Fachverband der
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PLANNING | CONSTRUCTION | OPERATION

INSTALLATION INSTRUCTIONS A 1465

Pressure Pipes

Gas, Water and Sewers Outside of Buildings

September 2016

Content

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Pressure Pipes

GAS, WATER, AND SEWERS OUTSIDE OF BUILDINGS

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General Information and Scope

General information

These installation instructions have been developed by the "Pressure Pipes" task force of KRV's "Supply" expert group and are based on the experience gathered by its members. The objective of the instructions on hand is to put together to the best of our knowledge the technical specifications and guidelines that exist in this sector. In spite of thorough research, neither the publisher nor the companies involved are liable for the correctness of the publication's content.

The requirements, regulations, and classifications of the organisations and authorities responsible for the material selection, product specifications, construction planning, construction, inspection, and operation, as well as the producers' installation instructions must be taken into consideration by the implementing company as part of the project-specific liability.

Pressure piping systems are to be planned, constructed, and operated in a way to comply at least with the generally acknowledged rules of technology. The installation work and connections may be awarded only to those piping construction companies whose executing employees avail of the relevant knowledge, accepted qualifications, and certificates.

The accident prevention regulations of the employers' liability insurance associations and factory inspectorate regulations regarding occupational safety, environmental protection, and consumer protection and of other potentially involved authorities are to be followed.

For activities within the traffic areas, the road traffic regulations have particular importance. Compliance is also required with the "RAS" guidelines for the safety of working places at streets ("Richtlinien für die Sicherung von Arbeitsstätten an Straßen"). When awarding construction services as per VOB, the VOB/C, "Allgemeine technische Vertragsbedingungen für Bauleistungen" (General technical specifications in construction contracts) applies.

Scope

These installation instructions apply to buried pressure piping systems made of polyethylene (PE 80, PE 100, PE 100-RC), cross-linked polyethylene (PE-X), polyvinylchloride (PVC-U), and polyamide 12 (PA12-U) for the public supply of gas and water and sewerage in accordance with the norms listed in table 13.

In divergent areas of application, e.g. with regard to permissible operating pressure, processing temperatures, flow medium, other regulations apply. All welded connections must be performed in accordance with the DVS guidelines (DVS leaflet 2207-1 (PE), DVS 2207-1 suppl. 1 (PE-X) and DVS 2207-16 (PA)).

When using PE-X pipes, particular consideration is required for possible process-related restrictions in the connection technology.

Please note

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An overview of the relevant norms, standards, and guidelines can be found in the annex.

Designation of wall constructions and of typical jointing methods

Single-layer pipes

Single-layer pipes consist of a homogeneous layer of one material. In accordance with the existing product standards, they can be manufactured from PE 80, PE 100, PE 100-RC, PE-X, PVC-U, or PA12-U.

Pipes made of PE 100-RC and PA12-U (VESTAMID® NRG) meet the increased requirements on the stress cracking resistance. This characteristic, for example, is verified in PAS1) 1075 "Pipes made from Polyethylene for alternative installation techniques – Dimensions, Technical Requirements, and Testing" and confirmed by accredited certifiers.

1) PAS = Publicly Available Specification by DIN (Deutsches Institut für Normung e.V.)

The material PVC-U does not contain any plasticisers.

Multi-layer pipes

Two-layer pipes are manufactured from PE 100 or PE 100-RC with an integrated, internal coextruded protective layer made of PE 100-RC , or from PE 100, PE 100-RC, or PE-X with a dimensionally integrated, coextruded, coloured signal layer.

Specifically for sewerage, the PE pipes are manufactured with a light inner surface allowing for easy inspection.

Triple layered pipes consist made of PE 100 or PE 100-RC with an integrated, internal and external co-extruded layer of PE 100-RC.

Figure 1: single-layer pipes

Source: Westfälische Kunststoff Technik GmbH

Figure 2: single-layer pipes

Source: Evonik Resource Efficiency GmbH

Pipes with additional protective layers

Pipes with additional protective layers consist of a core pipe made of PE 100-RC and an external layer for protection against scoring and notching.

Specifically for the installation in contaminated soils, the core pipe can additionally be coated with a metallic/polymer multi-layer film. During the production process, the individual are welded together in order to obtain a homogeneous, continuous barrier layer.

Pipes with plain ends

Pipes made of PE 80, PE 100, PE 100-RC, PE-X, PVC-U, or PA12-U are produced with plain ends.

Pipes with moulded socket

Pipes made of PE 100 and PE 100-RC can also be manufactured with longitudinal force-fit plug-in sockets.

Pipes made of PVC-U are manufactured with a one-piece moulded socket with a lip seal integrated into the plug-in socket or solvent cement sockets.

Figure 3: multi-layer pipes

Source: Gerodur MPM Kunststoffverarbeitung GmbH & Co. KG

Figure 4: PVC-U pipe with moulded solvent sockets

Source: Westfälische Kunststoff Technik GmbH

Delivery Form of Pipes

Pressure pipes made of PE 80, PE 100, PE 100-RC, PEX, and PA12-U are usually delivered with overall lengths 6 m, 12 m, or 20 m in rods, and as coiled bundle or on rolls.

Winding diameters of the coiled bundles differing from the European regulations can be agreed between the client and the manufacturer.

Pressure pipes from PE and PA12-U (VESTAMID® NRG) can be delivered in the dimensional range of between 32 mm (16 mm) and 630 mm (da 1,200 mm for PE) in rods and usually up to da 160 mm as coiled bundles.

Pipes made of PVC-U are delivered in the dimensional range of between 16 mm and 450 mm in rods with overall lengths up to 5 m with plain pipe ends, or 6 m with moulded sockets.

Pipes should be firmly sealed to ensure the inner surface remains clean until installation.

The pipes and fittings must be protected against damage while transported and stored.

Figure 5: Pipes in rods

Source: ©Fotolia: fefufoto

Figure 6: Pipe on roll

Source: Gerodur MPM Kunststoffverarbeitung GmbH & Co. KG

Planning and Construction
Site Preparation

Structural design

In accordance with the recommendations of the DVGW Code of Practice W 400-2, buried pipes can be installed without special ultimate limit state design, stability check and deformation analysis at cover heights between 0.8 m and 2.0 m, bedding and backfilling material in the trench according to DVGW Code of Practice W 400-2 and traffic load SLW 60.

In case of substantially varying installation conditions, the structural design according to DWA Code of Practice A-127 by DWA (Deutsche Vereinigung für waterwirtschaft, waste water und Abfall e. V., German Association for water, Wastewater and Waste) can be provided for special individual cases (without operational pressure).

For gas pipelines, the usual cover height according to DVGW Code of Practice G 472 amounts to a range between 0.6 m to 2.0 m. Otherwise, the DVGW W 400-2 applies accordingly.

During laying in trenches without sand backfill or trenchless installation, pipes that comply with the requirements of e.g. PAS 1075 are to be used. Especially for installation methods with increased mechanical load, it must be made sure that, with regard to the joining technique, as little harm as possible is caused to the pipe surface in the joint area.

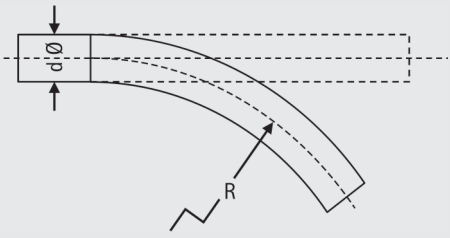
The manufacturer's instructions concerning the approved use of pipes and fittings must be taken into consideration.

Change in direction of the pipe route

To change the direction of the pipe route, the elasticity of the pipe material can be used, bending the pipe without warming. Here, the values for the lowest allowable bending radius may not be lower than those provided in table 1.

Table 1: Lowest allowable bending radius depending on the laying temperature

Laying temperature	Lowest permissible bending radius R
°C	PE/PE-X/PA
0	50 x d
10	35 x d
20	20 x d



An additional heat treatment of the pipes at the construction site in order to reduce the bending radius is not permitted.

In case of larger-scale changes in direction, drawn bends or injection moulded fittings can be used.

Crossing or parallel positioning, minimum distances to electrical cables

For crossing or parallel positioning with other lines, the pertinent regulations and specific installation instructions of the client must be followed.

Source: © Ilkercelik – Fotolia.com

Qualification and Quality Requirements

Personnel

Only those pipeline construction companies whose executing personnel avails of the relevant knowledge and qualifications may be awarded installation work and jointing technique. The awarded company must cater for a professional supervision of the construction work in line with the type and scope of the construction project.

For the gas and drinking water sector, this supervision is deemed as proven, if the pipeline construction company avails of e.g. a certification in accordance with the recommendations of the DVGW Code of Practice GW 301 "Verfahren für die Erteilung der DVGW-Bescheinigung für Pipeleitungsbauunternehmen" (Procedures for Granting DVGW Certificates for Pipe Construction Companies).

For connecting pipes and their supervision, certificates of qualification are required, e.g. DVGW Code of Practice GW 330 "Schweißen von Pipeen und Pipeleitungsteilen aus Polyethylen für Gas- und waterleitungen; Lehr- und Prüfplan" ("Welding of pipes and pipeline components made of polyethylene for gas and water pipings; schooling and test plan") and DVGW Code of Practice GW 331 "Schweißaufsicht für Schweißarbeiten an Pipeleitungen aus PE-HD für die Gas- und waterversorgung; Lehr- und Prüfplan" ("Welding supervision for welding work on pipelines made of PE-HD for gas and water supply; schooling and test plan").

Inspection of incoming goods

Upon arrival of the pipeline components at the construction site, the labels, the completeness of the delivery, as well as the accordance with the order documents must be verified.

All components must be transported, handled, and stored with care. Prior to unloading, the components must be inspected for transport damage.

According to DIN EN 12007-2 (as at 2015), DVGW G 472, and DVGW W 400-2, PE pipes with surface damages whose depth exceeds 10 % of the nominal wall thickness may not be used. For pipes made of PA12-U, this applies accordingly as per DIN ISO 16486-6.

In the joint area, other requirements apply.

Colour and Marking

Colour of pipes

Based on the colour scheme for the surface of pipes made of PE 80 in the gas and water supply regulated by normative terms in Germany, the surface is yellow (for gas) or black, labelled with yellow (gas) or light blue stripes (for water).

The colour coding of pipes/pipe surfaces made of PE 100 is either evenly orange-yellow (for gas) or royal blue (for water) or black, labelled with orange-yellow (gas) or signal blue stripes (water).

To exclude confusion, the plastic pipe association "Kunststoffpipeverband e.V." recommends an additional, clearly recognisable marking of the pipes made of PE 100-RC. This marking should be carried out in form of at least one additional longitudinal stripe or a stripe-like marking in white colour. In case of several stripes, these should be evenly spread over the circumference. The stripe or stripe-like marking may include additional information.

PE sewage pressure pipes usually have a black, brown, or green surface or are black with brown stripes. Pipes made of PVC-U sewage pressure pipes are usually brown or grey.

Table 2:
Usual colours of pipes for gas supply

Material	Pipe	Stripe
PE 80	RAL 1018	–
PE 80	RAL 9004	RAL 1018
PE 100	RAL 1033	–
PE 100	RAL 9004	RAL 1033
PE 100-RC		
PE 100-RC		
PE X		–
PA 12-U	RAL 1018	–
PA 12-U	RAL 9004	RAL 1018

The tables 2 to 4 represent the pipe colour determined by normative terms or recommended in Germany.

The colours of the outside surface should approximately correspond to the stated RAL numbers.

Table 3: Usual colours of pipes for water supply

Material	Pipe	Stripe
PE 80	RAL 9004	RAL 5012
PE 100	RAL 5005	–
PE 100	RAL 9004	RAL 5005
PE 100-RC		
PE 100-RC		
PE-X		–
PA 12-U	RAL 5005	–
PA 12-U	RAL 9004	RAL 5005
PVC-U		–
PVC-U		–
PVC-U		–

Table 4: Usual colours of sewage pressure pipes

Material	Pipe	Stripe
PE 80		–
PE 80		
PE 100		–
PE 100		–
PE 100		
PE 100		–
PE 100-RC		–
PE 100-RC		
PE 100-RC		–
PVC-U		–
PVC-U		–

Source: © Christian Schwier - Fotolia.com

Marking of pipes and fittings

The Marking elements shall be printed or formed directly on the pipe or component in a way that the

durability in use is ensured through the entire lifecycle of the pipe after storage, weathering, handling and installation.

The pipes and fittings must be provided with a minimum required marking that includes at least the information in accordance with table 5 and table 6.

The SDR series stated on the fitting gives an unequivocal indication of the maximum operational pressure in accordance with European standards and flow medium.

Which pipes and SDR combinations can be welded with this component, can be read in the technical specifications of the manufacturers.

Due to the lack of harmonised standards, plastic pipes may not be CE-marked.

Table 5: Marking example e.g. minimum required marking of pipes in accordance with DIN EN 12201-2

Aspects	Marking or symbol
Standard Number	EN 12201
Manufacturer's name and/or trademark	Name or symbol
Dimensions (d_n x e_n)	e.g. 110 x 10
SDR series	e.g. SDR 11
Intended use	e.g. W, P oder W/P
Material and designation	e.g. PE 100
Pressure rating in bars	e.g. PN 16
Manufacturer's information	e.g. 1009[a)]
Type of pipe if applicable	e.g. co-extruded or peelable layer

a) In clear figures or in code providing traceability to production period within year and month and if the manufacturer is producing at different sites, the production site.

Table 6: Marking example e.g. minimum required marking of fittings in accordance with DIN EN 12201-3

Aspects	Marking or symbol
Standard Number[a)]	EN 12201
Manufacturer's name and/or trademark	Name oder Symbol
Nominal outside diameter(s) of pipe d_n	e.g. 110
Material and designation	e.g. PE 100
Design application series (ie design SDR)	e.g. SDR 11
Nominal pressure[a)]	e.g. PN 16
Applicable SDR fusion range of pipe[a)]	e.g. SDR 11 – SDR 26
Tolerance (only for spigot fittings) $d_n \geq 280$ mm[a)]	e.g. Grad A
Manufacturer's information	e.g. 1009[b)]
Intended use[a)]	e.g. W, P oder W/P

a) This information may be printed on a label associated with the fitting or on an individual bag.

b) For providing traceability, the following details shall be given:
- the production period, year and month, in figures or in code;
- a name or code for the production site if the manufacturer is producing the same product at different sites.

Electrofusion fittings are provided with a bar-code for automatic recognising the fusion parameters in accordance with ISO 13950. For the automatic recognising of batch data for the traceability of pipe components, a barcode in accordance with ISO 12176-4 can be used.

Table 7: Additional possible Marking

Aspects	Marking or symbol
Confirmation of regular monitoring by an accredited certification body	Certification mark with registration number
Date of manufacture (year, month, and day)	Numbers or as a code
Material code	Four-digit number
Additional material definition	e.g. RC (resistance to crack), RT (raised temperature resistance)
Meter marking of coiled pipes and pipes on rolls	
MFI	
Tolerance bands	Level B (in accordance with ISO 11922-1)
Machine no./shift	e.g. 8
Traceability coding	in accordance with ISO 12176-4

General Handling and Processing Instructions at Low Temperatures

Due to their physical properties, polyethylene and polyamide are resistant against impact and shock up to a temperature of approx. –20 °C. However, the specific instructions of the manufacturers must be considered for jointing.

PVC-U tends to brittleness when the temperature falls below 5 °C. This is of particular relevance when handling the components at the construction site. As for adhesive joints, the instructions of the adhesive manufacturer must be followed.

Source: © ilkercelik – Fotolia.com

Transporting and Storing Pipe Components

Transporting pipe components

The pipe components are to be transported with appropriate vehicles, and loaded and unloaded in a professional manner.

For unloading, appropriate devices must be employed; broad belts and, for longer pipes, traverses are recommendable. Coils should be unloaded individually by using loops. Dropping or unrolling the pipes from the lorry bed is not permitted.

When transporting the pipes on the construction site, it is not allowed to drag them on the ground.

Storage place

The storage area should be as even as possible and free from debris, sharp-edged objects and the like. The pipes may not get in contact with fuels, oils, greases, or aggressive chemical substances. All pipes and pipe components need to be stored in a way that they cannot be contaminated inside. The Locking caps of the pipes and the packaging of the pipe components should be removed only immediately before being installed.

Stacking height

Loose pipes and coils made of PE should not be stacked higher than 1 m, the pipe stack being secured laterally. Unpalletted pipes made of PVC-U should not be piled higher than 1.5 m.

Outdoor storage

In normative terms, the outdoor storage of coloured pipes in Central Europe is limited to a maximum period of one year. For all coloured pipes made of PE compound included in the KRV material list "Zugelassene PE-Werkstofftypen für Druckrohre und Formstücke" ("certified PE compound for pressure pipes and fittings"), a maximum outdoor storage period of two years has been established for Central Europe.

Black coloured pipes made of PE or PA12-U can be stored outside without time limits. The maximum outdoor storage period for coloured pipes made of PA12-U (VESTAMID® NRG) can be obtained from the pipe manufacturer.

One-sided exposure to sunlight may cause bending especially for thin-walled pipes ("banana effect") due to temperature differences. This process can be avoided or even reversed e.g. by covering the pipes.

Moulded parts, electrofusion fittings, and mechanical pipe connections must be stored in their original packaging in closed spaces and protected against ultraviolet radiation and weather conditions, free of frost, and at temperatures below 50 °C.

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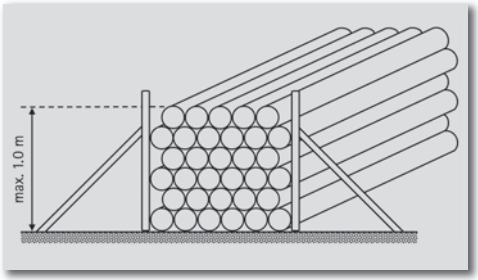
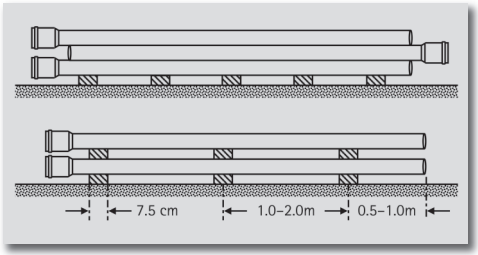


Secure pipe stack laterally, the height of not palletted PE pipes does should not exceed 1 m

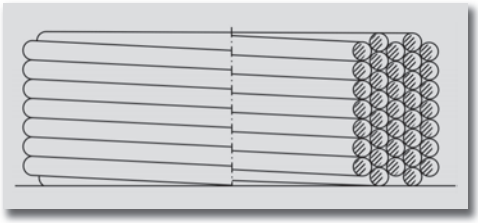
Can faded PVC pipes be used safely?

PVC pipes can be used unscrupulously for drinking water supply and sewerage, even in case of discolouration of the surface after outdoor storage—just as untainted pipes.

The discoloured surfaces can be hard to dissolve. Therefore, this discolouration must be removed with appropriate measures in case of bonding.



Storage of PVC-U pipes and PE pipes with moulded sockets on wooden blocks or with shifted sockets.



Coils must be stored horizontally. The maximum pile height is of 1 m.

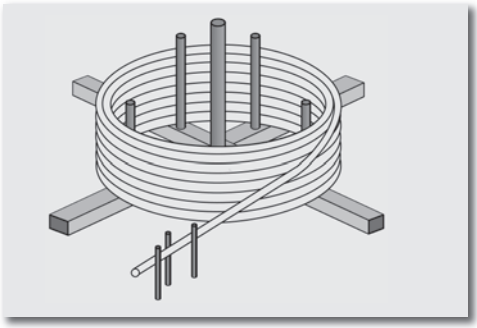
Unwinding Pipes and Cutting them to Length

Unwinding the pipes

Unwinding the pipes from the coil can be carried out in several ways. For pipes with an external diameter of up to an 63 mm, the coil is generally unrolled in a vertical position, while the head end of the pipe must be fixed. For larger dimensions, the use of an unreeling device is recommendable.

The pipes must be unwound in a straight way and may not be folded. Pulling off in a spiral is not permitted.

When unwinding, it must also be considered that the flexibility of the pipes depends on the ambient temperature.



Unwinding pipes from coils

Source: © fotomek - Fotolia.com

When unwinding pipes from rollss or coils, it needs to be taken into account that the pipe ends and individual layers of the coil may bounce up after releasing the fastening. After having fixed the pipe end, the ropes are released consecutively from the outside to the inside.

Since substantial forces are released when unwinding larger pipes, appropriate equipment must be used due to the increased danger of accident.

Cutting pipes to length

Cuts must be performed with a saw suitable for plastic pipes (e.g. electrical drywall saw with a saw blade suited for plastic pipes) or with a pipe cutter for plastic pipes. In any case, pipes are to be cut in a right angle. Burrs and uneven areas of the cut surface must be removed by means of an appropriate tool such as a scraper.When removing the uneven areas, notches and incisions should be avoided and chips removed.

Cut pipe ends must be processed in accordance with the type of jointing. Pipes get longer when the temperature rises, and shorten when the temperature falls.

When cutting the pipes, this temperature-based change in length must be taken into consideration in accordance with the values stated in table 8.

Based on manufacturer information, potentially conically sagged pipe ends must be cut back in order to ensure the nominal diameter in the connection area.

Table 8: temperature-based length change by pipe meter

Pipe material	Change in length α
PE	0.2 mm/m°C
PVC-U	0.08 mm/m°C
PA12-U	0.14 mm/m°C

Exemplary calculation for establishing the temperature-based change in length:

Pipe length L = 10 m,

Temperature change 20 °C,

Pipe material PE (α = 0.2 mm/m°C)

$\Delta L = L \cdot \Delta T \cdot \alpha$

$\Delta L = 10\ m \cdot 20\ °C \cdot 0.2\ mm/m°C$

$\Delta L = 40\ mm$

Pipe jointing

For pressure pipes made of PE and PA12-U (VESTAMID® NRG), the following is used:

- welding
  - heating element butt fusion (HS)
  - electrofusion joints (HM)
- mechanical pipe connections (clamp, push, press-fitting, and screw connections)
- flange connections

For pressure pipes made of PVC-U, the following is used:

- adhesive joints
- socket joints
- flange connections

The pipe locking caps, which are expected to prevent any contamination during storage, must be removed before pipe jointing.

Source: © fotomek - Fotolia.com

When establishing welded joints:

1. the requirements of the client,
2. the DVS regulations, especially DVS 2207 et seq., and
3. the instructions provided by the manufacturers

need to be taken into account.

Figure 7:
electrofusion fitting

Source: FRIATEC AG

Figure 8:
longitudinal cut of the electrofusion joint

Source: FRIATEC AG

Figure 9:
heating element butt fusion

Source: Gerodur MPM Kunststoffverarbeitung GmbH & Co. KG

Welding

The method description, process steps, and technical requirements for the heating element butt fusion and electrofusion joints are established by the guidelines DVS 2207-1 (PE), and DVS 2207-16 (PA12-U). Permissible type of jointing pipes and pipes with moulded parts are listed in table 9.

Information related to the devices

Welding devices must comply with the requirements stated in the DVS guideline 2208-1, accessories such as scraping devices, rounding clamps, and additional equipment must be in line with the supplement 1 to DVS 2208-1. Power sets must be able to provide the required performance in a stable fashion.

The operating instructions of the device manufacturers must be followed.

Requirements on the fittings

electrofusion fittings, socket fittings, and fittings manufactured from pipes must fulfil the relevant requirements of the European standards. Only those fittings which avail of a certificate of usability for the relevant application may be used.

Consider the area of application with regard to the processing temperature and the weldable pipe series (SDR). For HS, only pipes with the same wall thickness (SDR) can be welded together.

A distinction is made between fitting types (HM and HS):

- Sockets (only HM), angles, T-piece, reductions, locking caps etc. and fittings manufactured from pipes
- Saddle parts (HM): saddles, tapping valves.

Table 9: Permissible types of jointing pipes and pipes with moulded parts

Pipe	Fitting	Type of jointing	Annotation
PE 80 PE 100 PE 100-RC	PE 100 PE 100-RC	Schweißen (HS, HM)	DVS 2207-1
PE-X	PE 100 PE 100-RC	Schweißen (HM)	DVS 2207-1 suppl. 1
PA12-U[a)]	PA12-U	Schweißen (HS, HM)	DVS 2207-16

a) For pipes made of PA12-U, experience up to d200 mm is currently available.

Connection lateral fittings are available in long (suited for HM and HS) and in short version (only HS).

Instructions for a professional and appropriate welding can be found in the KRV installation instructions "Verbindungstechnik – Schweißen".

Welding records

Every welding seam should be logged. Specific reporting requirements with regard to the client must be taken into account. State-of-the-art welding devices/-machines usually avail of logging functions that allow an automatic documentation of the entire joining process.

Qualification of the welder

The qualification is confirmed by a test certificate acknowledged by the client and a permit, e.g. the welder certificate.

Monitoring the welding work and controlling the fusion data by means of the welding record carried out by the welding supervisor represent important elements of quality assurance. They must be performed by qualified specialists.

Figure 10: push fitting for the use in drinking water supply

Figure 11: clamp ring elements

Figure 12: Clamp fitting for jointing drinking water pipes made of PE 80, PE 100, or PE-Xa

Source: PLASSON GmbH

Mechanical pipe connections

Mechanical connectors such as double sockets etc. must usually fulfil the relevant requirements of the European standards. Only those connectors that avail of a certificate of usability for the relevant application may be used.

To connect pressure pipes, the following mechanical pipe connection elements made of plastics or metal are usually used:

- clamp fittings
- push fittings
- press fittings

The work is carried out by trained professionals.

Flange connection

The specifications of the regulation DVS 2210-1 suppl. 3 "Industrierohrleitungen aus thermoplastischen Kunststoffen – Projektierung und Ausführung – Oberirdische Rohrsysteme – Flanschverbindungen: Beschreibung, Anforderungen, Montage" (industry pipelines made of thermoplastic materials – project planning and implementation – above-ground pipe systems´ – flange connections: description, requirements, assembly) must be fulfilled.

Flange connections, welding necks, flanges, seals, screws, and flat washers must comply with the requirements regarding dimension, medium, operating pressure, and operating temperature.

For jointing PE pipes with flanges, welding necks with removable or fixed flange starting from an external pipe diameter of 32 mm are available. Two different versions exist here.

- welding necks for electrofusion jointing
- welding necks for heating element butt fusion

Elastomer seals with a steel wire are to be used here.

Flange connections must be tightened crosswise by using a torque wrench (cf. table 10).

The specific requirements of the seal manufacturers on the tightening torque must be considered with priority.

When assembled, the seal must adjoin without any gaps and be centred at the sealing surfaces. The front surface of the welding necks must be parallel to each other. The alignment of the connection must be free from axial and bending stress.

When using steel-reinforced plastic flanges, flat washer must be used in order to transmit the effective axial forces evenly to the flanges.

For pipes made of PVC-U, flanges with adhesive collar bushings are used.

Table 10: screw torques for the assembly of flange connections while using elastomer seals fittings in accordance with DVS 2210-1

Nominal diameter DN	Reference values for screw torque Flat rings (reference values) perm. p ≤ 10 bar	Profile ring (reference values) perm. p ≤ 16 bar	O-ring (reference values) perm. p ≤ 10 bar
32	20	15	15
40	30	15	15
50	35	20	20
65	40	20	20
80	40	20	20
100	40	20	20
125	50	30	25
150	60	35	30
200	70	40	35
250	80	50	40
300	100	60	45
350	100	70	50
400	120	80	60
500	190	90	70
600	220	100	80

perm. p = permissible operating pressure, perm. p ≤ 6 bar

Adhesive joints

When dealing with adhesive joints, the KRV adhesive bonding instruction A 117, the DVS guideline 2204-4, and the specific instructions provided by the pipe and adhesive manufacturer must be followed.

Pipes and fittings made of PVC-U are connected by using a solvent-based adhesive, whereas a tolerance range from a maximum of –0.2 mm of press fit, up to a maximum of +0.6 mm clearance fit is possible.

The points listed below require special attention:

- An overlap of tolerances of pipe and fitting can cause press fits; in such case, the pipe and the fitting can be pushed together only after applying a cleaning agent and adhesive.

- In order to ensure a light dissolution of the pipe surface, the pipe surface should become matt after using the cleaning agent.

- The pipe ends must be well chamfered in order to avoid that the adhesive layer is not pushed away when the pipe and the fitting are pulled together.

- Where the pipe diameter exceeds 160 mm, the use of a device is recommended for pulling the parts together.

KRV adhesive bonding instruction A 117 "PVC-U Druckleitungen" (PVC-U pressure pipes)

www.krv.de

Only available in German language.

- PVC pipes that have been stored outdoor for a longer period may feature discoloured surfaces that are hard to etch. The discolouration must be removed before adhesive bonding, e.g. by slight grinding.

- Special attention should be given to the setting time of the adhesive joint.

Adhesives in accordance with DIN EN 14814 "Adhesives for thermoplastic piping systems for fluids under pressure – Specifications" must be provided with the CE-mark.

Installation, Backfilling, and Compaction

Before installing, pipes and fittings must be checked for transport damages and similar impairments and cleaned in the jointing area.

The technical details of the pipes and fittings must be controlled in alignment with the planning requirements as per marking (cf. tables 5 and 6).

During the installation, the pipes must be protected against internal contamination. Especially for drinking water pipes, the hygiene guidelines must be followed when dealing with and installing the components. When interrupting or concluding work, all openings of pipes and pipe components must be closed.

Trenched with sand bedding

When installing pipes made of PE 80, PE 100, and PVC-U, sand bedding is mandatory.

With regard to the trench excavation, the provisions of both national and international standards apply. For Germany, DIN 4124 "Excavations and trenches – Slopes, planking and strutting breadths of working spaces" is relevant.

Besides, the specifications of the piping system operator must be fulfilled.

The trench must be realised in a way that all pipe components can be installed in regular laying depth.

Figure 13: installation in a trench with sand bedding

Source: SIMONA AG

Figure 14: example: pipeline trench in accordance with DIN EN 1610 "Construction and testing of drains and sewers"

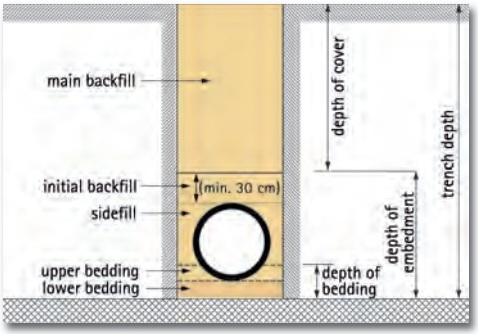


Table 11: reference values for materials used for embedment (cf. e.g. DVGW-W 400-2)

Pipe material	Grain size of round material	Grain size of crushed material
PE 80 ≤ DN 200	0–22 mm	Crushed stone fines–grit–mixture 0–11 mm
PE 100 > DN 200	0–40 mm	Crushed stone fines–grit–mixture 0–11 mm
PVC-U ≤ DN 600	0–40 mm	Crushed stone fines–grit–mixture 0–11 mm
PE-X	0–63 mm	0–63 mm
PE 100-RC[a)]	comparable to native soil as per DIN EN 1610 section 5.2.2	
PA12-U[a)]	comparable to native soil as per DIN EN 1610 section 5.2.2	

a) Information provided by the pipe manufacturer must be considered

The trench bottom must be prepared in a way that the pipe lies evenly on the surface. In case of rocky or stony soil, the trench bottom must be excavated at least 0.15 m deeper, and the excavated soil must be replaced with an appropriate soil material (e.g. sand or fine gravel).

Where required, additional socket holes shall be provided in the trench bottom as appropriate.

The trench width must be selected in a way to ensure a professional compacting of the pipe zone (cf. minimum trench width as per DIN 4124).

Figure 15: Preparing the bottom of the trench

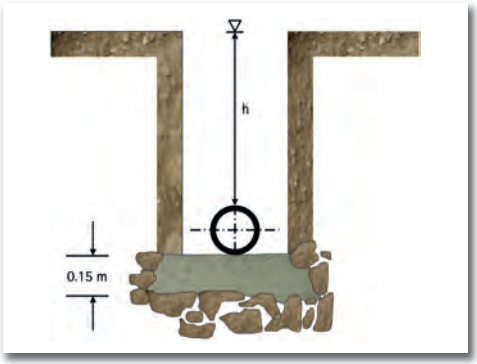


Figure 16: pipe warning tape

Source: © Christian Schwier – Fotolia.com

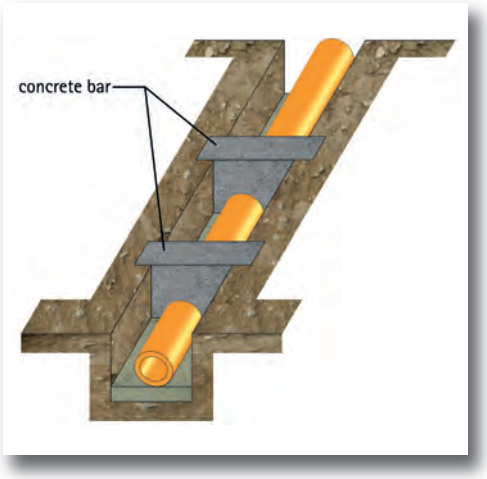
In terms of the mechanical resistance of the pipes, the grain size distribution must be suitable for embedding the pipe (cf. table 11).

Before setting a second fixed point (e.g. inspection chamber connections), the difference between pipe wall temperature and ambient temperature needs to be minimised by slightly roofing the pipes over an appropriate period of time.

For a better recognisability, a pipe warning tape can be laid over the pipe.

Backfilling the trench in roadways must be performed in accordance with the regulation ZTVA-StB "Zusätzliche Technische Vertragsbedingungen und Richtlinien für Aufgrabungen in Verkehrsflächen" ("Additional technical terms of contract and guidelines for excavations in traffic areas").

Figure 17: installation in steep sections



Machine devices may be employed, while taking into consideration the compaction depth of the devices and the structural circumstances.

Where allowed by the conditions at the construction site, the joints should be kept free until the pressure test has been carried out.

Installation in steep sections

In steep sections, it must be avoided by appropriate security measures that the backfilled pipe trench has a drainage effect, thus washing away the pipe bedding and undermining the pipe. In slope directions and steep sections, the pipe must be protected against sliding off, e.g. by using bars.

Self-compacting filling materials

The necessary parameters of the liquid soil for conducting the structural analysis of the pipe-soil system can be obtained from the manufacturer of the liquid soil.

The installation instructions and conditions of the liquid soil producer must be followed.

Installation without sand bedding

The requirements on the filling material mainly result from the requirements on the surface to be reproduced.

Soil from the excavation of the trebch is deemed appropriate for filling the embedement, if pipes suitable for installation without sand bedding (PE 100-RC pipes as per PAS 1075 or pipes made of PE-X or PA12-U) are used. Here, the material must be free of all pipe-damaging material (chemical attack or excessive pipe deformations).

In the field of traffic areas, the excavation material must be compactible as per the specifications of the static analysis.

Installation of a PE 100 RC pressure pipe in the open trench

Source: Wavin GmbH

Native soil as per DIN EN 1610, section 5.2.2

Re- use of native soil shall meet all the following requirements:

- it is permitted by the work specification/design;
- it complies with any compactability requirements in the the work specification/design;
- it is free from materials detrimental to the pipe (e.g. "oversized" particles, tree roots, waste, organic material, snow and ice) and any clay lumps larger than 75 mm.

Trenchless Technologies and Rehabilitation

Besides the traditional "open trench", alternative trenchless technologies have established for pressure pipes due to the flexibility and large pipe lengths as well as tensile strength joints:

- relining[1)2)3)4)]
- plowing[5)]
- trench cutting[5)]
- horizontal directional drilling[6)]
- burstlining[7)8)]
- Close-fit lining

Figure 18: plowing method

Source: SIMONA AG

The stated DVGW standards[1) 2)5) 6)7)] no longer apply in all points, e.g. the materials PE 100-RC and PA 12-U are not considered today. Information on the material PE 100-RC can be found in the listed leaflets of "RSV – Rohrleitungssanierungsverband e. V.".

1) cf. DVGW GW 320-1 „Erneuerung von Gas- und waterrohrleitungen durch Rohreinzug oder Rohreinschub mit Ringraum"
2) cf. DVGW GW 320-2 „Rehabilitation von Gas- und waterrohrleitungen durch PE-Reliningverfahren ohne Ringraum; Anforderungen, Gütesicherung und Prüfung"
3) cf. RSV Merkblattt 2 „Renovierung von waste waterleitungen und -kanälen mit Rohren aus thermoplastischen Kunststoffen durch Liningverfahren ohne Ringraum"
4) cf. RSV Merkblattt 3 „Renovierung von waste waterleitungen und -kanälen durch Liningverfahren mit Ringraum"
5) cf. DVGW GW 324 „Fräs- und Pflugverfahren für Gas- und waterrohrleitungen; Anforderungen, Gütesicherung und Prüfung"
6) cf. DVGW GW 321 „Steuerbare horizontale Spülbohrverfahren für Gas- und waterrohrleitungen - Anforderungen, Gütesicherung und Prüfung
7) cf. DVGW GW 323 „Grabenlose Erneuerung von Gas- und waterversorgungsleitungen durch Berstlining; Anforderungen, Gütesicherung und Prüfung"
8) cf. RSV data sheet 8 „Erneuerung von Entwässerungskanälen und Anschlussleitungen mit dem Berstliningverfahren"

Subsequent Work on Pipes in Operation and Repair Work

When working on gas pipes presently in operation, the requirements of BGR 500[9] "Operating work materials" must be followed.

Work on pipe under operating pressure, especially in case of explosive flow media, may be carried out by suitably qualified personnel only.

For maintenance work performed on PVC-U gas pipes in operation, the DVGW worksheet G 466-3 "Gasrohre aus PVC – Instandhaltung" (gas pipes made of PVC – maintenance) must be followed.

Figure 19: pressure tapping tees

Source: FRIATEC AG

Squeezing[10] (PE and PA)

Squeezing the plastic pipes is seen as emergency measure in case of damage.

Bag positioning (PVC-U, PA, and PE)

Tested stop-off technology, consisting of a bag positioning device and a stop-off bag, are certified and marked with a DVGW mark. Different stop-off technologies are available on the market.

In general, a distinction is made between single-bag and double-bag positioning device, which is used in combination with rubber-bags or bag with textile cover. Stop-off bags must be checked for leakage and external damages before being used.

The relevant manufacturer instructions should be followed.

Subsequent installation of moulded parts (PVC-U, PA, and PE)

The belated installation of moulded parts can be performed with clamp, screw, or welded joints. For welded joints, it needs to be ensured that the welding area is free of moisture influence during the entire welding process (entering water e.g. due to non-closing shut-off valves in the water supply).

The relevant manufacturer instructions should be followed.

Tapping under operating pressure (PVC-U, PA, and PE)

To create connections, the pipe does not need to be shut off, when using tapping valves. Thanks to its special construction, tapping under operating pressure is possible without media leakage. During the installation, the instructions of the manufacturer must be followed.

9) Berufsgenossenschaftliche Regeln für Sicherheit und Gesundheit bei der Arbeit (employers' liability insurance associations rules for safety and health at work)
10) Cf. DVGW GW 332 "Abquetschen von Rohrleitungen aus Polyethylen in der Gas- und waterverteilung"

Documentation

Welding records and component traceability

Depending on the application, the scope of documentation must be agreed upon in advance during the project planning phase. Often, a subsequent request of batch-related quality certificates and evidence is not possible.

Besides the legally regulated marking of fittings, barcode labels can be used to automatically capture in electronic form welding and traceability data as a module of the pipe record.

Standards and Regulations

Scope

Table 12: product standards for pipes (selection)

Regulation number	Application	Material	Title	Publication date
DIN 8061	Gas Water Waste water	PVC-U	Unplasticized polyvinyl chloride (PVC-U) pipes – General quality requirements, testing	**05-2016**
DIN 8062	Gas Water Waste water	PVC-U	Unplasticized polyvinyl chloride (PVC-U) pipes – Dimensions	**10-2009**
DIN 8074	Gas Water Waste water	PE	Polyethylene (PE) – Pipes PE 80, PE 100 – Dimensions	**12-2011**
DIN 8075	Gas Water Waste water	PE	Polyethylene (PE) pipes – PE 80, PE 100 – General quality requirements, testing	**12-2011**
ISO 4065	Gas Water Waste water	PE PVC-U PA	Thermoplastic pipes - Universal wall thickness table	**12-1996**
ISO 16892	Gas Water	PE-Xc	Crosslinked polyethylene (PE-X) pipes – General requirements, testing	**07-2000**
DIN EN 1555-2[a)]	Gas	PE	Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 2: Pipes	**12-2010**
DIN EN 12201-2[b)]	Water Waste water	PE	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 2: Pipes	**12-2013**
DIN EN ISO 1452-2	Water Waste water	PVC-U	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure – Unplasticized poly(vinyl chloride) (PVC-U) – Part 2: Pipes	**04-2010**
DIN ISO 16486-2[c)]	Gas	PA	Plastics piping systems for the supply of gaseous fuels – Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing – Part 2: Pipes	**07-2015**

Continuation and footnotes, see page 36

Continuation – table 12: product standards for pipes (selection)

Regulation number	Application	Material	Title	Publication date
DVGW GW 335-A1	Water	PVC-U	Kunststoff-Rohrleitungssysteme in der Gas- und Wasserverteilung; Anforderungen und Prüfungen - Teil A1: Rohre und daraus gefertigte Formstücke aus PVC-U für die Wasserverteilung	**06-2003**
DVGW GW 335-A2	Gas Water	PE	Kunststoff-Rohrleitungssysteme in der Gas- und Wasserverteilung; Anforderungen und Prüfungen – Teil A2: Rohre aus PE 80 und PE 100	**11-2005**
DVGW GW 335-A3	Gas Water	PE-Xa	Kunststoff-Rohrleitungssysteme in der Gas- und Wasserverteilung; Anforderungen und Prüfungen – Teil A3: Rohre aus PE-Xa	**06-2003**
DVGW GW 335-A6	Gas Water	PA	Plastic pipeline systems for gas and water supply; requirements, testing – part A6: pipes and fittings made of PA-U 160 or PA-U 180 and jointing	**12-2015**
PAS 1075	Gas Water Waste water	PE 100-RC	Pipes made from Polyethylene for alternative installation techniques - Dimensions, technical requirements and testing	**04-2009**

a) For fittings and valves made of PE, their mutual connections as well as with pipeline components made of other materials, those for the use at a maximum permissible operating pressure MOP of not more than 10 bar and an operating temperature of 20 °C as a reference temperature, the requirements of the parts 3 to 5 of EN 1555 must be complied with.

b) For fittings and valves made of PE, their mutual connections as well as with pipeline components made of other materials, those for the use at a maximum permissible operating pressure PFA of not more than 25 bar and an operating temperature of 20 °C as a reference temperature, the requirements of the parts 3 to 5 of DIN EN 12201 must be complied with.

c) In December 2016 TC155 agree to take over the standards of ISO 16486 series in a new EN ISO 16486 series.

Table 13: regulations for welding thermoplastic synthetics (excerpt)

Regulation number	Application	Material	Title	Publication date
DVS 2207-1	Gas Water Waste water	PE	Welding of thermoplastics – Heated element welding of pipes, piping parts and panels made out of polyethylene	**08-2015**
DVS 2207-1 suppl. 1	Gas Water Waste water	PE	Welding of thermoplastics – Heated tool welding of pipes made of PE-Xa with pipeline components made of PE-HD	**12-2005**
DVS 2207-16	Gas Water Waste water	PA12-U	Welding of thermoplastics – Heated tool welding of pipes and piping parts made of Polyamide 12	**07-2010**

Planning and construction site preparation

Table 14: implementation standards (excerpt)

Regulation number	Application	Material	Title	Publication date
DIN EN 805	Water	Open to all materials	Water supply – Requirements for systems and components outside buildings	**03-2000**
DIN EN 1610	Waste water	Open to all mat.	Construction and testing of drains and sewers	**12-2005**
DIN EN 12007-1	Gas	PE	Gas infrastructure – Pipelines for maximum operating pressure up to and including 16 bar – Part 1: General functional requirements	**10-2012**
DIN EN 12007-2	Gas	PE	Gas infrastructure – Pipelines for maximum operating pressure up to and including 16 bar – Part 2: Specific functional requirements for polyethylene (MOP up to and including 10 bar)	**10-2012**
DIN EN 12889	Waste water	Open to all mat.	Trenchless construction and testing of drains and sewers	**03-2000**

Open to all mat. = Open to all materials

Continuation and footnotes, see page 38/39

Continuation – table 14: implementation standards (excerpt)

Regulation number	Application	Material	Title	Publication date
DVGW GW 320-1[a)]	Gas Water	Open to all mat.	Erneuerung von Gas- und Wasserrohrleitungen durch Rohreinzug oder Rohreinschub mit Ringraum	**02-2009**
DVGW GW 320-2[a)]	Gas Water	PE	Erneuerung von Gas- und Wasserrohrleitungen durch PE-Reliningverfahren ohne Ringraum; Anforderungen, Gütesicherung und Prüfung	**06-2000**
DVGW GW 321[a)]	Gas Water	Open to all mat.	Steuerbare horizontale Spülbohrverfahren für Gas- und Wasserrohrleitungen – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**10-2003**
DVGW GW 322-1[a)]	Gas Water	Open to all mat.	Grabenlose Auswechslung von Gas- und Wasserrohrleitungen – Teil 2: Hilfsrohrverfahren – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**10-2003**
DVGW GW 322-2[a)]	Gas Water	Open to all mat.	Grabenlose Auswechslung von Gas- und Wasserrohrleitungen – Teil 2: Hilfspipeverfahren – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**03-2007**
DVGW GW 323[a)]	Gas Water	Open to all mat.	Grabenlose Erneuerung von Gas- und Wasserversorgungsleitungen durch Berstlining; Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**07-2004**
DVGW GW 324[a)]	Gas Water	Open to all mat.	Fräs- und Pflugverfahren für Gas- und Wasserrohrleitungen; Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**08-2007**
DVGW GW 325[a)]	Gas Water	Open to all mat.	Grabenlose Bauweisen für Gas- und Wasser-Anschlussleitungen; Anforderungen, Gütesicherung und Prüfung	**03-2007**
DVGW W 333	Water	Open to all mat.	Anbohrarmaturen und Anbohrvorgang in der Wasserversorgung	**06-2009**
DVGW W 400-1	Water	Open to all mat.	Technische Regeln Wasserverteilungsanlagen (TRWV); Teil 1: Planung	**02-2015**
DVGW W 400-2	Water	Open to all mat.	Technische Regeln Wasserverteilungsanlagen (TRWV); Teil 2: Bau und Prüfung	**09-2004**

Continuation and footnotes, see page 39

Open to all mat. = Open to all materials

Continuation – table 14: implementation standards (excerpt)

Regulation number	Application	Material	Title	Publication date
DVGW G 472	Gas	PE PE-Xa	Gasleitungen bis 10 bar Betriebsdruck aus Polyethylen (PE 80, PE 100 und PE-Xa) – Errichtung	**08-2000**
DVGW G 459-1	Gas	PE PE-Xa	Gas-Hausanschlüsse für Betriebsdrücke bis 4 bar; Planung und Errichtung	**07-1998**
ATV-DVWK-A 127	Waste water	Open to all mat.	Statische Berechnung von Abwasserkanälen und –leitungen	**04-2008**

a) The regulations of DVGW stated here are not up to date in all aspects, e.g. the material PE 100-RC is not taken into consideration.

Open to all mat. = Open to all materials

Qualification and quality Requirements

Table 15: implementation standards (excerpt)

Regulation number	Application	Material	Title	Publication date
DIN EN 12007-2	Gas	PE	Gas infrastructure – Pipelines for maximum operating pressure up to and including 16 bar – Part 2: Specific functional requirements for polyethylene (MOP up to and including 10 bar)	**10-2012**
DVGW W 400-2	Water	Open to all mat.	Technische Regeln Wasserverteilungsanlagen (TRWV); Teil 2: Bau und Prüfung	**09-2004**
DVGW G 472	Gas	PE PE-Xa	Gasleitungen bis 10 bar Betriebsdruck aus Polyethylen (PE 80, PE 100 und PE-Xa) – Errichtung	**08-2000**
DVGW GW 301	Gas Water	Open to all mat.	Unternehmen zur Errichtung, Instandsetzung und Einbindung von Rohrleitungen – Anforderungen und Prüfungen	**10-2011**
DVGW GW 330	Gas Water	PE PE-Xa	Schweißen von Rohren und Rohrleitungsteilen aus Polyethylen (PE 80, PE 100 und PE-Xa) für Gas- und Wasserleitungen; Lehr- und Prüfplan	**11-2000**
DVGW GW 331	Gas Water	PE	Schweißaufsicht für Schweißarbeiten an Rohrleitungen aus PE-HD für die Gas- und Wasserversorgung; Lehr- und Prüfplan	**10-1994**

Open to all mat. = Open to all materials

Colour and marking

Table 16: additional marking of pipes (excerpt)

Regulation number	Application	Material	Title	Publication date
ISO 11922-1	Gas Water Waste water	Open to all mat.	Thermoplastics pipes for the conveyance of fluids – Dimensions and tolerances – Part 1: Metric series	**04–1997**
ISO 12176-4	Gas Water Waste water	Open to all mat.	Plastics pipes and fittings – Equipment for jointing polyethylene systems – Part 4: Traceability coding	**11–2003**

Open to all mat. = Open to all materials

Pipe jointing

Table 17: regulations on the realisation of pipe connections (excerpt)

Regulation number	Application	Material	Title	Publication date
DIN EN 14814	Water Waste water	PVC-U	Adhesives for thermoplastic piping systems for fluids under pressure – Specifications	**08–2015**
ISO 13950	Gas Water Waste water		Plastics pipes and fittings – Automatic ecognition systems for electrofusion joints	**01–2008**
DVS 2207-1	Gas Water Waste water	PE	Welding of thermoplastics – Heated element welding of pipes, piping parts and panels made out of polyethylene	**08–2015**
DVS 2207-16	Gas Water Waste water	PA12-U	Welding of thermoplastics – Heated tool welding of pipes and piping parts made of Polyamide 12	**07–2010**
DVS 2208-1	Gas Water Waste water	Open to all mat.	Welding of thermoplastics – Machines and devices for the heated tool welding of pipes, piping parts amd panels	**03–2007**
DVS 2208-1 Beiblatt 1	Gas Water Waste water	Open to all mat.	Welding of thermoplastics - Tools and devices for the heated tool welding of pipes and piping parts	**02–2012**

Continuation, see page 41

Continuation – table 17: regulations on the realisation of pipe connections (excerpt)

Regulation number	Application	Material	Title	Publication date
DVS 2210-1	Gas Water Waste water	Open to all mat.	Industrial pipelines made of thermoplastics – Planning and execution – Above-ground pipe systems	**04-1997**
DVS 2210-1 Beiblatt 1	Gas Water Waste water	Open to all mat.	Industrial piping made of thermoplastics – Design and execution – Above-ground pipe systems – Calculation example	**05-2006**

Installation, backfilling, and compaction

Table 18: regulations on the installation of pipe connections (excerpt)

Regulation number	Application	Material	Title	Publication date
DIN 4124	Gas Water Waste water	Open to all mat.	Excavations and trenches – Slopes, planking and strutting breadths of working spaces	**01-2012**
DIN EN 1610	Waste water	Open to all mat.	Construction and testing of drains and sewers	**12-2015**
DVGW GW 320-1[a)]	Gas Water	Open to all mat.	Erneuerung von Gas- und Wasserrohrleitungen durch Rohreinzug oder Rohreinschub mit Ringraum	**02-2009**
DVGW GW 320-2[a)]	Gas Water	PE	Rehabilitation von Gas- und Wasserrohrleitungen durch PE-Reliningverfahren ohne Ringraum; Anforderungen, Gütesicherung und Prüfung	**06-2000**
DVGW GW 321[a)]	Gas Water	Open to all mat.	Steuerbare horizontale Spülbohrverfahren für Gas- und Wasserrohrleitungen – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**10-2003**
DVGW GW 322-1[a)]	Gas Water	Open to all mat.	Grabenlose Auswechslung von Gas- und Wasserrohrleitungen – Teil 1: Press-/Ziehverfahren – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**10-2003**

Continuation and footnotes, see page 42

Continuation – table 18: regulations on the installation of pipe systems (excerpt)

Regulation number	Application	Material	Title	Publication date
DVGW GW 322-2[a)]	Gas Water	Open to all mat.	Grabenlose Auswechslung von Gas- und Wasserrohrleitungen – Teil 2: Hilfsrohrverfahren – Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**03-2007**
DVGW GW 323[a)]	Gas Water	Open to all mat.	Grabenlose Auswechslung von Gas- und Wasserversorgungsleitungen durch Berstlining; Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**07-2004**
DVGW GW 324[a)]	Gas	Open to all mat.	Fräs- und Pflugverfahren für Gas- und Wasserrohrleitungen; Anforderungen, Gütesicherung und Prüfung; mit Korrekturen vom Januar 2009	**08-2007**
DVGW GW 325[a)]	Gas Water	Open to all mat.	Grabenlose Bauweisen für Gas- und Wasseranschlussleitungen; Anforderungen, Gütesicherung und Prüfung	**03-2007**
DVGW W 400-2	Water	Open to all mat.	Technische Regeln Wasserverteilungsanlagen (TRWV); Teil 2: Bau und Prüfung	**09-2004**

a) The regulations of DVGW stated here are not up to date in all aspects, e.g. the material PE 100-RC is not taken into consideration.

Subsequent work on pipe in operation and repair work

Table 19: regulations on the development of as-built drawings and marking of pipelines (excerpt)

Regulation number	Application	Material	Title	Publication date
DVGW GW 332	Gas Water	PE	Abquetschen von Rohrleitungen aus Polyethylen in der Gas- und Wasserverteilung	**09-2001**
DVGW G 466-3	Gas	PVC-U	Gasrohrnetze aus PVC – Instandhaltung	**04-2014**

Source: © Jan Reichel – Fotolia.com

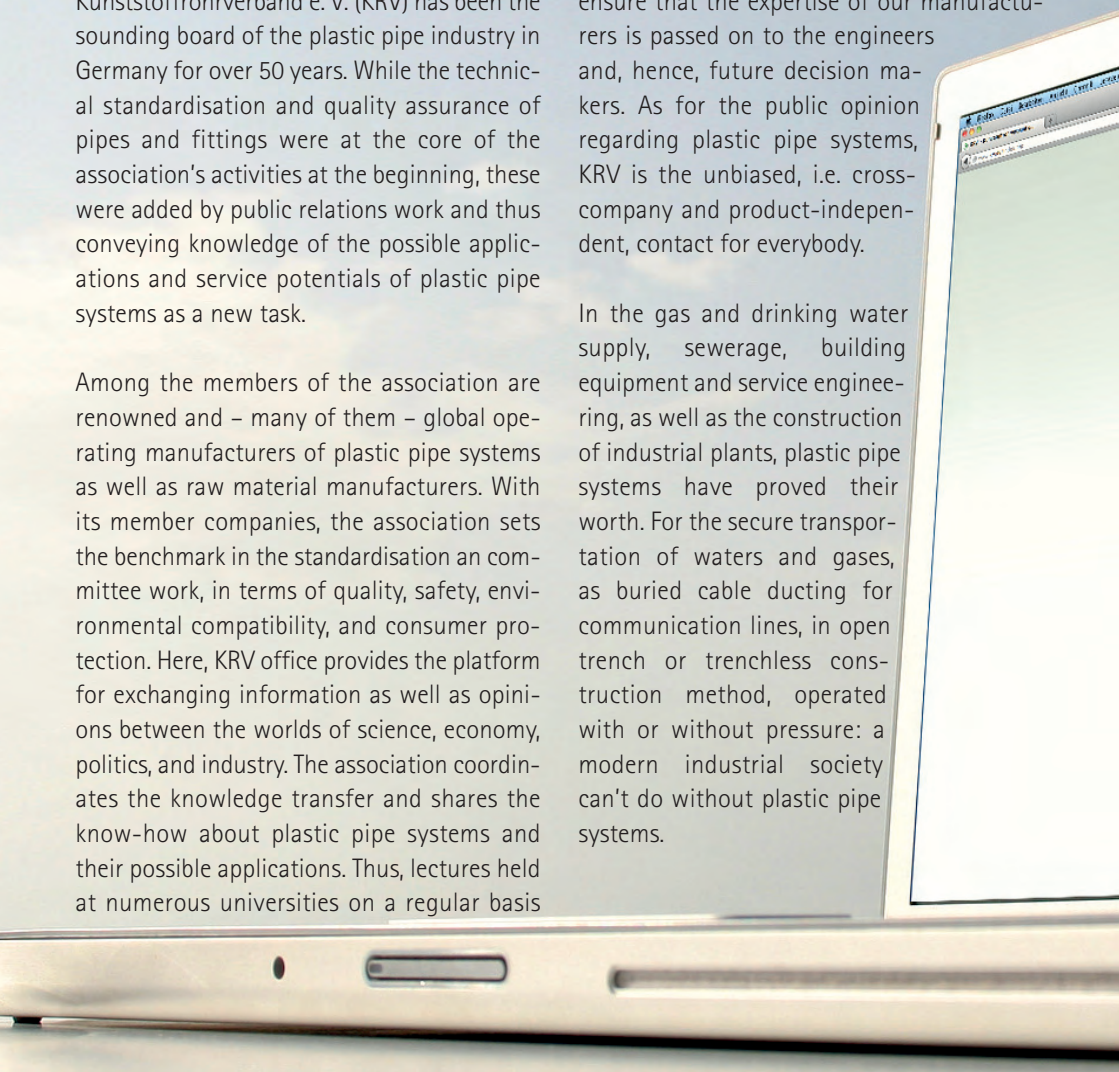
Kunststoffrohrverband e. V. Association of the German Plastic Pipe Industry

DIALOGUE PARTNER FOR PLASTIC PIPE SYSTEMS

Kunststoffrohrverband e. V. (KRV) has been the sounding board of the plastic pipe industry in Germany for over 50 years. While the technical standardisation and quality assurance of pipes and fittings were at the core of the association's activities at the beginning, these were added by public relations work and thus conveying knowledge of the possible applications and service potentials of plastic pipe systems as a new task.

Among the members of the association are renowned and – many of them – global operating manufacturers of plastic pipe systems as well as raw material manufacturers. With its member companies, the association sets the benchmark in the standardisation an committee work, in terms of quality, safety, environmental compatibility, and consumer protection. Here, KRV office provides the platform for exchanging information as well as opinions between the worlds of science, economy, politics, and industry. The association coordinates the knowledge transfer and shares the know-how about plastic pipe systems and their possible applications. Thus, lectures held at numerous universities on a regular basis ensure that the expertise of our manufacturers is passed on to the engineers and, hence, future decision makers. As for the public opinion regarding plastic pipe systems, KRV is the unbiased, i.e. cross-company and product-independent, contact for everybody.

In the gas and drinking water supply, sewerage, building equipment and service engineering, as well as the construction of industrial plants, plastic pipe systems have proved their worth. For the secure transportation of waters and gases, as buried cable ducting for communication lines, in open trench or trenchless construction method, operated with or without pressure: a modern industrial society can't do without plastic pipe systems.



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Kabelwerk Eupen AG Kunststoffrohrwerk, Eupen	www.eupen.com
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LyondellBasell, Frankfurt/M.	www.lyondellbasell.com
Pipelife Deutschland GmbH & Co. KG, Bad Zwischenahn	www.pipelife.de
Plasson GmbH, Wesel	www.plasson.de
SABIC Europe, Sittard	www.sabic.com
SIMONA AG, Kirn	www.simona.de
Total Petrochemicals & Refining SA/NV, Düsseldorf	www.totalrefiningchemicals.com
Wavin GmbH, Twist	www.wavin.de
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