aalberts integrated piping systems

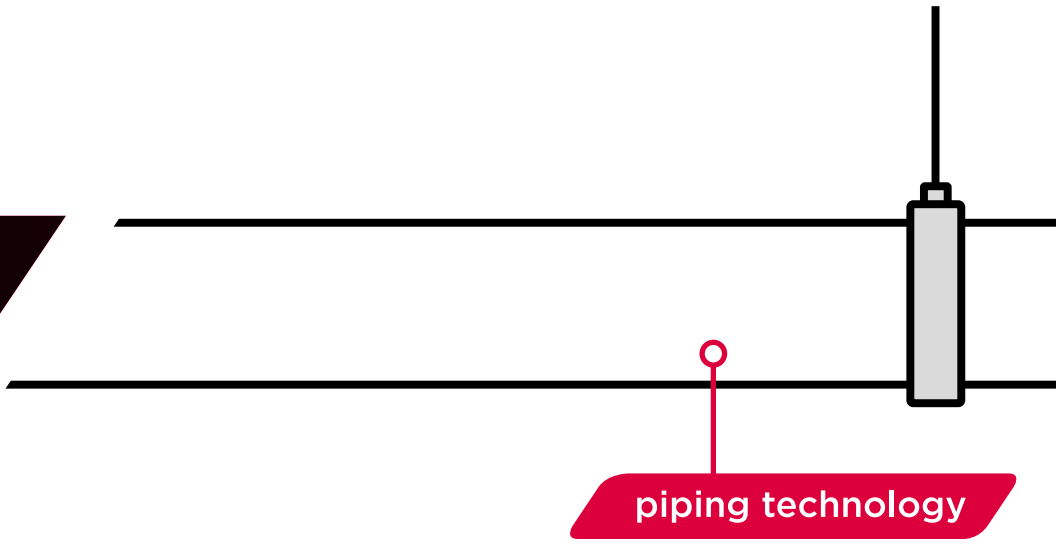
VSH UltraLine

EN technical manual

content

Aalberts integrated piping systems

don’t just buy products, buy solutions.



we are Aalberts integrated piping systems

Aalberts integrated piping systems engineers the most advanced integrated piping systems for the distribution and control of liquids and gases for key verticals, like industrial, utilities, commercial and residential. We offer fully integrated piping systems in valve, connection, fastening and piping technology. We work hand-in-hand with our customers to create the perfect integrated piping system, that meets their requirements. Our piping systems are easy to specify, install, control and maintain, saving important preparation and installation time. We meet the highest quality and industry standards needed in the selected verticals. We are the only business that truly offers its customers a single sourced and complete integrated piping solution, each and every time.
Don't just buy products, buy solutions.

our mission

With our integrated piping systems, supported by the unique Aips Digital Design Service, we ensure that you will always get the best and easiest solution for the installation of an integrated piping system. From the moment that your plan is being sketched out on the digital drawing board, you can get advice on complete and tailored solutions. With the Aips Revit Plug-in you have digital access to the complete product offering within Aalberts integrated piping systems. This information is always accessible and up to date, allowing the design of an optimal and economically attractive installation that will meet all your demands. So whether the task is project conception, installation, or on-going maintenance, we are the company that truly delivers a complete system and service offering. Our know-how, our can-do attitude, and our relentless innovation come as standard. We will sweat the small stuff in our quest to find the perfect solutions, even if we have to invent them.
This is how we deliver excellence.

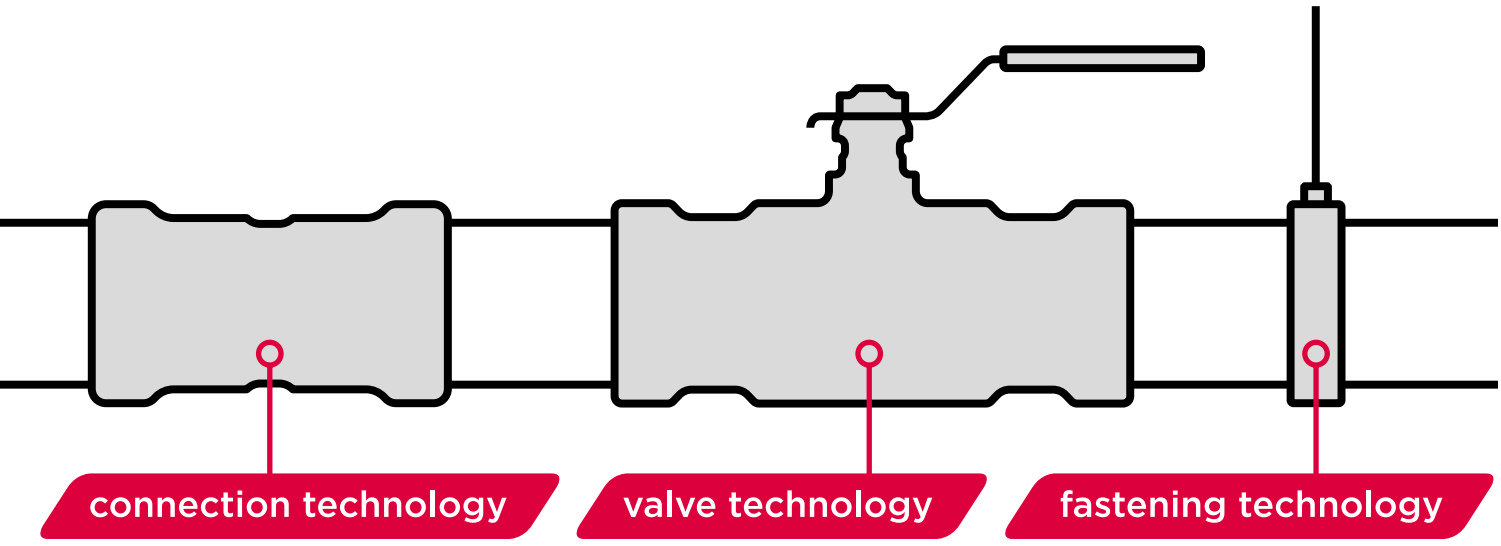
our way or working

We operate from various regions around the globe: America, United Kingdom, Middle East, Asia Pacific and Europe. As we have multiple locations in many countries, we are always close to our customers. More than 3500 mission critical employees are persistent to offer the best integrated piping system. They work on our products, solutions and services every day. No matter how big the opportunity is, when we say we've got this, we won't let go until there is nothing left to learn. We improve ourselves by exchanging knowledge and experience to stay ahead of our competitors.
Good is never good enough.

With our sustainable spirit we contribute to circularity every single day. This belief is strongly linked to the way we do business. Rethink, reduce and recycle. We are entrepreneurial and take ownership in everything we do. We are convinced that self-development and diversity is essential.
The Aalberts way, winning with people.

the strength of Aalberts integrated piping systems

- the perfect solution for every project
- smart, fast and efficient installation
- valuable advice from the drawing board to delivery
- a very wide product range



For more information about Aalberts integrated piping systems, go to www.aalberts-ips.eu

Aalberts integrated piping systems connect: our systems are easy to combine with each other

Aalberts integrated piping systems is the combination of different companies with a strong legacy in their markets. The individual brands are well-known and each represents a long history. Together they offer the best integrated piping system for now and in the future.

Connection technology

VSH
VSH has been supplying quality products for 90 years and delivers piping systems and fittings throughout the world. In the 1970's VSH brought the well-known VSH Super compression fitting on the market which is still a best-seller, followed by the VSH XPress pressfitting, a technology that makes it possible to realize a connection even faster and more reliable.

Shurjoint
The history of Shurjoint dates back to 1974, when the founders produced their first grooved couplings. These first couplings were produced from malleable iron, the casting material of choice at this time. Shurjoint is recognized as a world leader in the design and manufacture of mechanical piping components.

Valve technology

Apollo
Apollo Valves has been supplying the commercial and industrial valve markets since 1928. The valves, with their signature yellow handles, are designed and manufactured in their state-of-the-art facilities in the Carolinas, USA. Apollo's vertical manufacturing integration assures better quality control, better cost control, and the shortest delivery lead times possible for their range of ball valves, automation products, safety relief valves, backflow preventers and plumbing/heating products.

VSH PowerPress®

material	carbon steel
suitable for	thick-walled steel
connection	press / DW-profile
dimensions	½" - 2" (DN15 – DN50)

VSH SudoPress

material	carbon steel / stainless steel / copper
suitable for	steel / stainless steel / copper
connection	press / V-profile
dimensions	12 – 108 mm (DN10 – DN100)

VSH XPress

material	carbon steel / stainless steel / copper / cunifer
suitable for	steel / stainless steel / copper / cunifer
connection	press / M-profile
dimensions	12 – 108 mm (DN10 – DN100)

Aalberts integrated piping systems range

We offer a series of product ranges that:

- connect seamlessly
- are available in dimensions from 6 mm up to 104" (DN2600)
- can be used for thick-walled pipe and thin-walled metal or plastic tube
- have press, compression, groove and push connections
- can be expanded with valves and accessories
- are BIM ready

VSH Shurjoint

material	ductile iron / stainless steel
suitable for	thick-walled steel / stainless steel / HDPE
connection	groove
dimensions	½" - 104" (DN15 – DN2600)

VSH Super

material	brass
suitable for	steel / stainless steel / copper / plastic
connection	compression
dimensions	6 – 54 mm (DN4 – DN50)

Apollo ProFlow

material	brass / ductile iron
suitable for	steel / stainless steel / copper / plastic
connection	threaded / press / flange
dimensions	DN15 – DN300

VSH MultiPress

material	PPSU / brass
suitable for	plastic
connection	press / U & TH profile
dimensions	14 – 63 mm (DN10 – DN50)

VSH UltraLine

material	PPSU / brass / PVDF
suitable for	plastic
connection	sliding sleeve
dimensions	14 – 32 mm (DN10 – DN25)

VSH Tectite

material	brass / stainless steel / copper
suitable for	steel / stainless steel / copper
connection	push
dimensions	10 – 54 mm (DN8 – DN50)

VSH UltraLine

VSH UltraLine is a plastic piping system with fittings using the sleeve connection technique. VSH UltraLine is a system without o-rings and is suitable for use in potable water, heating, cooling and underfloor heating applications. The VSH UltraLine fittings are suitable to connect to VSH UltraLine multilayer tubes and can be used in surface and under screed installations. Thanks to its high chemical and thermal resistance, VSH UltraLine can also be used in compressed air installations.

VSH UltraLine is produced in a fully automated factory in Europe. Precise test procedures and extensive quality control of all products ensure an optimal quality.

advantages VSH UltraLine

- fittings without o-ring: permanent and secure connection without additional seals
- up to 25% increased system flow compared to competitors
- quick, simple and convenient installation, even in hard to reach places
- the most flexible tube on the installation market among sleeve systems
- suitable for embedding in concrete and reinforced concrete screed
- available from 14 up to 32 mm

VSH UltraLine

technical data

applications

The VSH UltraLine system has been specifically developed for the housing, commercial and industrial building markets. For example, the thin floor screeds and folding walls have been taken into account.

for sanitary and central heating applications, the following temperature profiles apply:

application class (EN ISO 10508)	T_d °C	T_d time/ years	T_{max} °C	T_{max} time/ years	T_{mal} °C	T_{mal} time/ hours	typical application
1a	60	49	80	1	95	100	hot water supply (60°C)
2a	70	49	80	1	95	100	hot water supply (70°C)
4b	20 40 60	2.5 20 25	70	2.5	100	100	underfloor heating and low temperature radiators
5b	20 60 80	14 25 10	90	1	100	100	high temperature radiators

NOTE: where the values for T_d, T_{max} and T_{mal} are higher than in the table above, this international standard does not apply.

a. a country may select class 1 or 2 in accordance with its national regulations.
b. where there is a combined temperature profile, as in classes 4 and 5, the times may be added together for a calculated total lifespan of 50 years. For example, for class 5: 20°C during 14 years + 60°C during 25 years + 80°C during 10 years + 90°C during 1 year + 100°C during 100 hours = 50 years.

temperature profiles

potable water installations

VSH UltraLine fittings in combination with VSH UltraLine tube

operating temperature:	in accordance with EN ISO 10508 classes 1a or 2a
max. operating pressure:	10 bar

central heating installations

VSH UltraLine fittings in combination with VSH UltraLine tube

operating temperature:	in accordance with EN ISO 10508 classes 4b or 5b
max. operating pressure:	10 bar

underfloor heating installations

VSH UltraLine fittings in combination with VSH UltraLine tube

operating temperature:	in accordance with EN ISO 10508 class 4b
max. operating pressure:	10 bar

cooling installations

VSH UltraLine fittings in combination with VSH UltraLine tube

min. temperature:	+5°C with water -10°C mixture of water and glycol (max. 50% glycol)
max. operating temperature:	70°C
max. operating pressure:	10 bar

Please note that the use of VSH UltraLine in cooling installations requires special measures. For more information, please contact Aalberts integrated piping systems.

compressed air installations

VSH UltraLine fittings in combination with VSH UltraLine tube

max. operating temperature:	70°C
max. operating pressure::	10 bar
oil content:	max. 25 mg/m^3, class 5, ISO 8573 Part 1

compressed air table ISO 8573

class	water content (mg/m^3)	oil content (mg/m^3)*	suitability
1	3	0.01	√
2	120	0.1	√
3	880	1	√
4	6000	5	√
5	7800	25	√
6	9400	>25	-

*only synthetic oils are allowed. Mineral oils are not allowed.

compressed air classes

Compressed air piping systems must be properly tested as soon as the installation work is finished. The system designer and installation contractor must ensure safe methods are selected for testing the system. The methods must comply with all current health and safety regulations. They may include testing compressed air lines with fluids or compressed air at a specific pressure, or a combination of both. We recommend that the maximum working pressure of the product is not exceeded during this process.

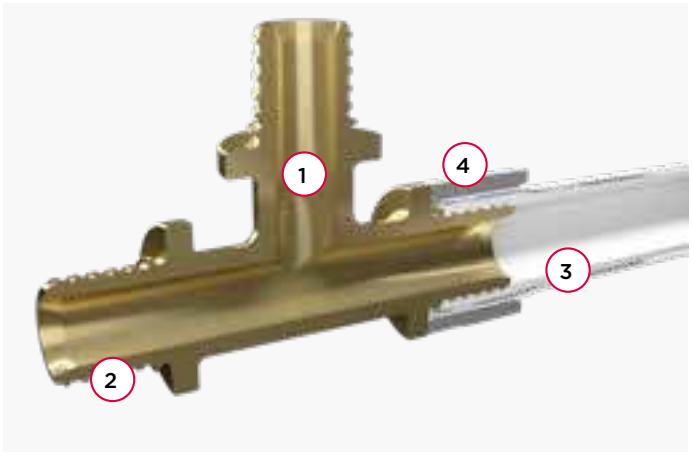
Since 30 May 2002, most pressure equipment and installations on the market have had to comply with the Pressure Equipment Directive (PED) 1999. The Directive concerns items such as vessels, pressurized storage containers, heat exchangers, steam generators, boilers, industrial piping, safety equipment and pressure accessories.

Please note that Article 3(3) of the PED applies to VSH UltraLine. This means that only sound design and safe instructions for use and maintenance are required.

fittings

materials

The VSH UltraLine piping system includes fittings and sliding sleeves. The fittings are available in plastic (PPSU*) and brass. The sliding sleeves are produced and offered only in the plastic (PVDF**).



1. brass or PPSU housing
2. end stub with profile and without o-ring
3. chamfer for better flow and reduced pressure loss
4. PVDF sliding sleeve

The VSH UltraLine fittings, are constructed without an o-ring, which ensures easy and safe assembly and long-term, trouble-free operation of the installation.

brass fittings

The material for these fittings is CW617N brass in accordance with EN 12164. The fittings are tested for water and approved in accordance with ISO 21003 and have Kiwa, KOMO and DVGW approval.

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PPSU fittings

PPSU is a high-quality plastic that is very often used for sanitary and central heating applications. PPSU has the advantage of high mechanical strength and good chemical resistance. PPSU is neutral in relation to potable water, which means the material does not give any taste or smell or colour to the water. The VSH UltraLine PPSU fittings have been tested and approved in accordance with ISO 21003 and have Kiwa, KOMO and DVGW approval.

VSH UltraLine sliding sleeves

The VSH UltraLine sliding sleeves are a very important part to connecting the tube with the fitting ensuring a water and air tight connection. The sleeves are produced of high quality PVDF plastic.

For proper tight and mechanically strong connections only VSH UltraLine sliding sleeves must be used. It is prohibited to use sleeves other than the recommended ones or products of foreign origin. Each original VSH UltraLine sliding sleeve is marked with company logo, material and the diameter embossed on the outer surface. The sleeve is symmetrical and can be installed in both directions.

* Polyphenylsulfone
** Polyvinylidene fluoride

tubes

outer diameter [d]	14	16	20	25	32
internal diameter [mm]	10	11.6	14.4	20	26
wall thickness [mm]	2.0	2.2	2.8	2.5	3.0
application class [EN ISO 21003-1]	2-4-5	2-4-5	2-4-5	2-4-5	2-4-5
max. operating pressure [bar]	10	10	10	10	10
thermal conductivity [W/mK]	0.43	0.43	0.43	0.43	0.43
linear expansion coefficient [mm/mK]	0.025	0.025	0.025	0.025	0.025
tube inner surface roughness [µm]	7	7	7	7	7
oxygen diffusion [mg/l]	0	0	0	0	0
minimum radius of curvature [manual]	≥5 x d	≥5 x d	≥5 x d	≥5 x d	≥5 x d
weight [kg/m]	0.097	0.114	0.180	0.239	0.365
capacity [dm^3/m]	0.079	0.106	0.163	0.314	0.531

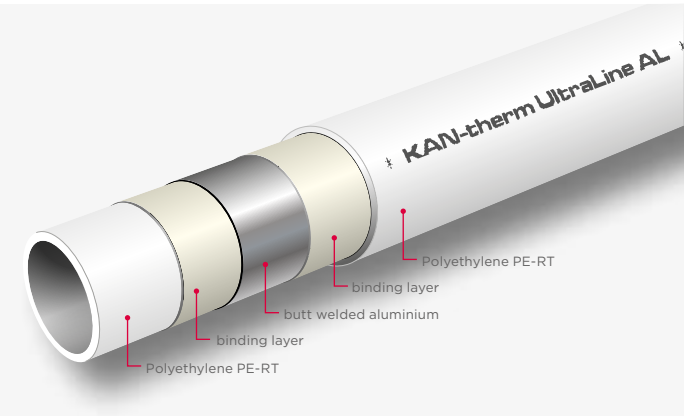
VSH UltraLine tube characteristics

multilayer tube

VSH UltraLine multilayer tube is made up of an inner and outer layer of PE-RT (polyethylene) and a butt-welded aluminum core. These three basic layers are bonded by two adhesive layers to form a stable tube wall. Thanks to this construction, the advantages of the plastic (light weight and corrosion resistant) and the metal (high mechanical strength, 100% oxygen diffusion tight, low expansion coefficient and dimensionally stable) are ideally combined in one tube. Also, the mechanical properties, temperature resistance and life span are improved considerably.

The butt-welded aluminum layer does not have any overlap. This gives a uniform wall structure without any unwanted discontinuities. Of course, VSH UltraLine tubes can be used in heating and sanitary installations. In case of use for any media or application areas other than those mentioned above, please contact Aalberts integrated piping systems for potential approval.

construction



approvals

Aalberts integrate piping systems has the following system approval marks for VSH UltraLine fittings in combination with VSH UltraLine tubes:

Kiwa for potable water

- certificate number K105506
- the products meet Kiwa's assessment guideline BRL K536 part G

KOMO for heating systems

- certificate numbers K106493
- the products meet Kiwa's assessment guideline BRL 5611

DVGW for potable water

- certificate number DW-8501DL0221

These approval marks are system approval marks. This means that they apply only to combinations of VSH UltraLine fittings and tubes.

threaded connections

The VSH UltraLine product range also includes components with female and male threads which are manufactured in accordance with ISO 7-1 (Rp) or ISO 228-1 (G). Clean the thread before assembly. Hemp, mastic or PTFE are suitable for thread sealing. We recommend that sealing is applied to the thread (in the thread direction) before sleeve connections are made, in order not to stress the sleeve connection.

tools

In order to achieve correct VSH UltraLine sleeve connections two types of tools are used. An expander tool to expand the tube ends and a crimp tool with special forks to make the sleeve connection. A set of forks is available for every used piping system diameter. To make a proper connection, always equip the crimping tool with a suitable set of crimping forks. All used tools should be approved by Aalberts integrated piping systems.

approved tools

All approved approved expansion and crimp tools to fit the right product are found in our online tool selector, available on our website: www.aalberts-ips.eu/presstool

maintenance and correct usage

Only use expansion and crimp tools that are in good condition. For the required periodic maintenance of the tools, please take notice of the manufacturer‘s instructions for usage and maintenance. It is the user's responsibility to ensure that the required periodic maintenance of the tools is carried out.

installation instructions

1. cut the tube to length

Cut the tube to the desired length with a special tube cutter/cutting blade or any other suitable cutter for plastic multilayer tube. To prevent burrs and irregularities, never use a saw.

2. place the sliding sleeve

Place the sliding sleeve onto the tube end. The sleeve is symmetrical and does not require orientation.

3. expand the tube end

Equip the expansion tool with an expansion head suitable for the used tube diameter. Insert the expanding head axially and fully into the tube end until it stops.
Expansion should be carried out in two steps:

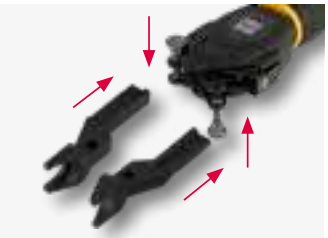
1. initial full expansion of the tube, in full range of the tool stroke, turn the expander by 30° after expansion
2. final expansion of the tube, in full range of the tool stroke

4. join tube and fitting

Immediately after expansion, insert the fitting into the expanded tube end to the last protrusion on the fitting.

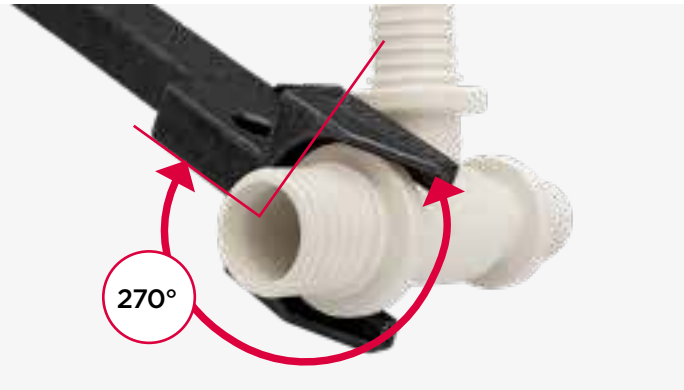
Note: do not push the tube end up to the fitting flange and do not use lubricants.

5. assemble the crimp forks on the crimp tool

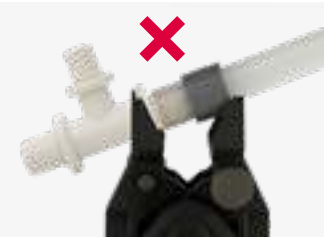


The manual or electric driven crimp tool must be equipped with special forks. The forks have special bumpers protecting the fitting and the sleeve against excessive crimping force damage. Fork sets are available for all tube diameters.

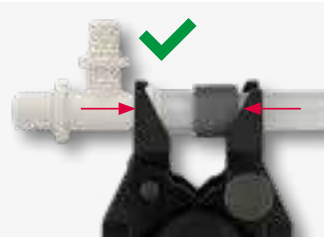
crimp forks
The design of the VSH UltraLine crimp forks ensures a very wide angle approach from 0° to even 270° which significantly increases installation comfort in hard to reach places.



6. crimp the connection

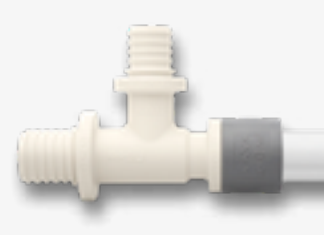


Before crimping, pay attention to the correct position of the forks on the fitting and sleeve.



Keep the tool perpendicular to the longitudinal axis of the fitting and tube. Crimp the connecion by sliding the sleeve using the manual or electric driven crimp tool. Do not slide the sleeves diagonally and do not slide two sleeves at once!

7. the connection is ready



After axial crimping the connection is ready. There may be a small gap visible between tube and fitting (max. 1 mm).

installation recommendations

tube bending

The VSH UltraLine tube holds its retention and can be bent manually. For manual bending of curves with a radius smaller than 5 x the external tube diameter, a bending tool can be used. The minimum bending radii are shown in the table below.

tube diameter d	minimum bending radius r_{min} [mm]	
	manual bending (r_{min} > 5 x d)	mechanical bending (r_{min} > 3.5 x d)
14	60	49
16	80	56
20	100	70
25	125	88
32	160	112

bending radius of VSH UltraLine tube

chemical erosion

Never expose components of the VSH UltraLine system to chemicals that might adversely affect the products' properties or cause corrosion. Avoid:

- the brass housing of the fittings being exposed to ammonia, nitrite or ammonium compounds.
- PPSU fittings coming into contact PUR (polyurethane construction foam), aggressive solvents or liquid gaskets based on cyanoacrylate, perspex and isocyanate, in order to prevent stress corrosion.

insulation

To avoid unwanted heat loss and sound transmission, sanitary tubing systems should be mechanically decoupled from the building structure by a corrugated protective tube or insulation.

Tube systems for heating applications should be thermally insulated to prevent undesired heat loss and a too low flow temperature of the radiators/convectors.

low temperature damage

Standard assembly of the VSH UltraLine system should be carried out at an ambient temperature above 0°C. If it is necessary to carry out assembly in subzero temperatures, please contact Aalberts integrated piping systems.

UV light

Due to the sensitivity to ultraviolet light, VSH UltraLine tubes should be protected against direct long-term exposure to sunlight, both during storage, transport and assembly.

mechanical overloading

Make sure that fitting on tube connections are always placed axially and not at an angle, and use a suitable form of tube guidance where necessary. In order to avoid bending due to excessive loading forces on fittings, it is recommended that tubes are not bent within a distance of less than 10 times the outer tube diameter away from fitting connections.
Avoid damage to the main tube and the corrugated protective tube sleeve. Do not drag the tube over rough surfaces, and avoid contact with sharp objects.

pressure test

As soon as a piping system is installed, it must be checked for leaks before being covered up and concealed. With potable water and heating installations, the pressure test can be carried out with water, air or inert gases. The tested medium and the results of the test must be documented in a so-called pressure test report.

Important: A pressure test of the piping system must be carried out in all cases. Before being covered up, insulated, painted or walled in, a piping system must first undergo a pressure test in order to be certain that there are no leaks. Pressure tests must always be performed in accordance with local regulations. As a rule of thumb, a pressure of 1.5 times the operating pressure is used for pressure tests with water.

Important: When testing water installations, always make sure to use clean, potable water.

pressure test of potable water systems

Important: The pressure test with water in a potable water piping system that has already been installed is performed in accordance with the ZVSHK/BHKS technical bulletins. The medium used for the pressure test with water must be of potable water quality (free of oil and other impurities) in order to avoid any contamination of the piping system. After being filled with pure, potable water, the piping system must be properly bled.

pressure test with air

Important: Pressure tests with air or inert gases can be carried out in accordance with the ZVSHK/BHKS technical bulletins, 'Pressure Test with Air or Inert Gases', (at 100 l. tube capacity a leak tightness test at 110 mbar for at least 30 minutes). For every additional 100 l., the time must be increased by 10 minutes. After the leak tightness test, the strength of the connection is to be tested during 10 minutes at a maximum of 3 bar. For safety reasons, the maximum test pressure is set at 3 bar.

pressure test for heating and cooling systems

Important: As a rule, the pressure test for piping systems that have already been installed are carried out with water in accordance with DIN-VOB 18380.

- the test pressure at each point of the system must be 1.3 times the operating pressure and at least 1 bar overpressure.
- immediately after the cold water pressure test, the water must be heated up to the highest hot water temperature on which the calculations were based in order to be certain that the system remains tight at high temperatures.
- during the test no pressure drops should occur.
- the pressure test must be adequately documented.

placing tubes in screed

For practical and aesthetic reasons, tubing systems are often embedded in walls and floor in modern homes. It is recommended that the fittings are insulated before being placed in the walls or floor and that local guidelines and recommendations are followed.

general notes

Place the tube with plastic brackets on the construction floor and respect the minimum bending radius according to the table on page 15.

- ensure that the fittings are mounted without any tension.
- always use a corrugated protective tube for dilatations and other transitions where building parts can move relative to each other.
- the distance between two tubes should be at least 2 cm so that the mortar of the screed is able to penetrate properly between them.
- put a cap on open tube ends if the tube is not immediately connected, in order to prevent any dirt getting inside.

VSH UltraLine multilayer tube

When installed in screed, VSH UltraLine tubes compensate for the changes in length and therefore no measures need to be taken.

placing of tubes in the construction

For fixing rigid VSH UltraLine tubes, use brackets with rubber inlays. See page 17. For the bracket distances and compensation for thermal length changes.

general installation information

introduction

Changes in temperature give rise to changes in the lengths of tubes in the tubing network, which in turn result in stresses. If it concerns small changes in length that can be absorbed by the tube network's own flexibility, no additional measures have to be taken. However, if the changes in length are greater, then expansion loops and/or bends must be placed in the tube network to give additional flexibility. Fixed points and sliding supports must be included in the tube network to ensure that length changes can be accommodated by the tube sections intended for this purpose.

securing of tubes

The tube brackets that are placed at fixed distances (see table below) to support the tubing and its weight can also serve as glide points (GP) or fixed points (FP).

tube diameter d	14	16	20	25	32
distance between brackets [m]	1.2	1.2	1.3	1.5	1.6

distance between brackets

glide points

Glide points should never be positioned in such a way as to block the tubes in the expected direction of movement. Therefore, never place an axial sliding support in the tube section that is intended for absorbing the changes in the radial length (the expansion loop).

fixed points

Fixed points must be able to absorb all the forces that operate and transmit them to the building structure. Tube brackets that serve as fixed points should, however, never be placed directly on a fitting but always on both sides of the fitting (picture below, left). Place the brackets for fixed points on gradient T-pieces always on the tubes with the greatest external diameter (picture below, right).

thermal expansion

The change in length (ΔI) of tubes causes a change in shape of the perpendicular placed on the tube section (l_b) or the expansion loop. This must be long enough so that no excessive stresses occur in the fittings and tubes. The factors that are relevant for the changes in length are the linear expansion coefficient of the material (α), the temperature difference (ΔT) and the length of the tube (I). The change in length can be calculated for VSH UltraLine tube using an equation or read off directly in the table below.

The equation for calculating the changes in length is as follows:

$$\Delta I = I \times \alpha \times \Delta T$$

I = total change in length [mm]
ΔI = length of the tube [m]
α = linear expansion coefficient for VSH UltraLine tubes
α = 0.025 mm/mK
T = temperature difference [K]

To simplify the calculation, the total changes in length in mm are shown in the table below for a range of tube lengths and a range of temperature differences.

	T [K]							
I [m]	10	20	30	40	50	60	80	90
0.5	0.13	0.25	0.38	0.50	0.63	0.75	1.00	1.13
1	0.25	0.50	0.75	1.00	1.25	1.50	2.00	2.25
2	0.50	1.00	1.50	2.00	2.50	3.00	4.00	4.50
3	0.75	1.50	2.25	3.00	3.75	4.50	6.00	6.75
4	1.00	2.00	3.00	4.00	5.00	6.00	8.00	9.00
5	1.25	2.50	3.75	5.00	6.25	7.50	10.00	11.25
6	1.50	3.00	4.50	6.00	7.50	9.00	12.00	13.50
7	1.75	3.50	5.25	7.00	8.75	10.50	14.00	15.75
8	2.00	4.00	6.00	8.00	10.00	12.00	16.00	18.00
9	2.25	4.50	6.75	9.00	11.25	13.50	18.00	20.25
10	2.50	5.00	7.50	10.00	12.50	15.00	20.00	22.50
15	3.75	7.50	11.25	15.00	18.75	22.50	30.00	33.75
20	5.00	10.00	15.00	20.00	25.00	30.00	40.00	45.00
25	6.25	12.50	18.75	25.00	31.25	37.50	50.00	56.25
30	7.50	15.00	22.50	30.00	37.50	45.00	60.00	67.50
35	8.75	17.50	26.25	35.00	43.75	52.50	70.00	78.75
40	10.00	20.00	30.00	40.00	50.00	60.00	80.00	90.00

total change in length (ΔI) VSH UltraLine tube

length of the expansion loop (l_b)

If the change in length (ΔI) is known, then the necessary length of the expansion loop (l_b), which depends on the tube diameter, can be calculated.

$$l_b = 36 \times \sqrt{(D \times \Delta I)}$$

l_b = necessary length of the expansion loop [mm]
ΔI = total change in length [mm]
D = external diameter of the tube [mm]

The length of the expansion loop (l_b) in mm needed to compensate the expansion in the tubes, is shown in the table.

ΔI [mm]	tube d [mm]							
	14	16	20	25	32	40	50	63
5	301	322	360	402	455	509	569	639
10	426	455	509	569	644	720	805	904
15	522	558	624	697	789	882	986	1,107
20	602	644	720	805	911	1,018	1,138	1,278
30	738	789	882	986	1,115	1,247	1,394	1,565
40	852	911	1,018	1,138	1,288	1,440	1,610	1,807
50	952	1,018	1,138	1,273	1,440	1,610	1,800	2,020
60	1,043	1,115	1,247	1,394	1,577	1,764	1,972	2,213
70	1,127	1,205	1,347	1,506	1,704	1,905	2,130	2,391
80	1,205	1,288	1,440	1,610	1,821	2,036	2,277	2,556
90	1,278	1,366	1,527	1,708	1,932	2,160	2,415	2,711
100	1,347	1,440	1,610	1,800	2,036	2,277	2,546	2,857

length of the expansion loop (l_b)

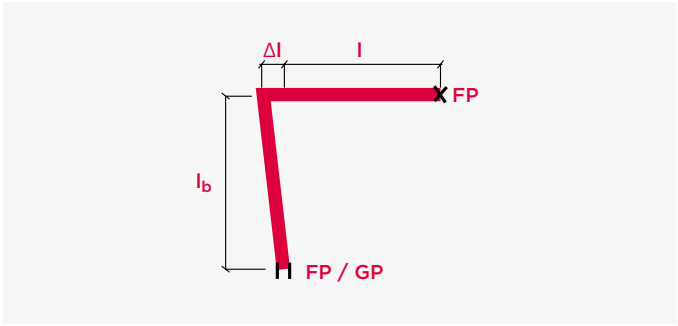
calculation of expansion

If the expansion is greater than the piping system is able to absorb without the tension becoming too high, additional measures must be taken, such as the use of expansion compensators, expansion loops or u-bends. the length of the expansion joints can be calculated using the following formulas in different situations:

type L

Determine the length of the expansion loop (l_b) as follows:

1 determine using the table on page 17 or by a calculation the length of the expansion (ΔI), using the length of the tube (I) and the temperature difference (ΔT).
2 based on the calculated length of the expansion (ΔI) for the tube (I) and the outer diameter of the tube, the length of the expansion loop (l_b) can be determined from the table on page 18.

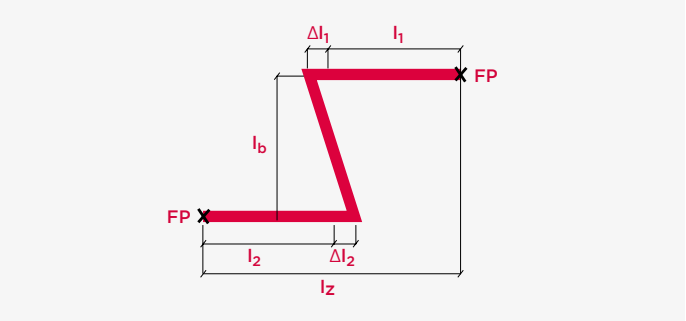


l_b = the length of the expansion loop
GP = the sliding support (so that the tube can only move axially)
FP = the fixed point (prevents the tube from moving)
I = the initial length of the tube
ΔI = the expansion of the tube

type Z

Determine the length of the expansion loop (l_b) as follows:

1 determine the equivalent size $l_z = l_1 + l_2$.
2 determine using the table on page 17 or by a calculation the length of the expansion (Δl_z), using the length of the tube (l_z) and the temperature difference (ΔT).
3 based on the calculated length of the expansion (ΔI) for the tube and the outer diameter of the tube, the length of the expansion loop (l_b) can be determined from the table on page 18.

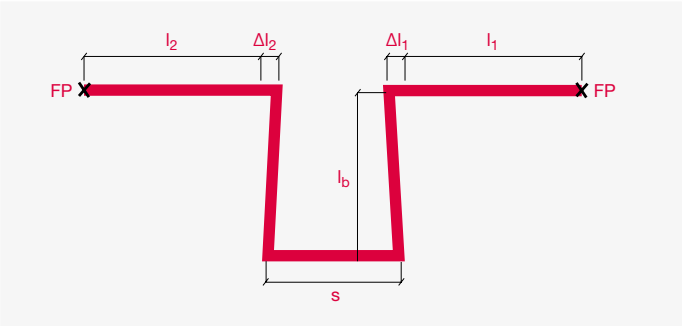


l_b = the length of the expansion loop
FP = the fixed point (prevents the tube from moving)
l_z = the initial length of the tube
Δl_z = the expansion of the tube

type U

Determine the length of the expansion loop (l_b) as follows:

1 determine the equivalent size $l_u = (l_1 + l_2)/1.8$
2 determine using the table on page 17 or by a calculation the length of the expansion (Δl_u), using the length of the tube (l_u) and the temperature difference (ΔT).
3 based on the calculated length of the expansion (ΔI) for the tube and the outer diameter of the tube, the length of the expansion loop (l_b) can be determined from the table on page 18.



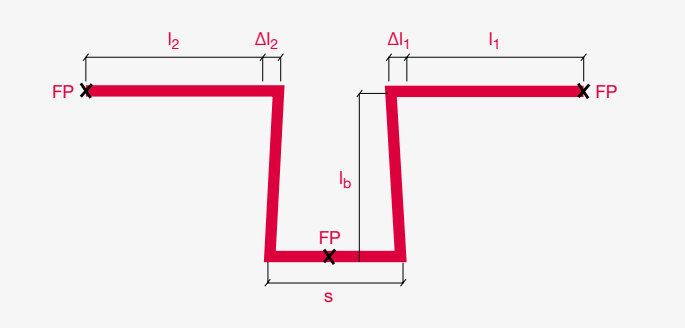
l_b = the length of the expansion loop
FP = the fixed point (prevents the tube from moving)
ΔI = the expansion of the tube
s = the length of the U-shaped compensation loop

The length of the compensation loop (s) must ensure the free movement of the tube sections l_1 and l_2, taking into account the thickness of the tube insulation and the installation circumstances.

$s \geq 2x\ d_{ins} + \Delta l_1 + \Delta l_2 + s_{min}$

d_{ins} = thickness of the insulation
Δl_1, Δl_2 = expansion in tube sections l_1 and l_2
s_{min} = minimum length of the fitting diameter or the radius of curvature of the tube

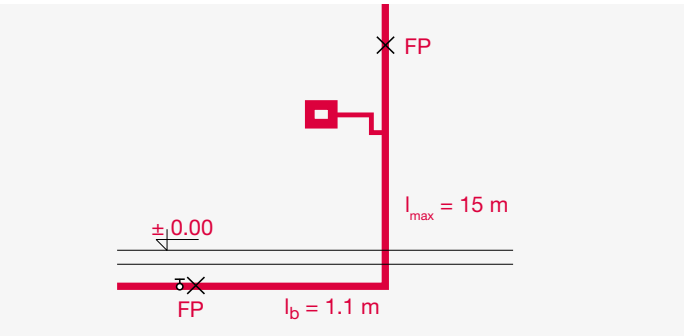
The length of the tube (s) must be as short as possible. If the length of the tube (s) is more than 10% of the values l_1 or l_2, a fixed point must be placed in the middle of the tube (s). In this case the length of the compensation loop (l_b) can be calculated as type Z, and this should be done on both sides of the fixed point.



l_b = the length of the supported loop
FP = the fixed point (prevents the tube from moving)
l = the initial length of the tube
Δl = the expansion of the tube
s = the length of the U-shaped compensation loop

installation advice concerning the fastening and expansion of the tube system

- the water and heat meters (and their attachments) connected to the tubes must be secured to the wall as fixed points (the weight and operation of these should not exert any force on the tube)
- a valve or instrument is neither to be installed in a section of the installation that serves as an expansion tube; nor may it obstruct the movement of the tube, such as at gliding points in any way. Ideally, fit valves or instruments as fixed points, whereby the tubes are also protected against excessive load from their weight and from the force resulting from the opening and closing of the valves.
- in no event may there be sections of tube that cannot move in the event of expansion.
- when connecting multilayer tubes to steel tubes, it is recommended that a fixed point be placed at the connection point to the steel tube (this should be included in the planning of the compensation of the steel tube).
- if tubes are connected at right angles to steel tubes, the connection should be treated as a point that prevents movement along the axis of the multilayer tube. It is not permitted to make a fixed point for steel tubes by mounting the brackets on the multilayer tubes. If the steel tube at the connection with the multilayer tube is subject to considerable expansion, then the connecting section of the multilayer tube must be fitted as an expansion loop with a sliding support being suitably located. The length of this loop should be determined on the basis of the expansion coefficient Δl of the steel tube.
- in case of an axial connection of multilayer tubes to steel tubes, the expansion loop that compensates for the expansion of this tube section is determined on the basis of the total of the expansion of both tubes.
- in shafts, risers must be able to move freely under thermal influences.

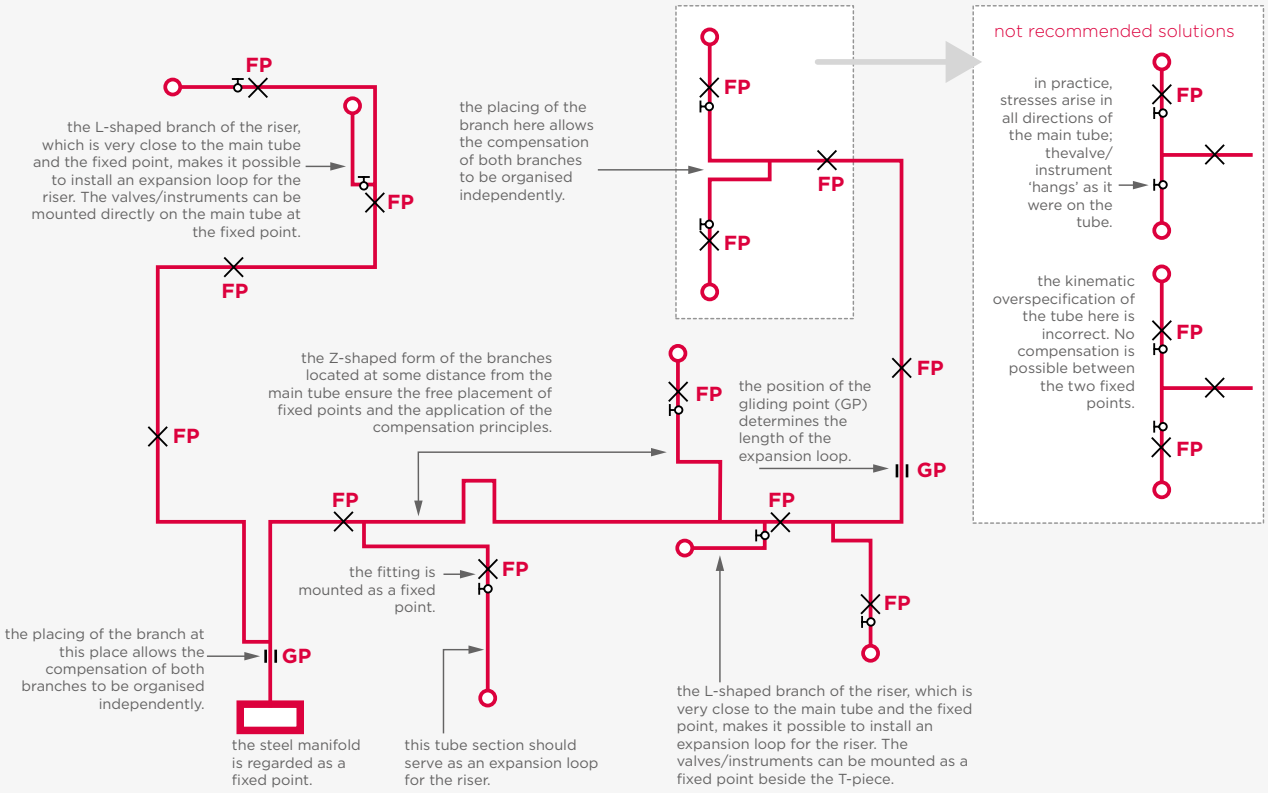


every place where a fixture is fitted is a fixed point

securing and expansion of a riser

- a 15 m long tube section will expand by 30 mm if the temperature increases by 80°C. The 30-mm expansion requires an expansion loop l_b of 1.1 m long for a tube with a diameter of 32 mm.
- based on the principle that the expansion loop at the base of the riser l_b = 1.1 m, and with the fixed point is located halfway up the riser, a riser height of 30 m is possible with a tube diameter of 32 mm.
- a greater riser height can be possible if we allow a greater expansion of the tube section above the fixed point. The length of the expansion loop l_b can also be increased.
- the branch is best carried out in the Z-form. Respect the necessary length of the expansion loop.
- the floor clearance must allow for movement by the tube both lengthwise and crosswise, to cater for a change in the shape caused by the expansion of section l_b.

example of securing and expansion of branches of a riser



pressure loss

Formula for calculating the pressure loss on the basis of the zeta values:

$$\Delta p = \frac{\zeta \times v^2}{0.001962}$$

Δp = pressure loss [Pa]
v = flow velocity [m/s]

pressure loss with VSH UltraLine fittings ζ - values.

fitting type	d14	d16	d20	d25	d32
	7.4	4.3	4.7	3.6	3.9
	2.8	1.2	1.4	0.9	1.0
	6.3	4.4	4.8	3.7	4.0
	7.5	4.3	4.7	3.7	4.0
	3.0	1.3	1.5	1.0	0.5
	4.7	3.1	5.7	3.0	-

pressure losses in VSH UltraLine for water

Any liquid loses energy when it flows through a tube as a result of the friction of the liquid against the walls of the tube. The pressure loss depends on the diameter of the tube and the flow velocity. The tables show the pressure loss for sanitary and central heating applications at a given flow rate and temperature.

pressure loss for VSH UltraLine tube for water at temperature 10°C

	14 × 2.0		16 × 2.2		20 × 2.8		25 × 2.5		32 × 3.0	
q [l/s]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]
0.01	0.13	53	0.09	29	0.06	12	0.03	3	0.02	1
0.02	0.25	107	0.19	59	0.12	25	0.06	7	0.04	2
0.03	0.38	326	0.28	162	0.18	37	0.1	10	0.06	3
0.04	0.51	529	0.38	263	0.25	95	0.13	13	0.08	5
0.05	0.64	774	0.47	384	0.31	139	0.16	30	0.09	6
0.06	0.76	1059	0.57	524	0.37	189	0.19	40	0.11	7
0.07	0.89	1381	0.66	682	0.43	245	0.22	52	0.13	15
0.1	1.27	2570	0.95	1264	0.61	452	0.32	96	0.19	28
0.13	1.66	4077	1.23	1999	0.8	712	0.41	150	0.24	43
0.14	1.78	4648	1.32	2277	0.86	810	0.45	170	0.26	49
0.15	1.91	5252	1.42	2571	0.92	913	0.48	192	0.28	55
0.2	2.55	8774	1.89	4279	1.23	1513	0.64	315	0.38	91
0.21			1.99	4667	1.29	1648	0.67	343	0.4	99
0.22			2.08	5071	1.35	1789	0.7	372	0.41	107
0.25					1.54	2243	0.8	465	0.47	133
0.27					1.66	2572	0.86	532	0.51	152
0.3					1.84	3102	0.95	640	0.57	183
0.35					2.15	4086	1.11	840	0.66	240
0.4							1.27	1064	0.75	303
0.45							1.43	1311	0.85	372
0.5							1.59	1581	0.94	448
0.55							1.75	1875	1.04	531
0.6							1.91	2191	1.13	619
0.65							2.07	2529	1.22	713
0.7									1.32	814
0.75									1.41	921
0.8									1.51	1033
0.85									1.6	1151
0.9									1.7	1275
0.95									1.79	1405
1									1.88	1541

pressure loss for VSH UltraLine tube for water at temperature 60°C

	14 × 2.0		16 × 2.2		20 × 2.8		25 × 2.5		32 × 3.0	
q [l/s]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]
0.01	0.13	38	0.1	19	0.06	5	0.03	1	0.02	0
0.02	0.26	122	0.19	60	0.12	22	0.06	5	0.04	1
0.03	0.39	246	0.29	121	0.19	43	0.1	9	0.06	3
0.04	0.52	407	0.38	200	0.25	71	0.13	15	0.08	4
0.05	0.65	603	0.48	295	0.31	105	0.16	22	0.1	6
0.06	0.78	834	0.58	407	0.37	144	0.19	30	0.11	9
0.07	0.91	1098	0.67	536	0.44	189	0.23	39	0.13	11
0.1	1.3	2088	0.96	1013	0.62	356	0.32	74	0.19	21
0.13	1.68	3366	1.25	1627	0.81	569	0.42	117	0.25	33
0.14	1.81	3856	1.35	1862	0.87	650	0.45	133	0.27	38
0.15	1.94	4376	1.44	2111	0.94	735	0.49	150	0.29	43
0.2	2.59	7446	1.92	3575	1.25	1238	0.65	251	0.38	71
0.21			2.02	3911	1.31	1353	0.68	274	0.4	77
0.22					1.37	1472	0.71	298	0.42	84
0.25					1.56	1860	0.81	375	0.48	106
0.27					1.69	2141	0.87	431	0.52	121
0.3					1.87	2599	0.97	521	0.57	146
0.35					2.19	3455	1.13	689	0.67	193
0.4							1.3	879	0.77	245
0.45							1.46	1090	0.86	303
0.5							1.62	1323	0.96	367
0.55							1.78	1576	1.05	436
0.6							1.94	1851	1.15	511
0.65							2.1	2147	1.25	592
0.7									1.34	678
0.75									1.44	769
0.8									1.53	866
0.85									1.63	968
0.9									1.72	1076
0.95									1.82	1189
1									1.92	1307

pressure loss for VSH UltraLine tubes for heating water at average temperature 70°C (80/60°C)

	14 × 2.0		16 × 2.2		20 × 2.8		25 × 2.5		32 × 3.0	
Q [W]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]
100	0.02	2	0.01	1						
200	0.03	4	0.02	2	0.01	1				
400	0.06	8	0.05	4	0.03	2	0.02	1		
600	0.09	12	0.07	7	0.04	3	0.02	1		
800	0.12	33	0.09	16	0.06	4	0.03	1		
1000	0.16	48	0.12	24	0.07	9	0.04	1		
1200	0.19	65	0.14	32	0.09	12	0.05	2	0.03	1
1400	0.22	84	0.16	42	0.1	15	0.05	3	0.03	1
1600	0.25	106	0.18	53	0.12	19	0.06	4	0.04	1
1800	0.28	129	0.21	64	0.13	23	0.07	5	0.04	1
2000	0.31	155	0.23	77	0.15	28	0.08	6	0.05	2
2200	0.34	182	0.25	91	0.16	33	0.09	7	0.05	2
2400	0.37	212	0.28	105	0.18	38	0.09	8	0.06	2
2600			0.3	121	0.19	44	0.1	9	0.06	3
2800			0.32	137	0.21	49	0.11	11	0.06	3
3000			0.35	154	0.22	56	0.12	12	0.07	3
3200			0.37	172	0.24	62	0.12	13	0.07	4
3400			0.39	191	0.25	69	0.13	15	0.08	4
3600			0.42	211	0.27	76	0.14	16	0.08	5
3800					0.28	83	0.15	18	0.09	5
4000					0.3	91	0.16	19	0.09	6
4200					0.31	99	0.16	21	0.1	6
4400					0.33	108	0.17	23	0.1	7
4600					0.34	116	0.18	25	0.11	7
4800					0.36	125	0.19	26	0.11	8
5000					0.37	134	0.19	28	0.11	8
5200					0.39	144	0.2	30	0.12	9
5400					0.4	153	0.21	32	0.12	9
5600					0.42	163	0.22	35	0.13	10
5800					0.43	174	0.23	37	0.13	11
6000					0.45	184	0.23	39	0.14	11
6200					0.46	195	0.24	41	0.14	12
6400					0.48	206	0.25	43	0.15	13
6600							0.26	46	0.15	13
6800							0.26	48	0.16	14
7000							0.27	51	0.16	15
7200							0.28	53	0.17	15
7400							0.29	56	0.17	16
7600							0.3	59	0.17	17
7800							0.3	61	0.18	18
8000							0.31	64	0.18	18
8200							0.32	67	0.19	19
8400							0.33	70	0.19	20
8600							0.33	73	0.2	21
8800							0.34	76	0.2	22
9000							0.35	79	0.21	23

pressure loss for VSH UltraLine tubes for heating water at average temperature 70°C (80/60°C)

	14 × 2.0		16 × 2.2		20 × 2.8		25 × 2.5		32 × 3.0	
Q [W]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]	v [m/s]	R [Pa/m]
9200							0.36	82	0.21	24
9400							0.37	85	0.22	24
9600							0.37	88	0.22	25
9800							0.38	91	0.23	26
10000							0.39	94	0.23	27
11000							0.43	112	0.25	32
12000							0.47	130	0.28	37
13000							0.51	149	0.3	43
14000							0.54	170	0.32	49
15000							0.58	192	0.34	55
16000							0.62	215	0.37	62
17000									0.39	69
18000									0.41	76
19000									0.44	84
20000									0.46	91
22000									0.51	108
24000									0.55	126
26000									0.6	145
28000									0.64	165
30000									0.69	187
32000									0.74	210

corrosion

general
All VSH UltraLine fittings fully meet the highest requirements in the market. Nevertheless stress corrosion can occur in brass and plastic under certain conditions and lead to failure of the material. Instructions are given below on how to prevent the occurrence of corrosion problems.

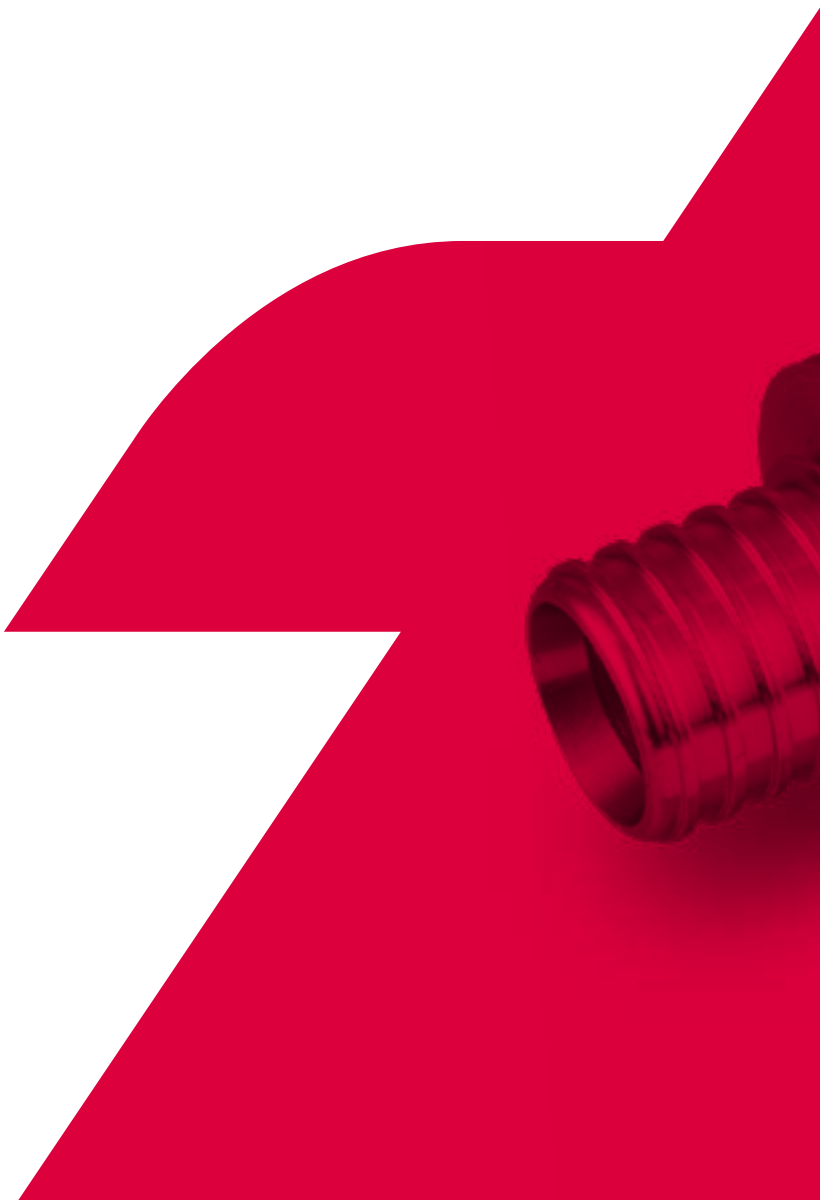
stress corrosion
Stress corrosion is characterized by the sudden appearance of cracks in the material after some time. These cracks are the result of a simultaneous action of certain chemicals and/ or mechanical stresses, combined with moisture from the environment. Stress corrosion can only occur if all these factors are present simultaneously and is not specific to metals or plastics; it can occur in both of them. It is well known that especially (but not exclusively) copper alloys, such as brass, are sensitive to ammonium compounds such as ammonia. Stresses arise from a combination of internal stresses from production and external stresses due to installation. Humidity often occurs as a result of condensation on the tube.

Ammonia also occurs biologically from the decomposition of manure and urine. That is why brass fittings should not be used around livestock farms. With use of certain insulation materials there is also a chance that small concentrations can release ammonia, which can settle on the VSH UltraLine fittings. with PPSU fittings, stress corrosion may occur when they come into contact with PUR* (construction foam), aggressive solvents or liquid gaskets based on cyanoacrylate, perspex and isocyanate.

electrolytic corrosion
Electrolytic corrosion is a reaction between two different metals in contact with each other in a damp environment. Due to the difference in potential between two different metals, there is a redox reaction in which the least precious metal is attacked at the expense of the nobler. Because aluminum (-1.662 V) is less noble than copper (+0.337 V), in the case of direct contact between the brass (about 60% copper) of the fitting and the aluminum of the multilayer tube in a humid environment, the aluminum can become corroded with characteristic 'blisters'. In time this can weaken the tube and cause the fitting to leak. To prevent this, the VSH UltraLine fittings have an end stop. This prevents the brass from coming into contact with the aluminum of the VSH UltraLine tubes.

warranty

Please contact Aalberts integrated piping systems for the most recent warranty conditions that apply to VSH UltraLine.



VSH UltraLine

tube & fittings

UL5140 multilayer tube

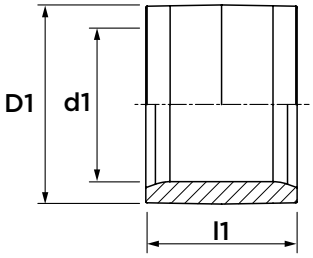
dimension	article no.	length
14 x 2.0	123 459 577	5 m (straight)
14 x 2.0	123 459 578	200 m (coil)
16 x 2.2	123 459 579	5 m (straight)
16 x 2.2	123 459 580	200 m (coil)
20 x 2.8	123 459 581	5 m (straight)
20 x 2.8	123 459 582	100 m (coil)
25 x 2.5	123 459 583	5 m (straight)
25 x 2.5	123 459 584	50 m (coil)
32 x 3.0	123 459 585	5 m (straight)
32 x 3.0	123 459 586	50 m (coil)

UL5150 multilayer tube

(with 6 mm grey insulation)

dimension	article no.	length (coil)
14 x 2.0	123 459 828	50 m
16 x 2.2	123 459 829	50 m
20 x 2.8	123 459 830	50 m
25 x 2.5	123 459 831	50 m
32 x 3.0	123 459 832	50 m

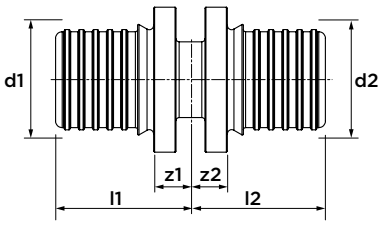
ULSLS sleeve PVDF



dimension	article no.	D1	l1
14	123 459 387	21	18
16	123 459 388	22	19
20	123 459 389	27	20
25	123 459 390	33	25
32	123 459 391	40	31

UL5201 straight coupling PPSU

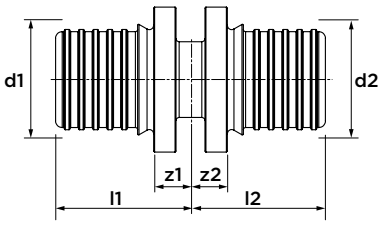
(2 x sleeve)



dimension	article no.	l1/l2	z1/z2
14	123 459 392	22	7
16	123 459 393	23	7
20	123 459 394	26	8
25	123 459 395	30	8
32	123 459 396	36	10

UL5301 straight coupling brass

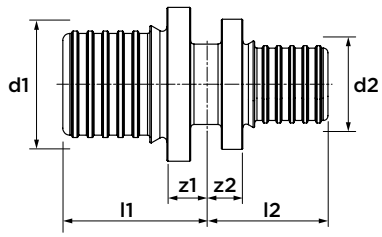
(2 x sleeve)



dimension	article no.	l1/l2	z1/z2
14	123 459 403	22	7
16	123 459 404	23	7
20	123 459 405	26	8
25	123 459 406	30	8
32	123 459 407	35	9

UL5207 reducer PPSU

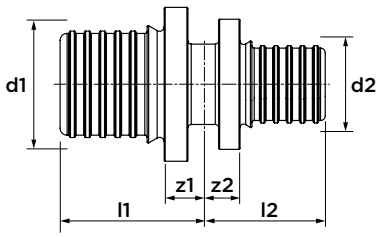
(2 x sleeve)



dimension	article no.	l1	l2	z1	z2
16 x 14	123 459 397	23	22	7	7
20 x 14	123 459 398	26	22	8	7
20 x 16	123 459 399	26	23	8	7
25 x 16	123 459 401	30	23	8	7
25 x 20	123 459 400	30	26	8	8
32 x 25	123 459 402	35	30	9	8

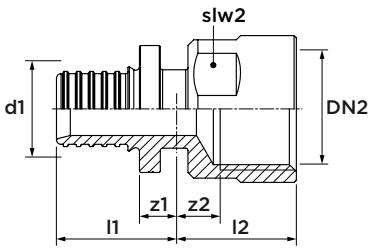
UL5307 reducer brass

(2 x sleeve)



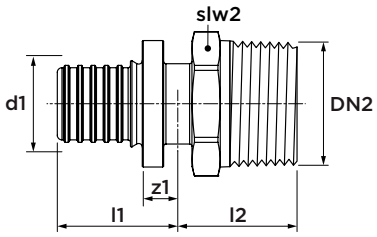
dimension	article no.	l1	l2	z1	z2
16 x 14	123 459 408	23	22	7	7
20 x 14	123 459 409	26	22	8	7
20 x 16	123 459 410	26	23	8	7
25 x 16	123 459 412	30	23	8	7
25 x 20	123 459 411	30	26	8	8
32 x 25	123 459 413	35	30	9	8

UL5302 straight connector brass
(sleeve x female thread)



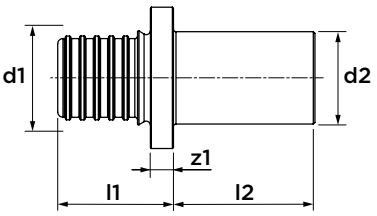
dimension	article no.	l1	l2	z1	z2	slw2
14 x Rp½"	123 459 507	22	24	7	9	25
16 x Rp½"	123 459 508	23	24	7	9	25
20 x Rp½"	123 459 509	26	24	8	9	25
20 x Rp¾"	123 459 510	26	27	8	10	30
25 x Rp¾"	123 459 511	30	27	8	10	30
32 x Rp1"	123 459 512	35	30	9	10	41

UL5305 straight connector brass
(sleeve x male thread)



dimension	article no.	l1	l2	z1	slw2
14 x R½"	123 459 500	22	24	7	22
16 x R½"	123 459 501	23	24	7	24
20 x R½"	123 459 502	26	24	8	27
20 x R¾"	123 459 503	26	25	8	27
25 x R¾"	123 459 504	30	27	8	34
25 x R1"	123 459 505	30	30	8	34
32 x R1"	123 459 506	35	30	9	41

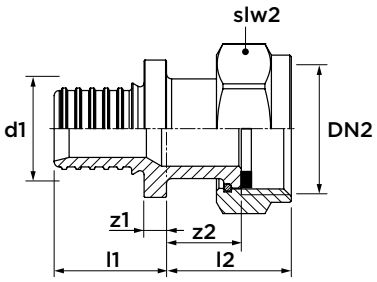
UL5336 straight connector brass
(sleeve x male*)



dimension	article no.	l1	l2	z1
14 x Ø15	123 459 414	19	28	4
16 x Ø15	123 459 415	20	28	4
20 x Ø18	123 459 416	23	28	5
25 x Ø22	123 459 417	27	31	5
32 x Ø28	123 459 418	32	37	6

*male insert suitable for VSH XPress. Make sure that there is enough space for the jaws during pressing.

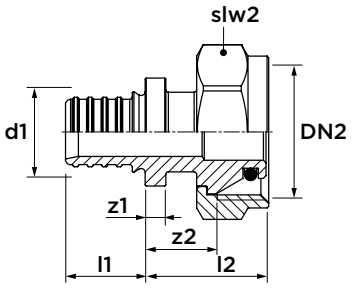
UL5362 coupling with nut brass
(sleeve x female thread)



dimension	article no.	l1	l2	z1	z2	slw2
14 x G½"	123 459 545	19	18	4	10	27
14 x G¾"	123 459 546	19	22	4	12	34
16 x G½"	123 459 547	20	18	4	10	27
16 x G¾"	123 459 548	20	22	4	12	34
20 x G½"	123 459 549	23	18	5	10	27
20 x G¾"	123 459 550	23	25	5	15	34
25 x G¾"	123 459 551	27	25	5	15	34
25 x G1"	123 459 552	27	22	5	12	40
32 x G1"	123 459 553	32	22	6	12	40
32 x G1¼"	123 459 554	32	32	6	20	50

UL5338 coupling with nut eurocone brass

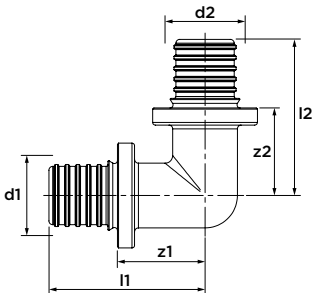
(sleeve x female thread)



dimension	article no.	l1	l2	z1	z2	slw2
14 x G¾"	123 459 543	19	20	4	10	30
16 x G¾"	123 459 544	20	20	4	10	30

UL5208 elbow 90° PPSU

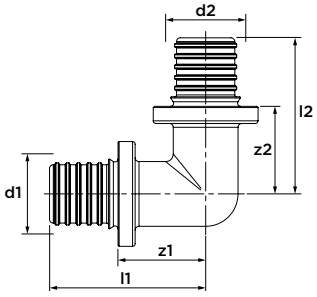
(2 x sleeve)



dimension	article no.	l1/l2	z1/z2
14	123 459 419	36	20
16	123 459 420	37	21
20	123 459 421	42	24
25	123 459 422	50	28
32	123 459 423	61	35

UL5308 elbow 90° brass

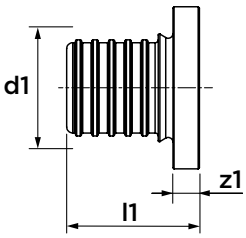
(2 x sleeve)



dimension	article no.	l1/l2	z1/z2
14	123 459 424	36	20
16	123 459 425	36	21
20	123 459 426	41	23
25	123 459 427	50	28
32	123 459 428	61	35

UL5329 stop end brass

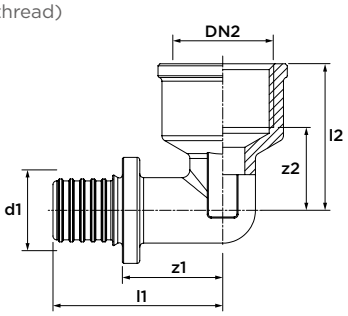
(1 x sleeve)



dimension	article no.	l1	z1
14	123 459 495	19	4
16	123 459 496	20	4
20	123 459 497	23	5
25	123 459 498	27	5
32	123 459 499	32	6

UL5309 angle adapter 90° brass

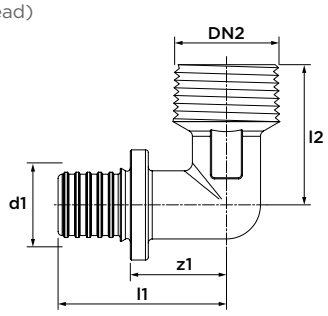
(sleeve x female thread)



dimension	article no.	l1	l2	z1	z2
14 x Rp½"	123 459 513	37	33	21	18
14 x Rp¾"	123 459 514	40	37	24	21
16 x Rp½"	123 459 515	39	33	23	18
16 x Rp¾"	123 459 516	42	37	26	21
20 x Rp½"	123 459 825	41	34	23	19
20 x Rp¾"	123 459 826	44	38	26	22
25 x Rp¾"	123 459 517	50	40	28	24
32 x Rp1"	123 459 518	61	51	35	31

UL5328 angle adapter 90° brass

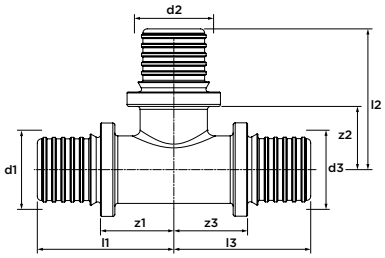
(sleeve x male thread)



dimension	article no.	l1	z1	l2
14 x R½"	123 459 519	36	20	31
16 x R½"	123 459 520	36	21	32
20 x R½"	123 459 521	39	21	35
20 x R¾"	123 459 522	42	24	35
25 x R¾"	123 459 523	48	26	39
32 x R1"	123 459 524	59	33	47

UL5214 tee PPSU

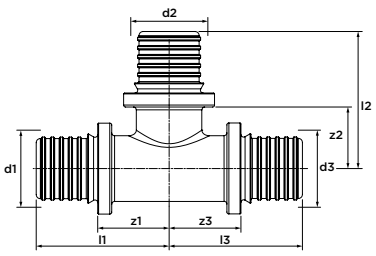
(3 x sleeve)



dimension	article no.	l1/l2/l3	z1/z2/z3
14	123 459 462	36	20
16	123 459 463	37	22
20	123 459 464	42	24
25	123 459 465	50	28
32	123 459 466	61	35

UL5314 tee brass

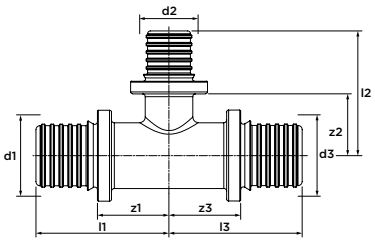
(3 x sleeve)



dimension	article no.	l1/l2/l3	z1/z2/z3
14	123 459 462	35	19
16	123 459 463	36	21
20	123 459 464	41	23
25	123 459 465	49	27
32	123 459 466	61	35

UL5225 tee reduced PPSU

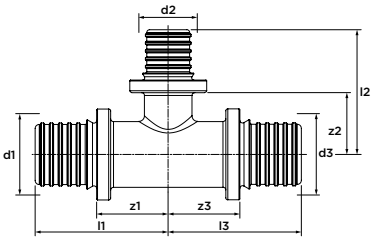
(3 x sleeve)



dimension	article no.	l1	l2	l3	z1	z2	z3
14 x 16 x 14	123 459 467	36	36	36	21	20	21
16 x 14 x 16	123 459 474	36	37	36	21	21	21
16 x 20 x 16	123 459 476	39	40	39	24	22	24
20 x 14 x 20	123 459 470	39	39	39	21	24	21
20 x 16 x 20	123 459 478	40	40	40	22	24	22
20 x 25 x 20	123 459 485	45	48	45	27	26	27
25 x 14 x 25	123 459 472	44	42	44	22	26	22
25 x 16 x 25	123 459 482	45	42	45	23	27	23
25 x 20 x 25	123 459 484	48	44	48	26	27	26
25 x 32 x 25	123 459 493	54	58	54	32	32	32
32 x 16 x 32	123 459 487	52	46	52	26	30	26
32 x 20 x 32	123 459 489	55	48	55	29	30	29
32 x 25 x 32	123 459 492	57	56	57	31	34	31

UL5325 tee reduced brass

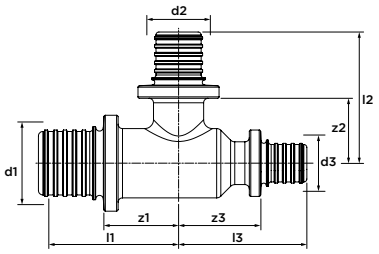
(3 x sleeve)



dimension	article no.	l1	l2	l3	z1	z2	z3
14 x 16 x 14	123 459 434	36	36	36	21	20	21
16 x 14 x 16	123 459 436	36	37	36	21	21	21
16 x 20 x 16	123 459 443	38	39	38	23	21	23
20 x 14 x 20	123 459 440	39	39	39	21	24	21
20 x 16 x 20	123 459 445	39	39	39	21	23	21
20 x 25 x 20	123 459 453	44	47	44	26	25	26
25 x 14 x 25	123 459 442	44	42	44	22	26	22
25 x 16 x 25	123 459 449	44	41	44	22	25	22
25 x 20 x 25	123 459 452	47	44	47	25	26	25
25 x 32 x 25	123 459 461	54	58	54	32	32	32
32 x 16 x 32	123 459 454	51	45	51	25	30	25
32 x 20 x 32	123 459 456	54	48	54	28	30	28
32 x 25 x 32	123 459 460	57	56	57	31	34	31

UL5226 tee reduced PPSU

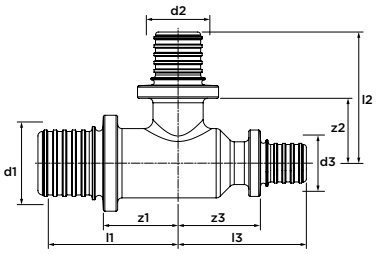
(3 x sleeve)



dimension	article no.	l1	l2	l3	z1	z2	z3
16 x 14 x 14	123 459 473	36	37	36	21	21	21
16 x 16 x 14	123 459 475	37	37	37	22	22	22
20 x 14 x 14	123 459 468	39	39	37	21	24	21
20 x 14 x 16	123 459 469	39	39	37	21	24	22
20 x 16 x 16	123 459 477	40	40	38	22	24	22
20 x 20 x 16	123 459 479	42	42	40	24	24	24
25 x 14 x 20	123 459 471	44	42	43	22	26	25
25 x 16 x 16	123 459 480	45	42	41	23	27	26
25 x 16 x 20	123 459 481	45	42	44	23	27	26
25 x 20 x 16	123 459 486	48	45	44	26	27	28
25 x 20 x 20	123 459 483	48	45	46	26	27	28
32 x 16 x 25	123 459 490	52	46	48	26	30	26
32 x 20 x 25	123 459 488	55	48	51	29	30	29
32 x 25 x 20	123 459 494	57	56	52	31	34	34
32 x 25 x 25	123 459 491	57	56	53	31	34	31

UL5326 tee reduced brass

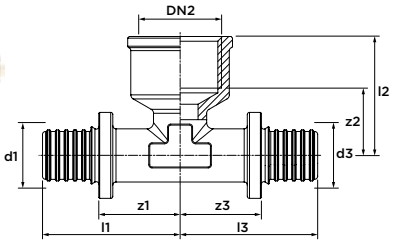
(3 x sleeve)



dimension	article no.	l1	l2	l3	z1	z2	z3
16 x 14 x 14	123 459 435	36	37	36	21	21	21
16 x 16 x 14	123 459 437	37	37	37	22	22	22
20 x 14 x 14	123 459 438	39	39	37	21	24	21
20 x 14 x 16	123 459 439	39	39	37	21	24	22
20 x 16 x 16	123 459 444	39	39	37	21	23	21
20 x 20 x 16	123 459 446	41	41	39	23	23	23
25 x 14 x 20	123 459 441	44	42	43	22	26	25
25 x 16 x 16	123 459 447	44	41	40	22	26	24
25 x 16 x 20	123 459 448	44	41	42	22	26	24
25 x 20 x 16	123 459 450	48	45	44	26	27	28
25 x 20 x 20	123 459 451	47	44	45	25	26	27
32 x 16 x 25	123 459 457	51	45	47	25	30	25
32 x 20 x 25	123 459 455	54	48	50	28	30	28
32 x 25 x 20	123 459 458	57	56	52	31	34	34
32 x 25 x 25	123 459 459	57	56	53	31	34	31

UL5318 tee threaded brass

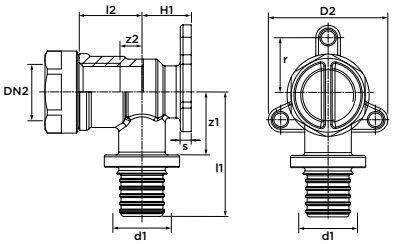
(sleeve x female thread x sleeve)



dimension	article no.	l1/l3	l2	z1/z3	z2
14 x Rp½" x 14	123 459 525	38	33	23	18
16 x Rp½" x 16	123 459 526	39	33	23	18
20 x Rp½" x 20	123 459 527	41	34	23	19
20 x Rp¾" x 20	123 459 528	44	38	26	22
25 x Rp½" x 25	123 459 529	47	38	25	23
25 x Rp¾" x 25	123 459 530	50	40	28	24
32 x Rp½" x 32	123 459 531	53	42	27	27
32 x Rp¾" x 32	123 459 532	56	44	30	28
32 x Rp1" x 32	123 459 533	60	51	34	31

UL5316 wall plate 90° short brass

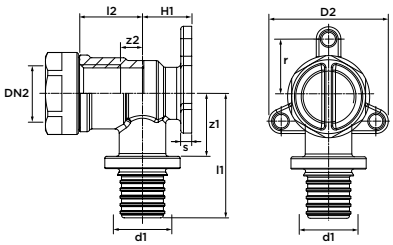
(sleeve x female thread)



dimension	article no.	l1	l2	z1	z2	H1	D2	r	s
14 x Rp½"	123 459 534	42	23	27	8	18	44	20	4
16 x Rp½"	123 459 535	43	23	27	8	18	44	20	4
20 x Rp½"	123 459 536	46	23	28	8	18	44	20	4

UL5337 wall plate 90° long brass

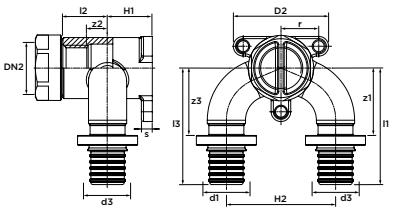
(sleeve x female thread)



dimension	article no.	l1	l2	z1	z2	H1	D2	r	s
14 x Rp½"	123 459 537	42	35	27	20	18	44	20	4
16 x Rp½"	123 459 538	43	35	27	20	18	44	20	4
20 x Rp½"	123 459 539	46	35	28	20	18	44	20	4
25 x Rp¾"	123 459 542	54	30	32	13	24	44	20	4

UL5339 wall plate U-type

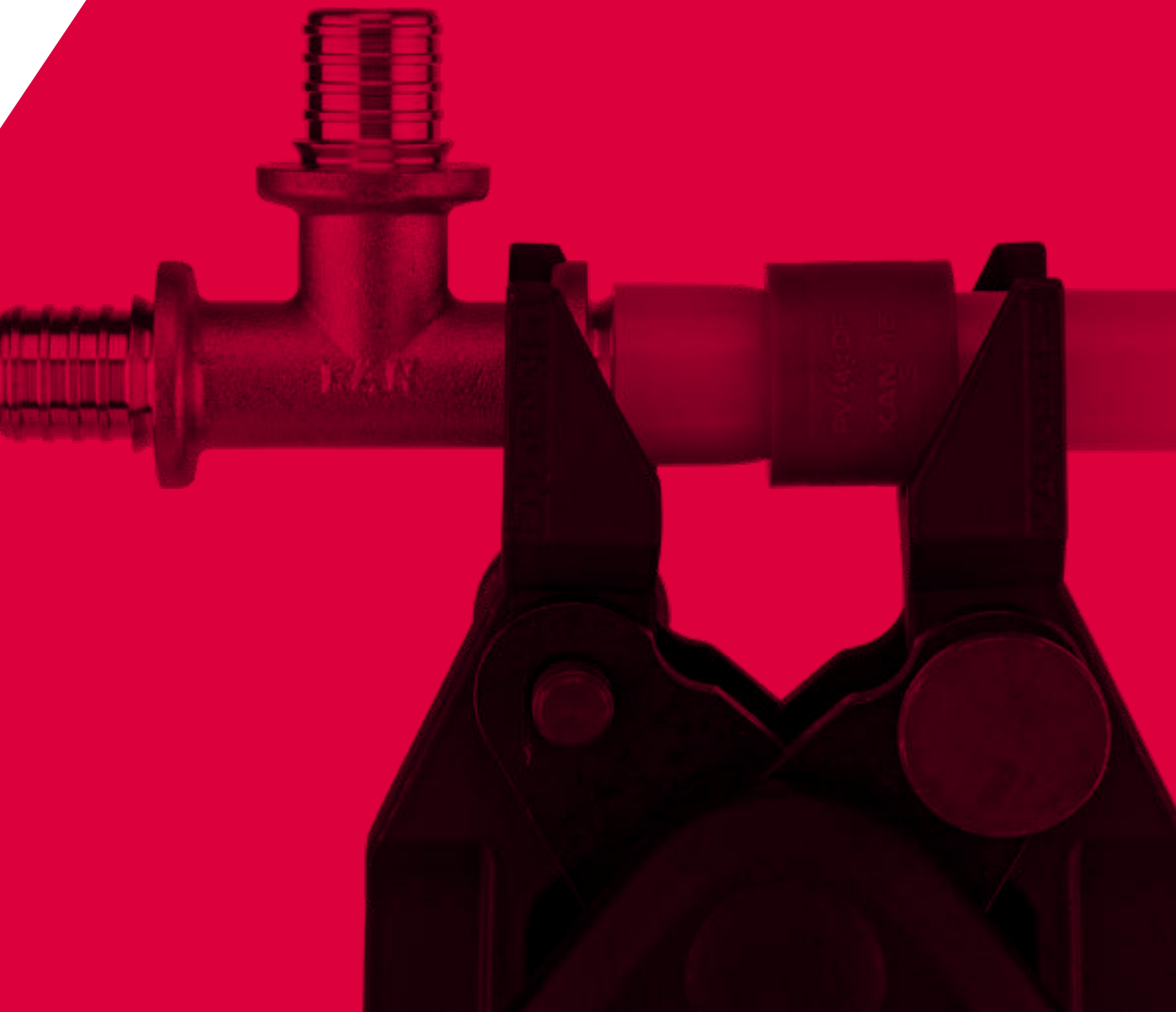
(sleeve x female thread x sleeve)



dimension	article no.	l1/l3	l2	z1/z3	z2	H1	H2	D2	r	s
14 x Rp½" x 14	123 459 827	50	21	34	8	21	50	44	20	5
16 x Rp½" x 16	123 459 540	50	21	35	8	21	50	44	20	5
20 x Rp½" x 20	123 459 541	53	21	35	8	21	50	44	20	5

VSH UltraLine

tools and accessories



K5782 crimp and expansion tool set

dimension	article no.	description
14-32	123 459 587	manual expansion & battery crimp tool
14-32	123 459 588	manual expansion & manual crimp tool
14-32	123 459 590	battery expansion & battery crimp tool
14-32	123 459 605	manual expansion tool in case

K5783 expansion head

dimension	article no.
14	123 459 594
16	123 459 595
20	123 459 596
25	123 459 597
32	123 459 598

K5784 fork sets

dimension	article no.
14	123 459 599
16	123 459 600
20	123 459 601
25	123 459 602
32	123 459 603

K5786 calibration tool

dimension	article no.
14-20	123 459 607

K5785 tube cutter

dimension	article no.
14-25	123 459 606
14-32	123 459 608

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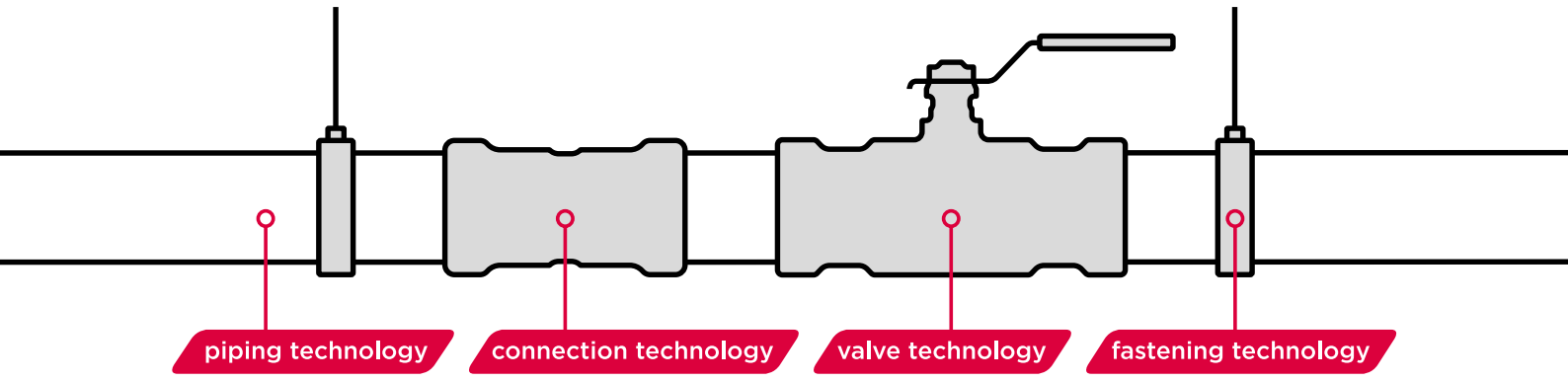

Aalberts integrated piping systems B.V.
Oude Amersfoortseweg 99 / 1212 AA Hilversum
P.O. Box 498 / 1200 AL Hilversum
The Netherlands
www.aalberts-ips.eu

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