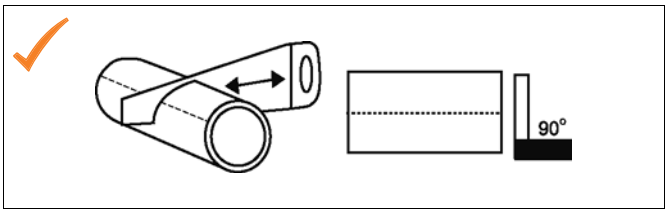
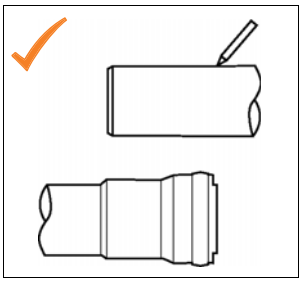


Illustration 5.27

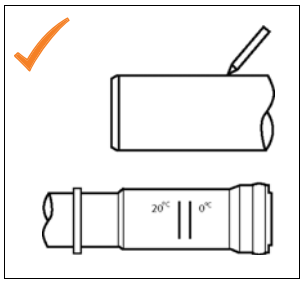
Mark insertion depth



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.

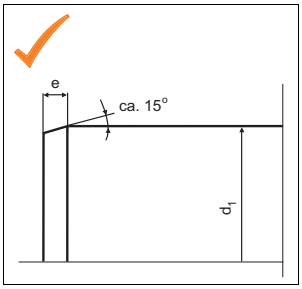
Illustration 5.28



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 5.29

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 5.30

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

5.5 Snap joint

Illustration 5.31

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

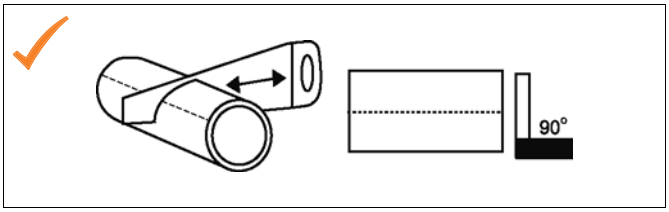
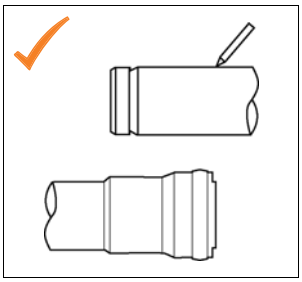


Illustration 5.32

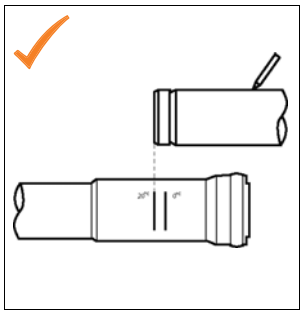
Mark insertion depth



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 5.33

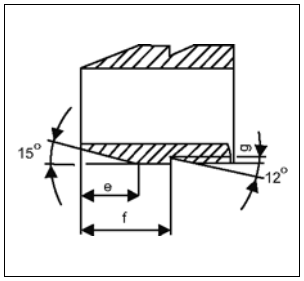


Snap-expansion socket:
Snap-expansion sockets are available from d40 to 75 mm and is used to accommodate the expansion and contraction in a pipe system.

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 5.34

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 5.5. To get an even cut and chamfer it is recommended to use an Akatherm groove cutter.

Illustration 5.35

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 5.5 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.

5.6 Screw-threaded joint

Illustration 5.36

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.

5.7 Flange joint

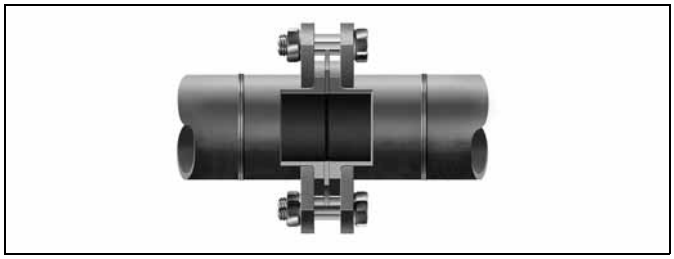


Illustration 5.37

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 with the bolt torque of table 5.6

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 5.6 Bolt torque for non-pressure applications

5.8 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 5.38

Jointing methods

5.9 Metal coupling

Illustration 5.39

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

5.10 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

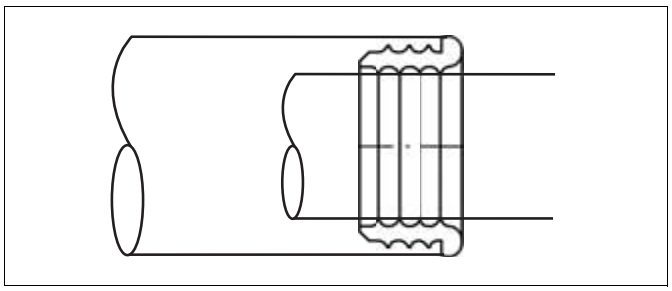


Illustration 5.40

6 Prefabrication

6.1 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 butt-welded together during prefabrication, after which the prefabricated sections are installed on site using electrofusion.

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 using retaining moulds.

Large identical pipe systems typically occur in for instance a hospital or an apartment complex.

Illustration 6.1 Prefabricated pipe sections

Illustration 6.2 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 6.3 Installation under difficult conditions

6.2 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:
- Simpler handling due to the light weight of HDPE. A related advantage is the lower transport costs in cases involving large distances between the factory and installation site.
- 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.

6.3 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 5.2). 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.

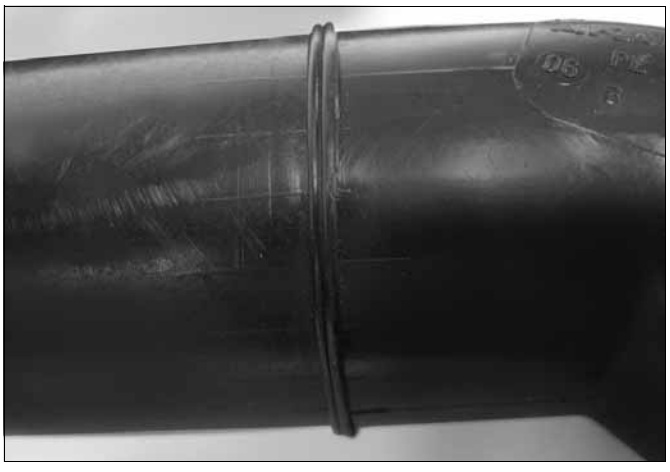


Illustration 6.4 Fitting with graduated arc

Prefabrication

Protection plugs

A single fitting or pipe is easy to inspect visually for blockages prior to installation. This is not always possible when prefabricating pipe segments.

To prevent blockages, it is recommended to leave the protection plugs in the fittings (included in delivery) and to close the pipe ends with the special protection plugs for pipe (Art. Nr. 40xx29).

Illustration 6.5 Protection plugs for pipe (Art. Nr. 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.

6.4 CAD software

The well-known CAD software available on the market includes Akatherm fittings in their libraries. By simply selecting the Akatherm brand, the parts list with the correct article numbers will be generated beside the drawing of the pipe system. This parts list also includes a sawing list for pipe lengths in order to simplify the prefabrication process.

7 Soil and waste pipe installation methods

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

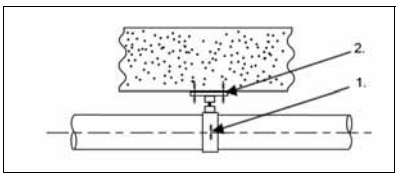
The choice of the pipe fixing system is essential to correctly install the pipe system. Depending on the temperature of the medium, the ambient temperature and the building constraints there are the following options:

1. Free moving guide bracket system with axial movement correction by means of:
   - (Snap) expansion sockets (7.4)
   - Deflection leg (7.5)
   - Deflection leg with (snap) expansion socket (7.5.2)
2. Rigid anchor point bracket system (7.6)
3. Embedding HDPE in concrete (7.7)
4. Underground installation of HDPE (7.8)

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.

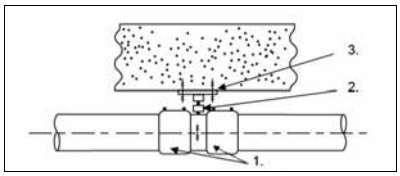


1. *Guide bracket Art. Nr. 70xx10/70xx80*
2. *Mounting plate for guide bracket Art. Nr. 7094xx*

Illustration 7.1 Guide bracket

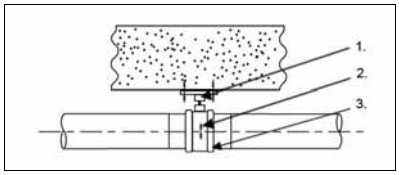
7.2.2 Anchor point bracket

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:



1. *Akafusion coupler Art. Nr. 41xx95*
2. *Anchor bracket Art. Nr. 70xxxx*
3. *Mounting plate for anchor bracket Art. Nr. 7094xx*

Illustration 7.2 Anchor bracket with 2 Akafusion couplers Art. Nr. 41xx95



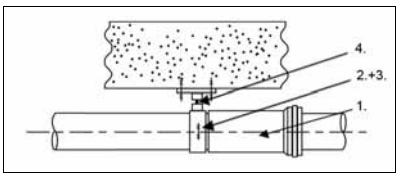
1. *Mounting plate for anchor bracket Art. Nr. 7094xx*
2. *Anchor bracket Art. Nr. 70xxxx*
3. *Double-flange bushing Art. Nr. 43xx15*

Illustration 7.3 Anchor bracket with double-flange bushing Art. Nr. 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 Art. Nr. 40xx20/42xx20*
2. *Clamp liner Art. Nr. 70xx15*
3. *Anchor bracket Art. Nr. 70xxxx*
4. *Mounting plate for anchor bracket Art. Nr. 7094xx*

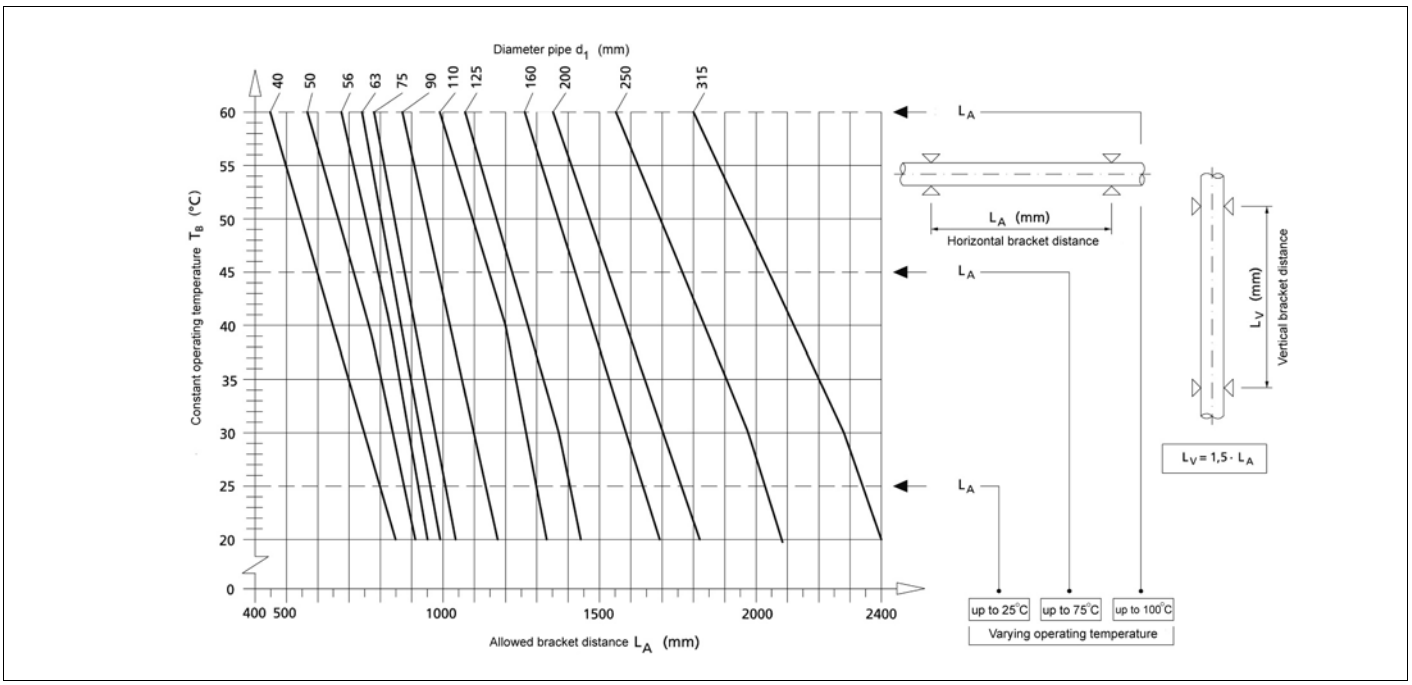
Illustration 7.4 Anchor bracket with expansion socket Art. Nr. 40xx20

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.

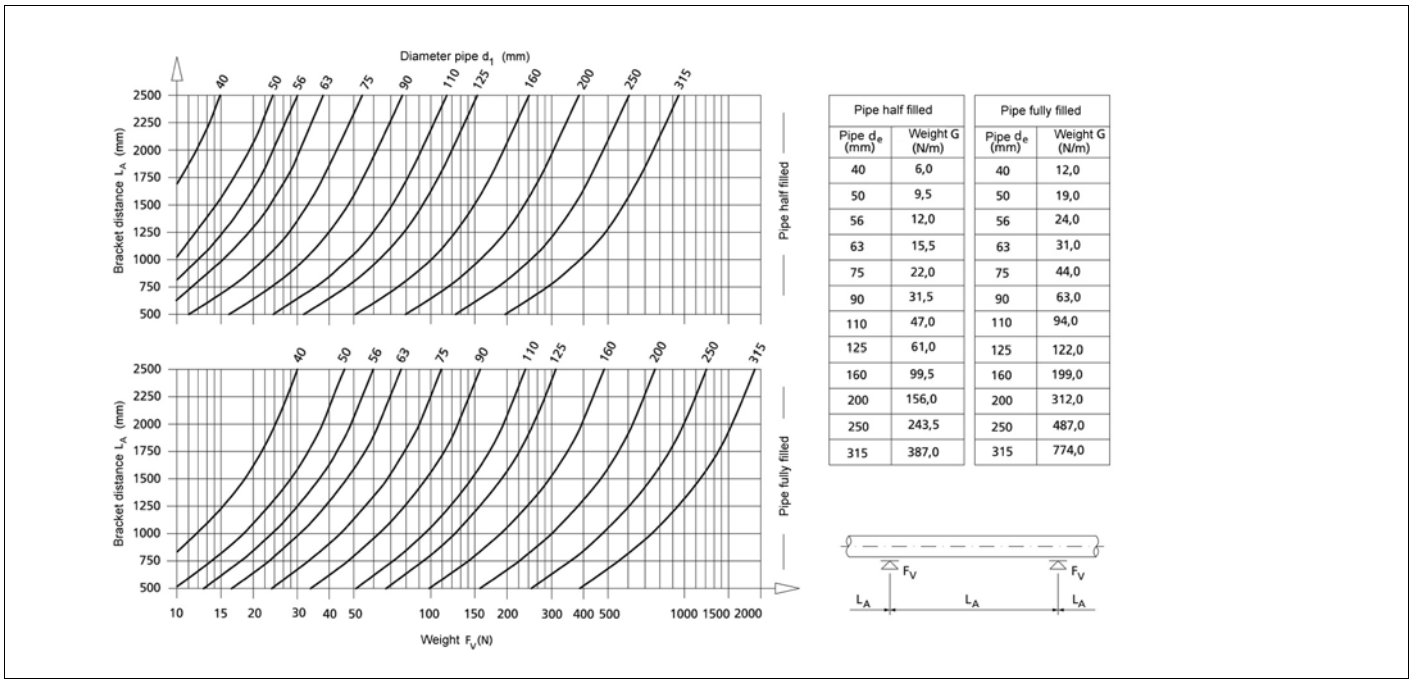
Soil and waste pipe installation methods

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 fully filled	
Pipe d_e (mm)	Weight G (N/m)	Pipe d_e (mm)	Weight G (N/m)
40	6,0	40	12,0
50	9,5	50	19,0
56	12,0	56	24,0
63	15,5	63	31,0
75	22,0	75	44,0
90	31,5	90	63,0
110	47,0	110	94,0
125	61,0	125	122,0
160	99,5	160	199,0
200	156,0	200	312,0
250	243,5	250	487,0
315	387,0	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

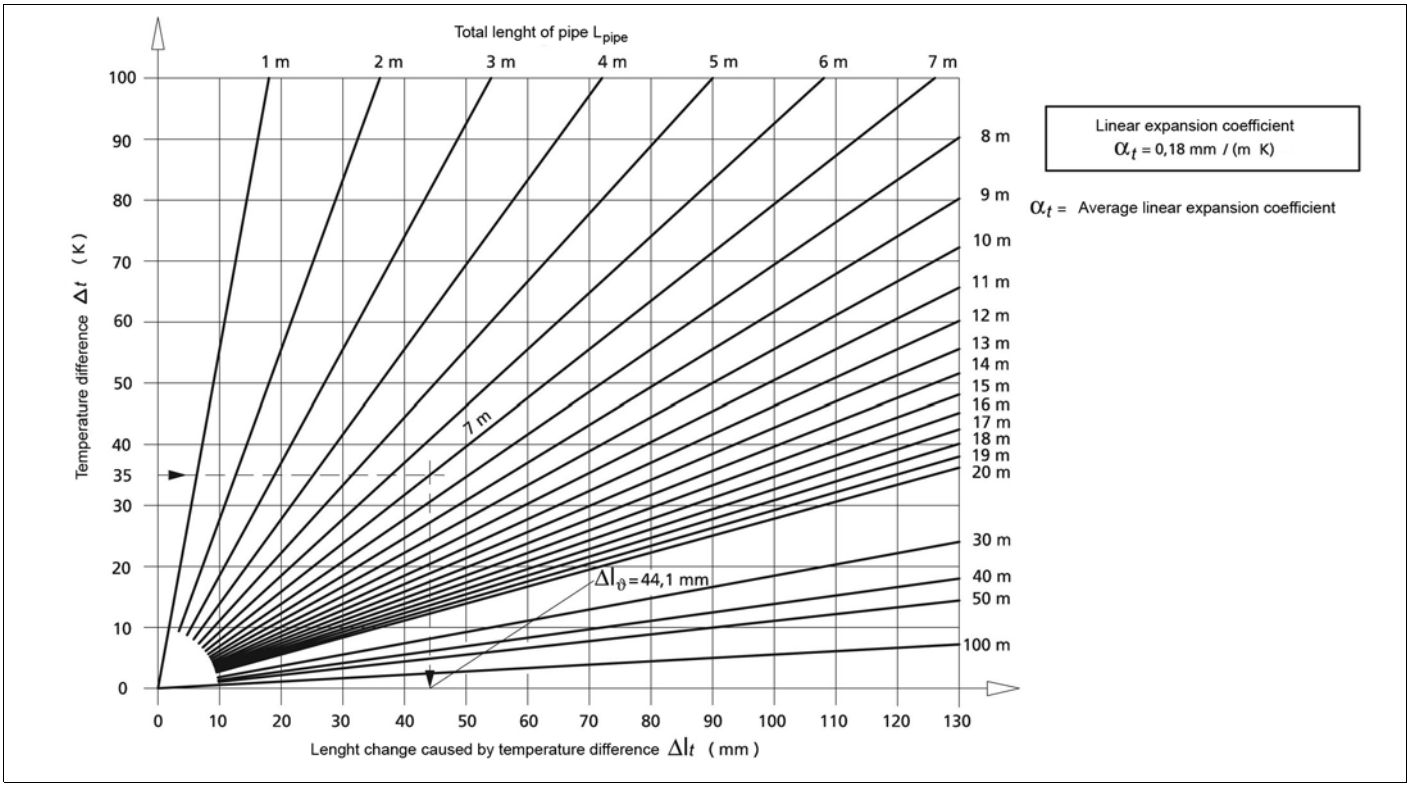
Δl_t = *Length change (mm)*
L_{pipe} = *Total length of pipe (m)*
αt = *Linear expansion coefficient (mm / m°K)*
t_{max} = *Temperature difference in* °C

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

d_1 (mm)	Art. Nr.	Total length (mm)	Min. insertion depth 20°C (mm)	Max. expansion (mm)
32	**40 03 20**	130	74	56
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 60**	230	120	110
250	**40 25 60**	250	125	125
315	**40 31 60**	270	126	144

**expansion sockets without snap function*

Table 7.1 Length change with expansion sockets



Graphic drawing 7.3 Length change caused by temperature difference

Soil and waste pipe installation methods

The general rule regarding the number of expansion sockets to be used is:

Every expansion socket can accommodate the expansion and contraction of a 5 m pipe. In every pipe section the required expansion sockets have to be installed. The number can be derived as follows (see example):

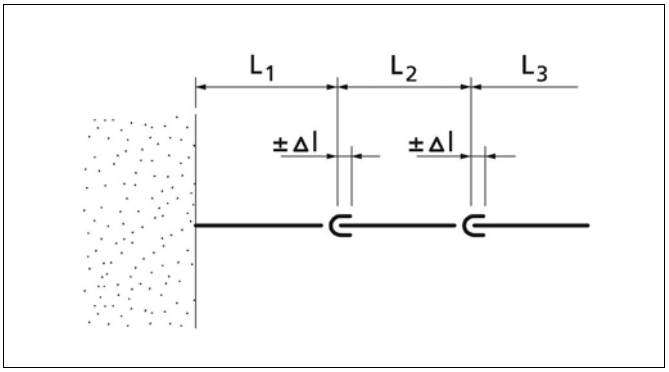


Illustration 7.5 Pipe section with expansion sockets

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

In a pipe section of 110 mm diameter this results in 227/141 = ~1,6 = 2 expansion sockets.

This general rule can be used for pipe sections of 5 m length and long term temperature differences ≤ 37,5°C.

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 ≤ 5 m in most drainage applications. With extreme high temperatures possibly in combination with a complex route the number of expansion sockets needs 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.

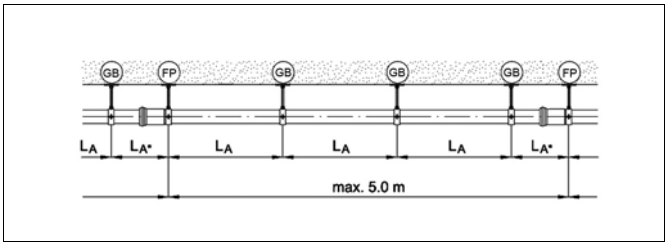


Illustration 7.6 Horizontal installation with expansion sockets without support trays

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.

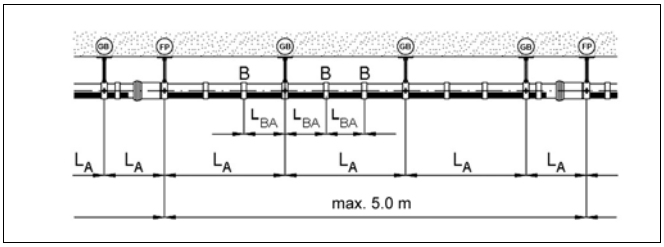


Illustration 7.7 Bracket distances horizontal installation with expansion sockets without support trays

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

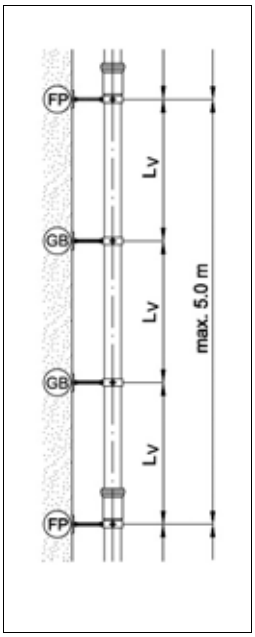


Illustration 7.8 Vertical installation to the wall

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.

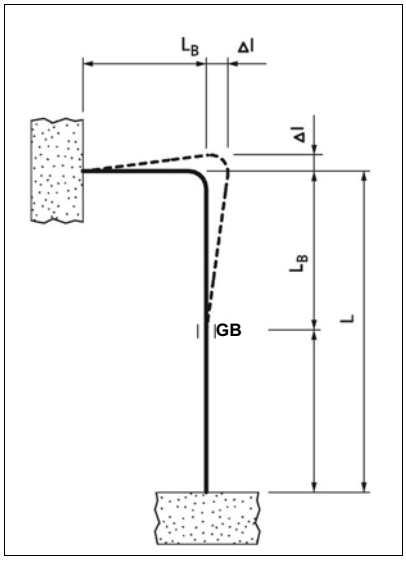
GB = guide bracket
FP = anchor point
L_V = bracket distance

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

7.5 Guide bracket system with deflection leg

7.5.1 Deflection leg calculation



L_B = Length deflection leg
L = Pipe length
GB = Guide bracket
Δl = Length change

Illustration 7.9
Installation with deflection leg

For computing 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.

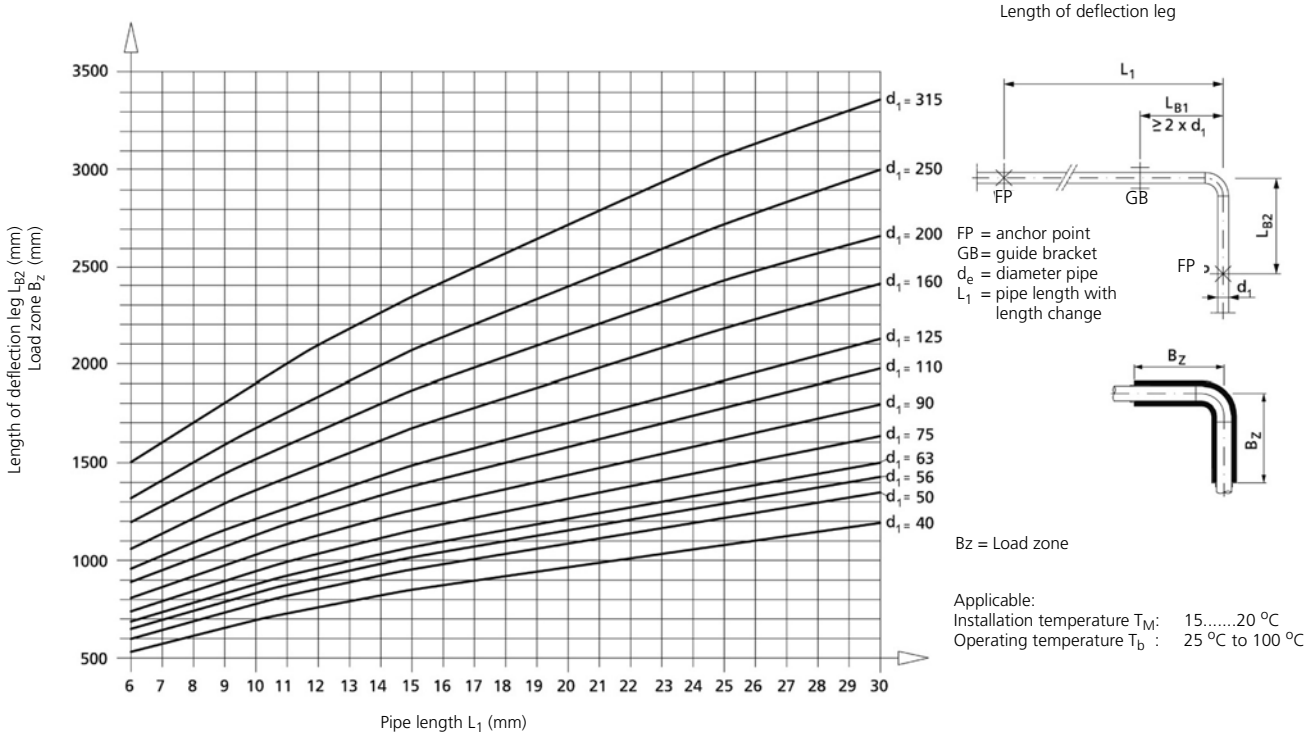
$$L_B \geq 10 \times \sqrt{\Delta l} \times d_{1,2}$$

Equation 7.2 Computing the length of deflection leg

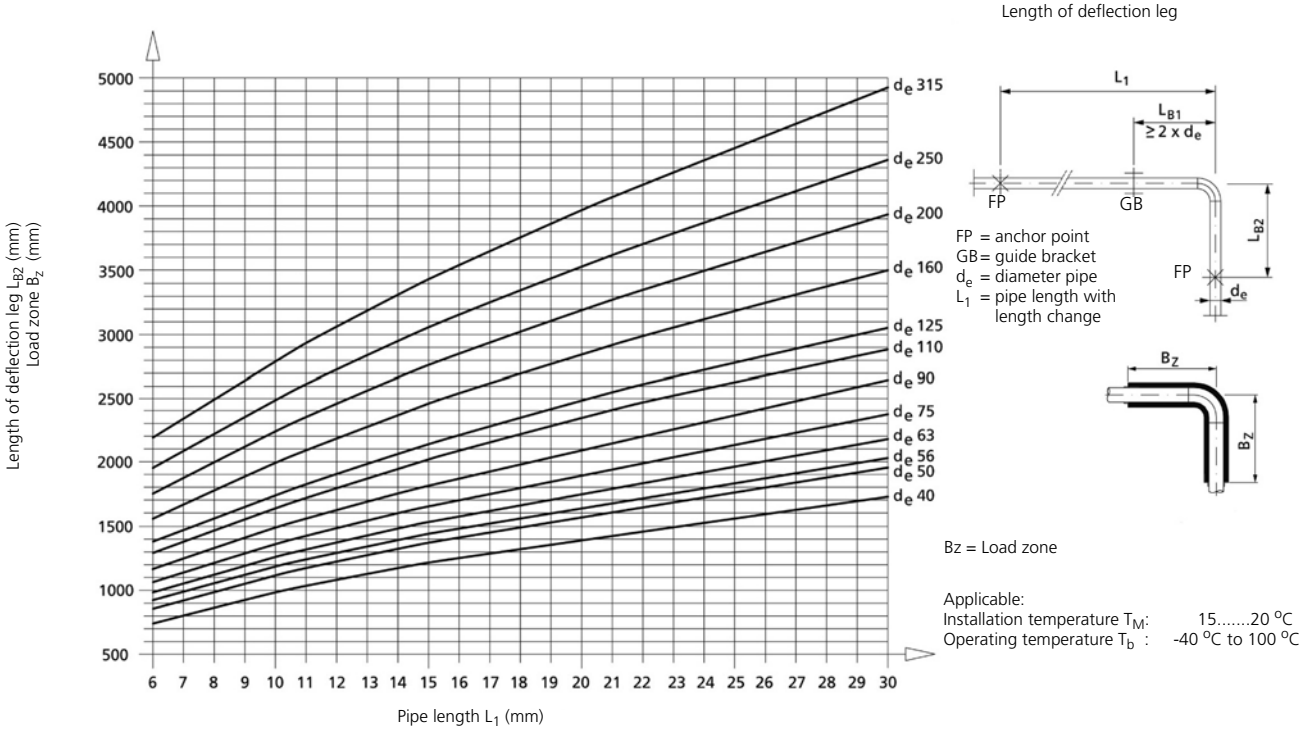
L_B = Length of deflection leg (mm)
d_1 = Diameter pipe
Δl = Length change caused by expansion

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

Soil and waste pipe installation methods



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

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

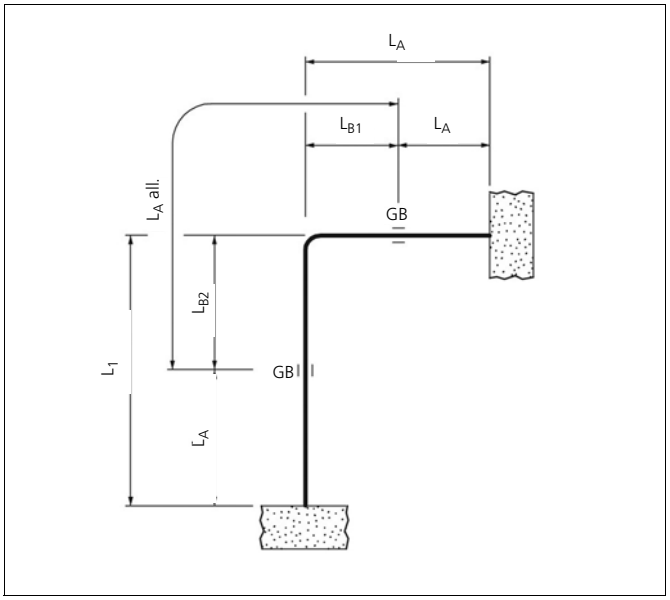


Illustration 7.10 Check fixing system

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.

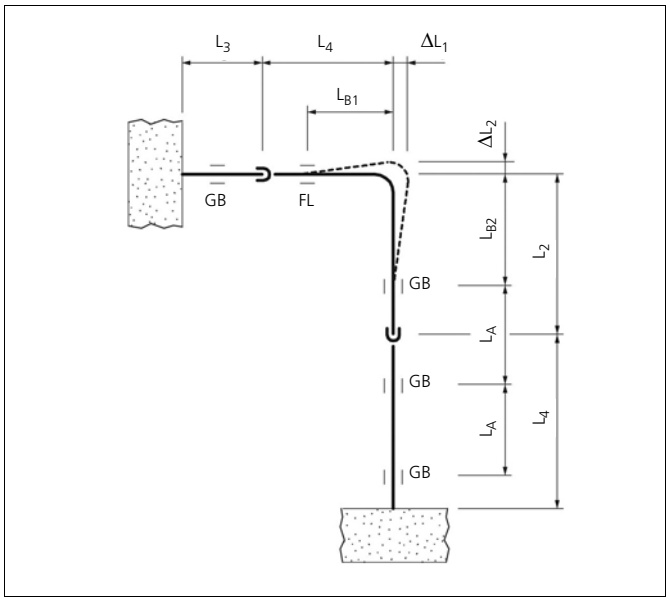


Illustration 7.11 Installation with deflection leg and expansion sockets

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

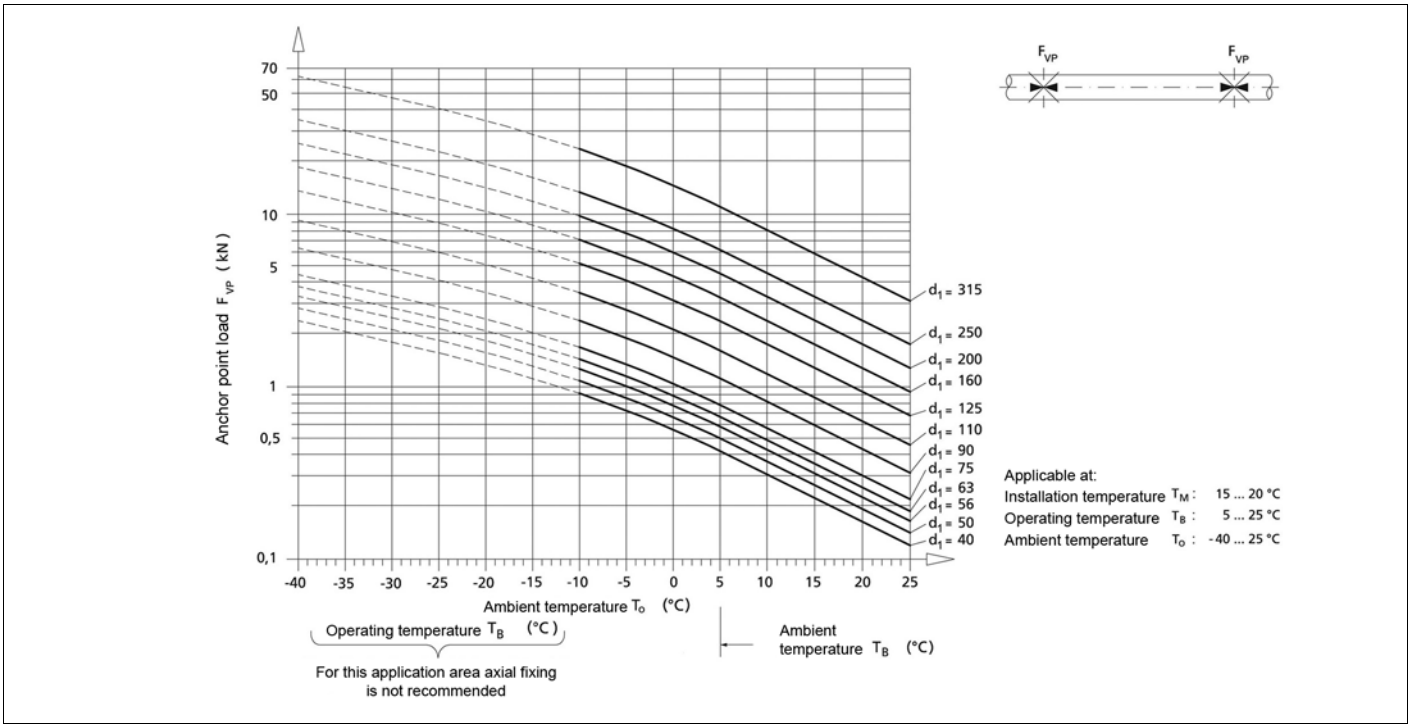
The expansion sockets take up the expansion of pipe sections L_3 and L_4. Several guide brackets have to be installed. The deflection leg L_{B1} and L_{B2} compensates the length change of L_1 and L_2 from pipe section L_1 and L_2. When the expansion is more than can be compensated in one expansion socket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

Soil and waste pipe installation methods

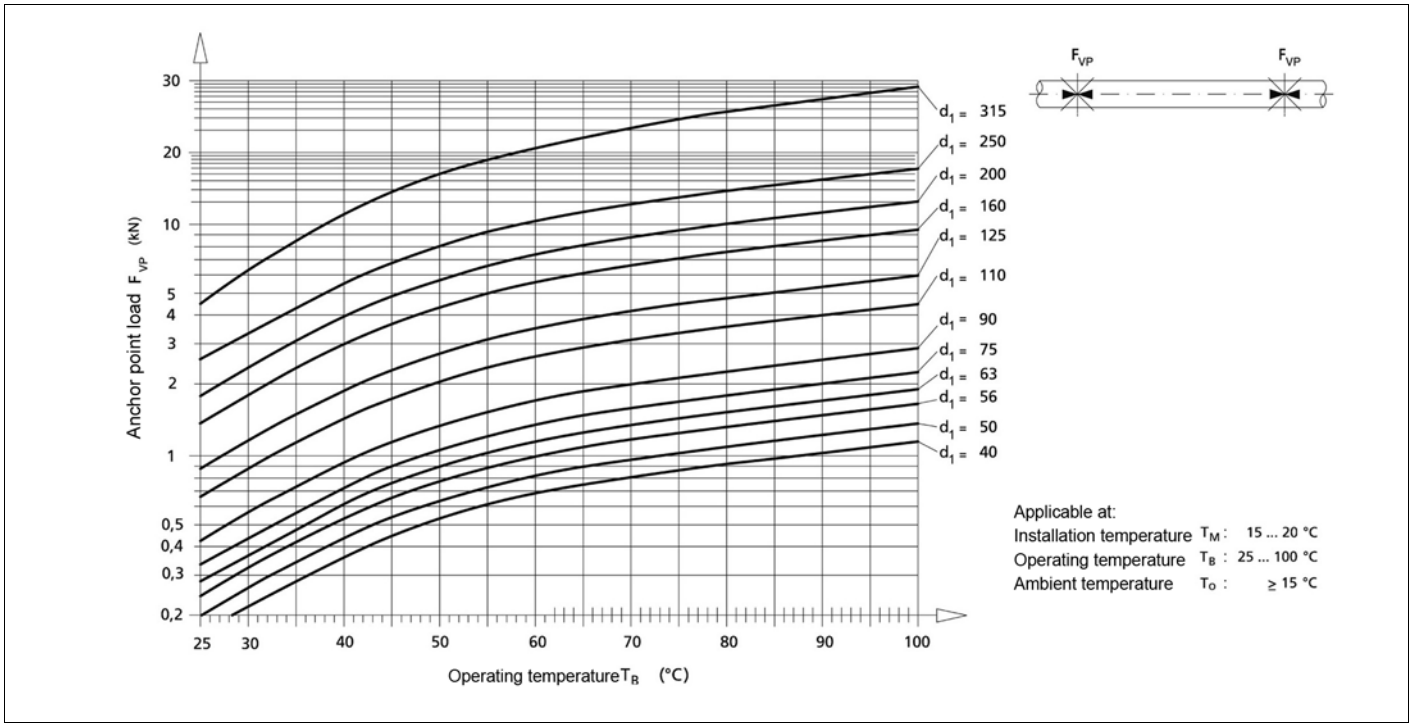
7.6 Anchor point bracket system

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

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.

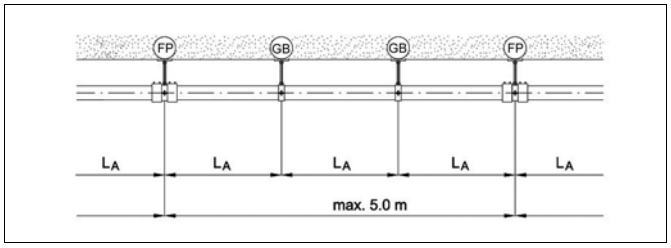


Illustration 7.12 Horizontal installation with anchor points

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.

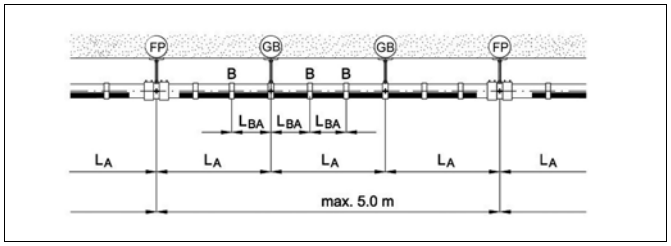


Illustration 7.13 Horizontal installation with anchor points and support trays

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

7.6.4 Vertical Installation

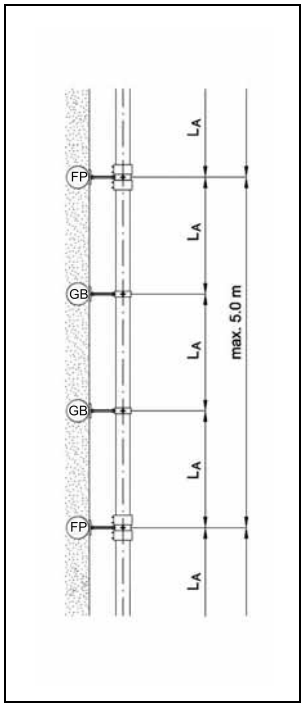


Illustration 7.14 Vertical installation with anchor points
GB = guide bracket
FP = anchor point
L_A = bracket distance

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

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

Soil and waste pipe installation methods

7.6.5 Distance of the bracket to the wall or ceiling

In table 7.9 the diameters of the connecting tube 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.

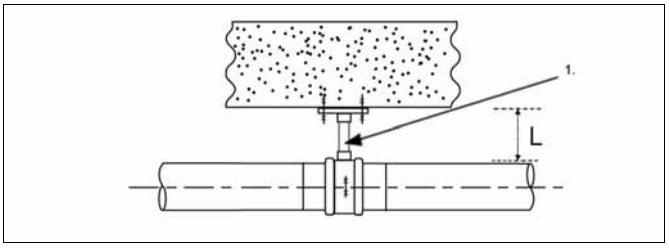


Illustration 7.15 1 = diameter of the connecting tube

Distance to wall/floor L (mm)	Pipe diameter d_1										
	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

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 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.

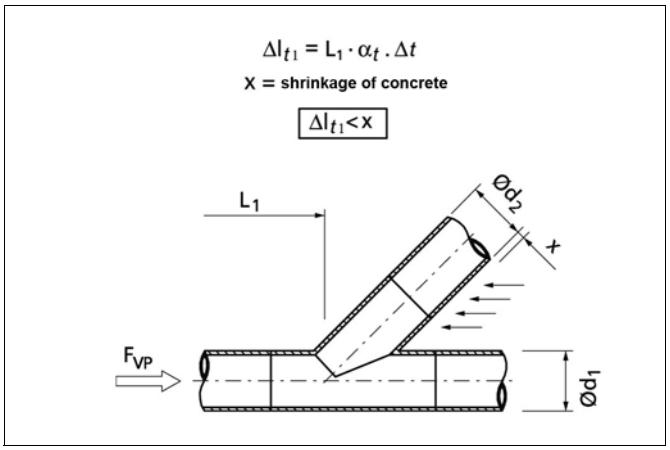


Illustration 7.16 HDPE expansion forces in concrete

All 45° and 88,5° branches are subdued to the expansion force (F_{VP}) which can be counteracted by installing an Akafusion coupler. The Akafusion coupler acts as an anchor point preventing the additional load to be transferred to the branch (see illustration 7.17).

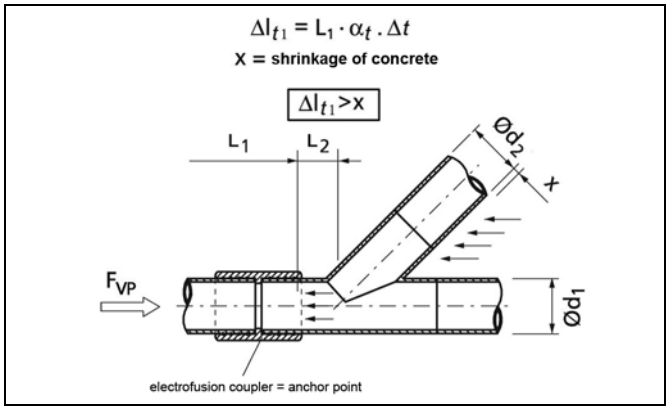


Illustration 7.17 Anchor point with an electrofusion coupler

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).

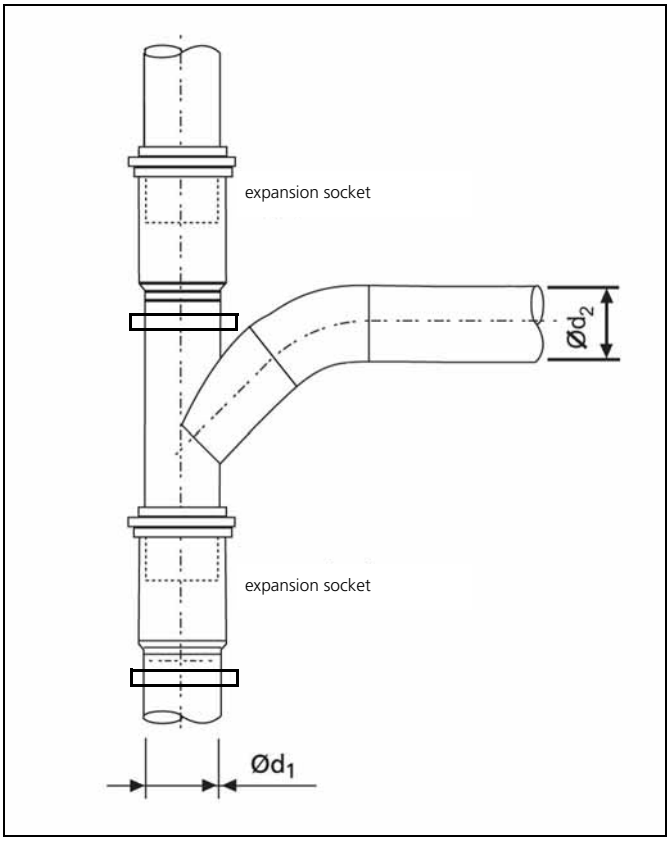


Illustration 7.18 Anchor point with (snap) expansion sockets

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 Akafusion coupler.

Soil and waste pipe installation methods

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.

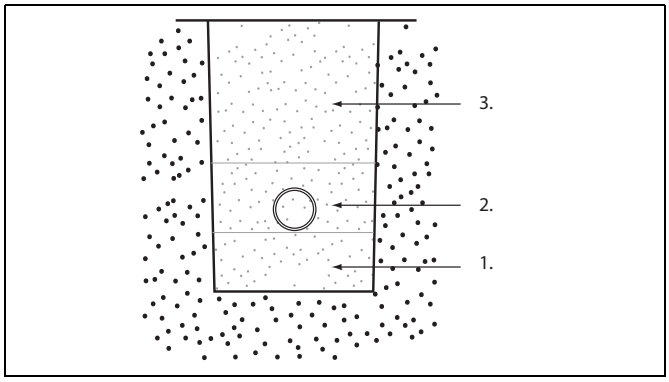


Illustration 7.19

The height of zone 1 depends on the soil conditions and the nominal pipe width, and is computed 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)

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.

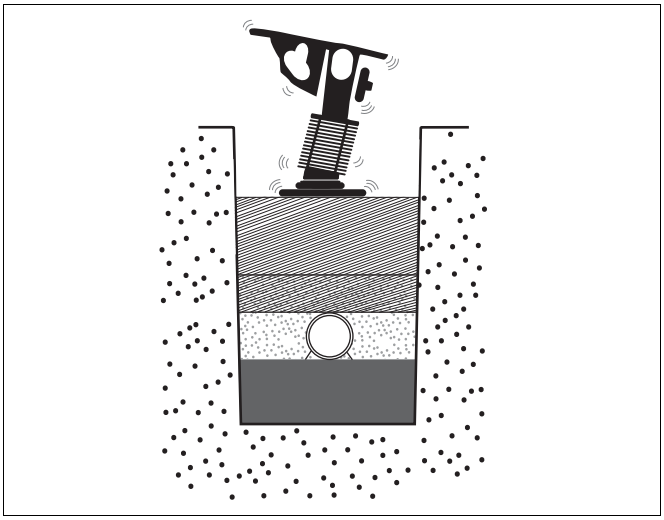


Illustration 7.20

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.

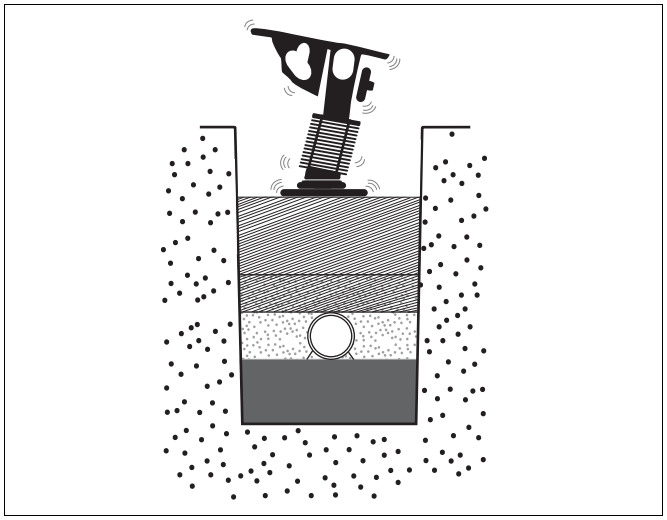


Illustration 7.21

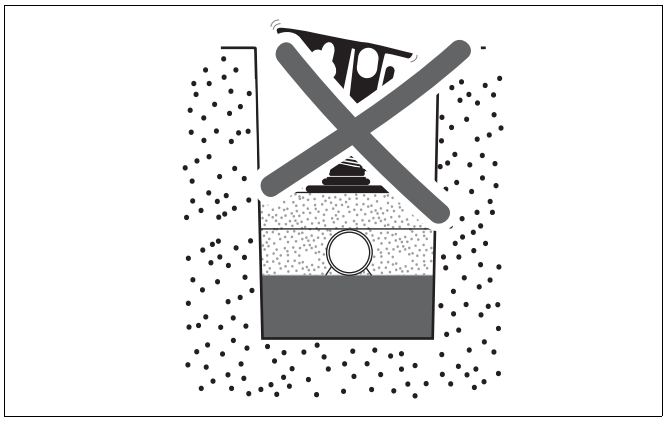


Illustration 7.22

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

Soil and waste pipe installation methods

A

Abbreviations 33
Akavent 7
Akavent aerator 11, 54
Aliaxis 31
Amplitude 27
Anchor bracket 11, 85, 105
Anchor bracket with expansion socket 105
Anchor point bracket 105
Anchor point bracket system 112
Anchor point joints 85
Applications and design guidelines 7
Approvals 31
Assessing an electrofusion weld 99

B

Base of the down pipe 13
Basic drainage unit 11
Before pouring concrete 115
Bend 15° 40
Bend 180° 41
Bend 30° 40
Bend 90° 39
Bend 90° reduced 41
Bend 90° with long side 39
Bends 39
Blind flange PP ductile iron core 67
Bolt torque 101
Bracket distances 106, 112
Branch 88,5° 46
Branch 88,5° swept entry 53
Branches 45
Butt-welding 33
Butt-welding machine 160C 91
Butt-welding machine 250C 91
Butt-welding machine 315C 91
Butt-welding machines 91

C

CAD software 104
Capacity 9
Chamfer pipe end 100
Chemical resistance 19
Clamp liners 84
Clean out branch 45° 48
Clean out branch 90° 49
Cold zone 97
Collar for plug-in socket, plug-in socket short, snap socket and expansion socket 82
Collector 13
Condensation insulation 28
Connector 13
Connectors 10, 14
Contraction sleeve 101
Contraction socket 65
Contraction socket joints 65
Control box Akafusion CB160 88
Control box Akafusion CB315-U 88
Control boxes Akafusion 88
Cooling 94
Cooling period 94

D

Decibels 27
Deflection leg calculation 109
Deflection leg calculation with expansion socket 111
Deformation 99
Dimensions 33, 104
Distance of the bracket to the wall or ceiling 114
Diverter 9
Double ball branch 88,5° 50, 51
Double branch 45° 47
Double wall-lavatory bend 90° (horizontal) 72
Double wall-lavatory bend 90° (vertical) 71
Double-flange bushing 70
Down pipe 7, 12, 15
Drain fixture 11, 13
Drain pipe 13
Drainage flow 13
Duct size 11

E

Elbow 45° 43
Elbow 45° with long side 43
Elbow 88,5° 42
Elbow 90° with long side 44
Elbows 42
Electrofusion 33, 97
Electrofusion coupler Akafusion 56
Electrofusion joints Akafusion 56
End cap 55
End caps 55
Equalisation pipe 9, 15
Evaluating the butt-weld joint 96
Expansion force 115
Expansion socket 100, 109
Expansion socket with anchor point 58

F

Female thread adaptor long 63
Female thread adaptor short 62
Fittings 34
Fixing system 11, 105
Flange bushing for screw coupler 61
Flanged joints 66, 101
Floor connector 10
Floor-lavatory 75
Floor-lavatory bend 90° 75
Floor-lavatory socket 75

akatherm

Index

Flow conditions 13
Fourfold ball branch 88,5° 53
Fusion zone 97

G

Gasket flat 66
Graduated arc 103
Gravity 13
Grease pencil 90
Ground pipes 13
Groundwater 116
Guide bracket 86, 105, 107
Guide bracket joints 86
Guide bracket system with deflection leg 109

H

Handling 33
HDPE 17
Heating element 93
Height difference 13
Horizontal installation 108
Horizontal installation with support tray 108
Horizontal pipes 14
Hydraulic pressure 7
Hydraulic seal 15

I

Incline 12, 15
Inclined joint 14
Insertion depth 100, 101
Inspection 31
Inspection screw lock long 60
Inspection screw lock short 61
Insulate 28
Insulation 27
Interior sewer system 13
Internal sewer noise 28
ISO 14001 31
ISO 9001 31

J

Joint 10
Joint-free zones 9, 15
Jointing methods 93
Jointing process 102

K

k-dimension 33, 103

L

Lengths 33
Loudness 27

M

Male thread adaptor long 64
Male thread adaptor short 63
Management system 31
Material properties 17
Metal coupling 102
Mounting plate for anchor bracket 85
Mounting plate for guide bracket 86

N

National approval 31
NEN 5077 28
Noise 27
Noise insulation 27
Noise nuisance 28
Not pull-tight 93

O

Offset 15
Output leads for control box Akafusion CB315-U 88
Overpressure 13
Oxygen layer 93

P

Physical characteristics of HDPE 17
Pipe 33
Pipe cutter 90
Pipe diameter 13
Pipe friction 13
Pipe in pipe joints 69
Pipe length 13
Pipe tempered 35
Pipe-in-pipe joint 102
Pipes 35
Pipework 13
Plug-in joint 100
Plug-in joints 57
Plug-in socket 59, 100
Polyethylene 17
Prefabrication 103
Pressure differences 13, 14
Pressure-relief pipes 13, 10, 15
Profile backing ring PP with ductile iron core 67
Protection cap for pipe 68
Protection plug 74
Protection plug for plug-in socket, plug-in socket short, snap socket and expansion socket 82
Protection plug for trap connection socket/bend 83
Protection plugs 104
P-trap 79
Pull-tight 93
Push-fit socket 8

Q

Quick drying concrete 115

R

Recycling 34
Reducer concentric 38
Reducer eccentric 36
Reducer eccentric long 37
Reducers 36
Reliable 103
Residential building 12
Residual waist 34
Roof drainage system 13
Rubber collar for pipe in pipe joints 69
Rubber collar for trap connection bend/socket 78
Rubber seal for floor-lavatory socket/bend 76
Running trap 80

S

Sample calculation 12
Scraper 89
Scraper Spider 89
Scrapers 89
Screw coupler short 60
Screw couplers 60
Screw threaded joint 101
Shower connections 14
Side joint 14
Simultaneity coefficient 11
Snap groove 100
Snap socket 57, 100
Snap socket short 59
Snap-expansion socket 100
Soil and traffic loads 116
Soil and waste systems for high-rise 7
Spare parts 82
Spider accessories 89
Stack 7
Standardised 104
Standards 31
Stench traps 14
Storage 33
S-trap 79
Stub flange 66
Support shell galvanised 87
Support shells 87
Support trays 113
System calculation 11

T

Technical support 31
Tempered pipe 33
Thermoplastic 17
Toilet connections 14
Toilets 10, 12
Tools 34
Tools miscellaneous 90
Top joint 14
Training 31
Transition to other material 70
Trap connection bend 90° 77
Trap connection socket 77
Trap connections 77
Traps 79
Traps with flange bushings 81
Triple ball branch 88,5° 52

U

Underground 11
Underground HDPE drainage pipes 116
Underground pipe 12
Underground pipe systems 116
Underground pipes 15, 116
Underpressure 13
Universal protection plug 78
Universal trap with flange bushing 81

V

Vent pipe 8
Venting 10
Vertical installation 109

W

Wall-lavatory 71
Wall-lavatory bend 90° 71
Wall-lavatory bend 90° (horizontal) left 72
Wall-lavatory bend 90° (horizontal) right 73
Wall-lavatory socket 73
Warranty 31
Waste connector 62
Waste water system 13
Welding by hand 96
Welding equipment 93
Welding parameters 95

Y

Y-branch 45° 45
Y-piece 60° 48

akatherm

Index

Index of article numbers

Art. Nr.	Page
04 04 01	79
04 04 02	79
04 04 03	80
04 05 01	79
04 05 02	79
05 05 01	79
05 05 02	79
05 05 03	80
05 06 01	79
05 06 02	79
05 56 01	79
06 06 01	79
06 06 02	79
06 06 03	80
06 06 09	81
07 07 01	79
07 07 09	81
09 09 09	81
10 04 00	35
10 05 00	35
10 06 00	35
10 07 00	35
10 09 00	35
10 11 00	35
10 12 00	35
10 16 00	35
10 20 00	35
10 20 10	35
10 25 00	35
10 25 10	35
10 31 00	35
10 31 10	35
10 56 00	35
11 04 92	39
11 04 99	41
11 05 92	39
11 05 99	41
11 06 92	39
11 06 99	41
11 07 92	39
11 09 92	39
11 11 09	81
11 11 92	39
11 12 92	39
11 16 91	39
11 20 91	39
11 25 91	39
11 31 91	39
11 56 92	39
11 56 99	41
12 04 45	43
12 04 88	42
12 05 45	43
12 05 88	42
12 06 45	43
12 06 88	42
12 07 45	43
12 07 46	43
12 07 88	42
12 09 45	43
12 09 46	43
12 09 88	42
12 09 93	44
12 11 45	43
12 11 46	43
12 11 88	42
12 11 93	44
12 12 45	43
12 12 88	42
12 16 45	43
12 16 88	42
12 20 45	43
12 20 88	42
12 25 45	43
12 25 88	42
12 31 45	43
12 31 88	42
12 56 45	43
12 56 88	42
14 20 11	37
14 20 12	37
14 20 16	37
14 25 20	37
14 31 20	37
14 31 25	37
15 04 03	38
15 05 03	38
15 05 04	38
15 06 04	38
15 06 05	38
15 06 56	38
15 07 04	38
15 07 05	38
15 07 06	38
15 07 56	38
15 09 04	38
15 09 05	38
15 09 06	38
15 09 07	38
15 09 56	38
15 11 04	38
15 11 05	38
15 11 06	38
15 11 07	38
15 11 09	38
15 11 56	38
15 12 05	38
15 12 06	38
15 12 07	38
15 12 09	38
15 12 11	38
15 12 56	38
15 16 11	38
15 16 12	38
15 20 16	38
15 25 16	38
15 25 20	38
15 31 20	38
15 31 25	38
15 56 04	38
15 56 05	38
16 05 04	36
16 06 04	36
16 06 05	36
16 06 56	36
16 07 04	36
16 07 05	36
16 07 06	36
16 07 56	36
16 09 04	36
16 09 05	36
16 09 06	36
16 09 07	36
16 09 56	36
16 11 04	36
16 11 05	36
16 11 06	36
16 11 07	36
16 11 09	36
16 11 56	36
16 12 05	36
16 12 06	36
16 12 07	36
16 12 09	36
16 12 11	36
16 12 56	36
16 16 11	36
16 16 12	36
16 56 04	36
16 56 05	36
17 05 04	41
17 06 05	41
18 11 15	40
18 11 30	40
18 12 15	40
18 12 30	40
18 16 15	40
18 16 30	40
18 20 15	40
18 20 30	40
18 25 15	40
18 25 30	40
18 31 15	40
18 31 30	40
20 04 04	46
20 05 04	46
20 05 05	46
20 06 04	46
20 06 05	46
20 06 06	46
20 06 56	46
20 07 04	46
20 07 05	46
20 07 06	46
20 07 07	46
20 07 56	46
20 09 04	46
20 09 05	46
20 09 06	46
20 09 07	46
20 09 09	46
20 09 56	46
20 11 04	46
20 11 05	46
20 11 06	46
20 11 07	46
20 11 09	46
20 11 11	46
20 11 56	46
20 12 05	46
20 12 06	46
20 12 07	46
20 12 09	46
20 12 11	46
20 12 12	46
20 12 56	46
20 16 05	46
20 16 06	46

akatherm

Index of article numbers

Art. Nr.	Page
20 16 07	47
20 16 09	47
20 16 11	47
20 16 12	47
20 16 16	47
20 16 56	46
20 20 07	47
20 20 09	47
20 20 11	47
20 20 12	47
20 20 16	47
20 20 20	47
20 25 11	47
20 25 12	47
20 25 16	47
20 25 20	47
20 25 25	47
20 31 11	47
20 31 12	47
20 31 16	47
20 31 20	47
20 31 25	47
20 31 31	47
20 56 05	46
20 56 56	46
23 04 00	49
23 05 00	49
23 06 00	49
23 07 00	49
23 09 00	49
23 11 20	49
23 12 00	49
23 16 00	49
23 20 00	49
23 25 00	49
23 31 00	49
23 56 00	49
24 11 01	50
24 11 02	51
24 11 03	51
24 11 14	50
24 11 15	50
24 11 16	50
24 11 17	50
24 11 19	50
24 11 24	51
24 11 25	51
24 11 26	51
24 11 27	51
24 11 29	51
24 11 34	51
24 11 35	51
24 11 36	51
24 11 37	51
24 11 39	51
24 12 01	50
24 12 02	51
24 12 03	51
24 12 12	50
24 12 14	50
24 12 15	50
24 12 17	50
24 12 22	51
24 12 24	51
24 12 25	51
24 12 27	51
24 12 32	51
24 12 34	51
24 12 35	51
24 12 37	51
25 11 11	53
30 04 04	45
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30 05 05	45
30 06 04	45
30 06 05	45
30 06 06	45
30 06 56	45
30 07 04	45
30 07 05	45
30 07 06	45
30 07 07	45
30 07 56	45
30 09 04	45
30 09 05	45
30 09 06	45
30 09 07	45
30 09 09	45
30 09 56	45
30 11 04	45
30 11 05	45
30 11 06	45
30 11 07	45
30 11 09	45
30 11 11	45
30 11 56	45
30 12 04	45
30 12 05	45
30 12 06	45
30 12 07	45
30 12 09	45
30 12 11	45
30 12 12	45
30 12 56	45
30 16 05	45
30 16 06	45
30 16 07	45
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30 16 11	45
30 16 12	45
30 16 16	45
30 16 56	45
30 20 05	45
30 20 06	45
30 20 07	45
30 20 09	45
30 20 11	45
30 20 12	45
30 20 16	45
30 20 20	45
30 20 56	45
30 25 07	45
30 25 09	45
30 25 11	45
30 25 12	46
30 25 16	46
30 25 20	46
30 25 25	46
30 31 07	46
30 31 09	46
30 31 11	46
30 31 12	46
30 31 16	46
30 31 20	46
30 31 25	46
30 31 31	46
30 56 04	45
30 56 05	45
30 56 56	45
33 11 00	48
33 12 00	48
33 16 00	48
34 11 01	52
34 11 02	52
34 11 14	52
34 11 15	52
34 11 16	52
34 11 17	52
34 11 19	52
34 11 24	52
34 11 25	52
34 11 26	52
34 11 27	52
34 11 29	52
34 12 01	52
34 12 02	52
34 12 12	52
34 12 14	52
34 12 15	52
34 12 17	52
34 12 22	52
34 12 24	52
34 12 25	52
34 12 27	52
36 11 04	47
36 11 05	47
36 11 11	47
37 05 04	48
37 06 05	48
37 11 11	48
40 03 13	82
40 03 19	82
40 04 10	57
40 04 13	82
40 04 19	82
40 04 20	58
40 04 29	68
40 05 10	57
40 05 13	82
40 05 19	82
40 05 20	58
40 05 29	68
40 06 10	57
40 06 13	82
40 06 19	82
40 06 20	58
40 06 29	68
40 07 10	57
40 07 13	82
40 07 19	82
40 07 29	68
40 09 10	57
40 09 13	82
40 09 19	82
40 09 29	68
40 11 10	57
40 11 13	82
40 11 19	82

Index of article numbers

Art. Nr.	Page
40 11 29	68
40 11 40	59
40 12 10	57
40 12 13	82
40 12 19	82
40 12 29	68
40 16 10	57
40 16 13	82
40 16 19	82
40 16 29	68
40 20 10	57
40 20 13	82
40 20 19	82
40 20 23	82
40 20 60	58
40 25 23	82
40 25 60	58
40 31 23	82
40 31 60	58
40 46 19	83
40 56 13	82
40 56 19	82
40 56 20	58
40 56 29	68
40 58 19	83
41 04 95	56
41 05 95	56
41 06 95	56
41 07 95	56
41 09 95	56
41 11 95	56
41 12 95	56
41 16 95	56
41 20 65	56
41 25 65	56
41 31 65	56
41 56 95	56
41 96 20	90
41 98 10	88
41 98 60	89
41 98 61	89
41 98 62	89
41 98 63	89
41 98 64	89
41 98 65	89
41 98 66	89
41 99 10	88
41 99 71	88
41 99 72	88
42 04 50	59
42 05 50	59
42 06 50	59
42 07 20	58
42 07 23	82
42 07 50	59
42 09 20	58
42 09 23	82
42 09 50	59
42 11 20	58
42 11 23	82
42 11 50	59
42 12 20	58
42 12 23	82
42 12 50	59
42 16 20	58
42 16 23	82
42 16 50	59
42 56 50	59
43 04 05	61
43 04 30	60
43 05 05	61
43 05 30	60
43 06 05	61
43 06 30	60
43 07 05	61
43 07 30	60
43 09 05	61
43 09 19	74
43 09 30	60
43 11 05	61
43 11 15	70
43 11 19	74
43 11 30	60
43 12 15	70
43 16 15	70
43 20 15	70
43 25 15	70
43 31 15	70
43 46 19	78
43 56 05	61
43 56 30	60
44 11 01	53
44 11 14	53
44 11 15	53
44 11 16	53
44 11 17	53
44 11 19	53
44 12 01	53
44 12 12	53
44 12 14	53
44 12 15	53
44 12 17	53
47 04 02	66
47 04 09 010	67
47 04 13 910	66
47 04 85 010	67
47 05 02	66
47 05 09 010	67
47 05 13 910	66
47 05 85 010	67
47 06 02	66
47 06 09 010	67
47 06 13 810	66
47 06 85 010	67
47 07 02	66
47 07 09 010	67
47 07 13 810	66
47 07 85 010	67
47 09 02	66
47 09 09 010	67
47 09 13 810	66
47 09 85 010	67
47 11 02	66
47 11 09 010	67
47 11 13 810	66
47 11 85 010	67
47 12 02	66
47 12 09 010	67
47 12 13 810	66
47 16 02	66
47 16 09 010	67
47 16 13 810	66
47 16 85 010	67
47 20 02	66
47 20 09 010	67
47 20 13 810	66
47 20 85 010	67
47 25 02	66
47 25 09 010	67
47 25 13 810	66
47 25 85 010	67
47 31 02	66
47 31 09 010	67
47 31 13 810	66
47 31 85 010	67
47 56 02	66
49 09 10	90
49 10 10	90
49 11 10	90
49 20 00	91
49 30 00	91
49 40 00	91
50 09 01	75
50 09 11	75
50 09 32	72
50 09 33	73
50 09 34	71
50 09 35	72
50 09 51	73
50 09 84	71
50 10 32	72
50 10 33	73
50 11 01	75
50 11 11	75
50 11 13	76
50 11 32	72
50 11 33	73
50 11 34	71
50 11 35	72
50 11 71	73
50 11 82	71
50 11 85	71
51 03 01	77
51 04 01	77
51 04 11	77
51 05 01	77
51 05 02	77
51 05 11	77
51 05 12	77
51 33 01	69, 78
51 33 03	69
51 35 01	69, 78
51 35 02	69, 78
51 35 03	69
51 36 02	69, 78
51 37 02	69, 78
51 56 01	77
51 56 02	77
51 56 11	77
51 56 12	77
55 04 01	65
55 04 02	65
55 05 03	65
55 05 04	65
55 06 01	65
55 06 03	65
55 07 01	65
55 07 02	65

akatherm

Index of article numbers

Art. Nr.	Page
55 09 02	65
55 11 02	65
55 11 03	65
55 11 04	65
55 12 01	65
55 12 02	65
55 16 02	65
55 16 04	65
55 20 01	65
55 25 01	65
55 56 01	65
56 56 01	79
56 56 02	79
56 56 03	80
60 11 17	54
60 16 17	54
61 33 11	89
66 04 40	60
66 05 40	60
66 06 40	60
66 07 00	61
66 07 40	60
66 09 40	60
66 11 20	61
66 11 40	60
66 56 40	60
67 04 07	55
67 05 07	55
67 06 07	55
67 07 07	55
67 09 07	55
67 11 07	55
67 12 09	55
67 16 09	55
67 20 09	55
67 25 09	55
67 31 09	55
67 56 07	55
70 04 10	86
70 04 15	84
70 04 78	85
70 05 10	86
70 05 15	84
70 05 78	85
70 06 10	86
70 06 15	84
70 06 78	85
70 07 10	86
70 07 15	84
70 07 78	85
70 09 10	86
70 09 15	84
70 09 78	85
70 11 10	86
70 11 15	84
70 11 78	85
70 12 10	86
70 12 15	84
70 12 78	85
70 16 10	86
70 16 15	84
70 16 78	85
70 20 15	84
70 20 80	85–86
70 25 80	85–86
70 31 80	85–86
70 56 10	86
70 56 15	84
70 56 78	85
70 94 10	86
70 94 78	85
70 94 80	85–86
90 04 00	87
90 05 00	87
90 06 00	87
90 07 00	87
90 09 00	87
90 11 00	87
90 12 00	87
90 16 00	87
90 56 00	87
91 04 78	62
91 04 79	62
91 04 80	62
91 04 81	62
91 05 80	62
91 05 81	62
91 05 82	62
91 06 82	62
91 06 83	62
92 04 78	63
92 04 79	63
92 04 80	63
92 04 81	63
92 05 78	63
92 05 79	63
92 05 80	63
92 05 81	63
92 05 82	63
92 05 83	63
92 06 82	63
92 06 83	63
92 07 84	63
92 56 83	63
96 04 78	63
96 04 79	63
96 04 80	63
96 04 81	63
96 05 80	63
96 05 81	63
96 05 82	63
96 06 82	63
96 06 83	63
97 04 78	64
97 04 79	64
97 04 80	64
97 04 81	64
97 05 80	64
97 05 81	64
97 05 82	64
97 06 82	64
97 06 83	64
97 07 84	64
97 56 83	64
98 03 81	62
98 04 82	62
98 05 83	62

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