7 Protecting Drinking Water in contaminated Soil

egeplast SLA® Barrier Pipe

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7 Protecting Drinking Water in contaminated Soil

7.1 Procedure Description

Fig 7-1: Causes of contamination

Our primary nutrient

When drinking water pipelines are laid in contaminated ground, there is a risk of contamination through pollutants finding their way into the drinking water. In particular, hydrocarbons that are chemically related to polyethylene exhibit high rates of permeation through polyethylene. Permeation refers here to the penetration of undesirable substances through the pipe wall into the drinking water.

A risk of contamination to drinking water exists primarily in regions near industrial zones, agricultural areas, cemeteries, landfill sites and petrol stations, on former military lands, near damaged sewer pipes or at crossings under rivers. There is also an increased risk of contamination in flood plains and in areas prone to inundation.

Both DVGW Worksheet W 403 and Worksheet W 400 recommend the use of pipes coated with appropriate (impermeable) materials here in place of unprotected HDPE pipes.

7 Protecting Drinking Water in contaminated Soil

7.2 Product Description

egeplast SLA® Barrier Pipe

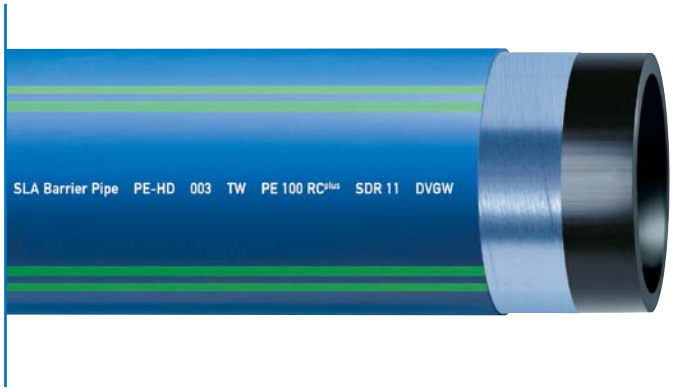


Fig 7-2: Kiwa Certificate

The egeplast SLA® Barrier Pipe developed by egeplast reliably eliminates the migration of pollutants into the drinking water. Through the use of a clever combination of the thermoplastic material properties of polyethylene, paired with the proof against diffusion of metallic materials, a pipe has been created which has made accessible a totally new area of application compared to conventional polyethylene pipes:

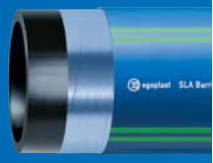
The installation of drinking water pipes made of plastic in contaminated ground, or in ground at risk of contamination, while ensuring that the requirements of the drinking water ordinance are met for water for human consumption.

The core of the egeplast SLA® Barrier Pipe is a DVGW-approved drinking water pipe manufactured from the material PE 100 RC^{plus} (optionally PE 80) in accordance with DIN 8074/75. In addition, the pipe is given an extremely abrasion resistant coating layer of mineral reinforced polypropylene. Four green double stripes serve to identify it as a multiple layer pipe. Proof against diffusion is guaranteed by a barrier made of multiple-layer aluminium foil between the core pipe and the coating layer.

Verification of resistance to permeation has been carried out by the Dutch KIWA institute. KIWA is an internationally recognised institute for the inspection of drinking water systems, headquartered in the Netherlands.

Long term testing for the permeation and diffusion measurements was performed using both helium diffusion and bottle tests under the external influence of a solution of methanol, acetone, trichloroethene, and toluene in saturated solution. As a result of the tests, it was determined that even after 100 years no penetration is to be expected.

On the basis of the positive test results, the egeplast SLA® Barrier Pipe received the product certificate BRL-K17101 from KIWA. With this, the egeplast SLA® Barrier Pipe system became the only plastic pipe in the world which is approved for installation in contaminated ground. Its proof against diffusion together with its high flexibility allows the installation of sewage and drinking water pipelines as a combined line in one culvert, as well as the installation of pipe bundles. An additional possible field of application is the use of the egeplast SLA® Barrier Pipe to carry effluent, so as to ensure that substances which pose a risk to the ground water remain inside the medium-bearing pipe.



7.3 egeplast SLA® Barrier Pipe Quality Assurance

7.3.1 Verification of Impermeability

Tests of the impermeability, that is, the resistance to diffusive penetration of the egeplast SLA® Barrier Pipe have been carried out by the Dutch KIWA institute. Long term testing for the permeation measurements was performed by means of a so-called bottle test under the external influence of test substances (Fig 7-3). A mixture of trichloroethene, toluene, methanol, and acetone at high concentration (in saturated solution) served as the test liquid. The behaviour of the permeation was extrapolated to give the long term behaviour over > 50 years using a mathematical model. All the requirements are listed in KIWA guidelines BRL-K17101.
As a result of the tests, it was determined that even after 100 years no penetration of the substances mentioned is to be expected.

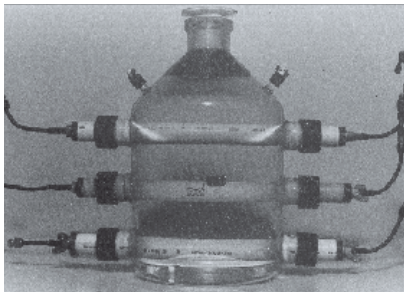


Fig 7-3: Bottle test

Organic Compounds	Impermeability Threshold µ/L			
	Polyethylene (PE)		Polyvinylchloride (PVC)	
	Homogenous	With AL Barrier (SLA)	Homogenous	With Rubber Ring
Monocyclic aromatic hydrocarbons	9			5
Benzene		1.780.000	178.000	
Toluene		515.000	51.500	
Xylol		190.000	19.000	
1,3,5- Trimethylbenzene		20.000	2.000	
Ethylbenzene		152.000	15.000	
Propylbenzene		60.000	6.000	
Chlorinated hydrocarbons	10			10
Trichloromethane (chloroform)		6.800.000	800.000	
Tetrachloromethane (tetraform)		680.000	80.000	
Trichloroethylene (tri)		935.000	110.000	
Tetrachloroethylene (per)		130.000	15.000	
1,2-Dichloroethane		7.395.000	87.000	
1,2-Dichloropropane		2.295.000	270.000	
Chlorobenzene		425.000	50.000	
Aliphatics	100			100
Hexane		9.500	2.375	
Heptane		3.000	750	
Octane		700	175	
Nonane		450	110	
Polycyclic aromatic hydrocarbons	5			5
Naphthalene		30.000	15.000	
Anthracene		1.300	650	
Phenanthrene		1.600	800	
Phenol	23.000	8.500.000	1.000000	23.000

Tab 7-1: Impermeability; source: KIWA institute

kiwa
Partner for progress

Number K5156/95 Replaces --

Issued 1995-12-01 Dated --

Certificate

Product Certificate

egeplast SLA piping systems for the transport of drinking water

Based on pre-certification tests as well as periodic inspections by Kiwa, the products referred to in this certificate and marked with the Kiwa-mark as indicated under 'Marking', manufactured by

egeplast Werner Strumann GmbH & Co. KG

may, on delivery, be relied upon to comply with the Kiwa evaluation guideline BRL-K545 "PE piping systems with an aluminium wound barrier layer for the transport of drinking water in polluted soils".

Kiwa N.V.

ing. B. Meekma
Director,
Certification and Inspection

This certificate is issued in accordance with the Kiwa-Regulations for Product Certification and consists of 3 pages.
Publication of the certificate is allowed.
*) This is a translation. Only the Dutch text is legally binding.

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Certification and Inspection
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Telephone +31 70 41 44 400
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Accredited by RvA

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Fig 7-4: KIWA attestation with product certificate no. K 5156/95 for the egeplast SLA® Barrier Pipe system for drinking water.

7.3.2 PE 100 RC^{plus} Quality Assurance

Modern installation procedures make special demands of pipe material. The materials used must satisfy additional requirements, over and above the material properties monitored according to the applicable standards and DVGW Worksheet GW 335 Part A2. The resistance of the pipe material to slow crack growth is critical for the lifespan of the pipe under extreme operating conditions, if the pipe is to achieve the standard service life of 100 years in spite of the increased demands. In particular, resistance to stress-induced cracking can be improved enormously through optimised polymerisation. The qualities of today's PE 100 RC^{plus} allow it to almost reach the resistance to stress-induced cracking of cross-linked polyethylene PEX, which has been used for years in harsh conditions.
The notch test and the FNCT test provide information about the stress-induced cracking behaviour (slow crack growth) of a pipe material.

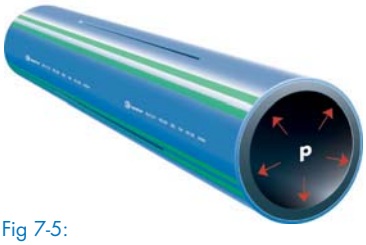

Fig 7-5:
Notch test (ISO 13479)

Fig 7-6:
Full notch creep test FNCT (ISO 16770)

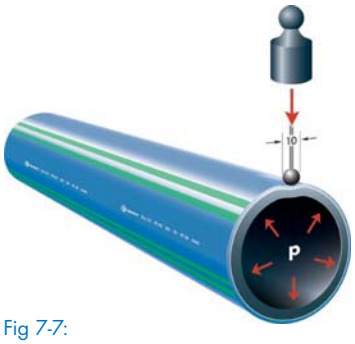

Fig 7-7:
Point load test using the Dr. Hessel method

In the notch test according to ISO 13479, a section of pipe is notched as specified, and afterwards tested to destruction at a test temperature of 80°C and test pressure of 9.2 bar (SDR 11, PE 100).

ISO 16770 describes a further development of the notch test. In the FNCT, small test bars of the material to be tested are incised with a sharp edge and, at 80°C (+2% Arkopal N 100), subjected to a constant tensile load of 4 N/mm^2 until they fail. The test simulates localised stress concentrations.

An additional check is the point load test using the Dr. Hessel method. This test reproduces very well the effect of a stone pressing against the pipe. A pipe, which has been internally pressurised, is also dented inwards using a round punch as a point load (penetration depth: 8.2% of the external diameter) in order to simulate the stress caused by a stone. The test is carried out at a temperature of 80°C (+2% Arkopal N 100).

So as to be able to make estimates of the service life of pipes under additional point loading, Dr. Hessel Ingenieurtechnik compared tests of pipes under internal pressure, and with additional point loading, to the results from the FNCT test (3R international 4/2001 and 6/2001). With this comparison, the stresses to which a pipe installed without a sand bed is exposed during its operating life may be related to the results of FNCT testing, and thus the FNCT test may be adopted for regular quality monitoring.

Performed within the framework of the full quality testing cycle are: monitoring of the material properties of all PE 100 RC^{plus} raw material charges by FNCT tests, and monitoring of the material properties after processing of the raw material. The latter is carried out on the produced pipe by a testing laboratory which is accredited to perform such analyses. The PE 100 RC^{plus} materials perform distinctly better than the standard PE 100 types in both the notch and FNCT tests, with values that lie well above those stipulated for pipes with protective properties.

	Internal Pressure Creep Test	S4 Test (Fast Crack Growth) 110x10 mm	Notch Test	FNCT	Point Load Test, Dr. Hessel Method
PE as per GW 335 Part A2	σ =12,4N/mm²; 20°C ≥ 100 h as per DIN 8075	pc ≥ 8 bar	80°C; 9.2bar ≥ 500 h	250 - 800 h 1)	1000 – 3000 h 1)
PE 100 + 2)	σ =12,4N/mm²; 20°C ≥ 200 h	pc ≥ 10 bar	80°C; 9.2bar ≥ 500 h	250 – 800 h 1) >300 h 3)	1000 – 3000 h 1)
PE 100 RC^{plus}	σ = 12,4N/mm²; 20°C ≥ 200 h	pc ≥ 10 bar	80°C; 9.2bar ≥ 5000 h	**≥ 8760 h**	**≥ 8760 h**

Tab 7-2 1) Values from 3R-international 4/2001 and 6/2001
2) The PE 100+ Association is an amalgamation of polyethylene manufacturers who voluntarily exceed the standard requirements
3) Data from a few manufacturers

The quality of the material utilised can be documented on request with a 3.1 B certificate.

egeplast uses only selected PE 100 materials (PE 100 RC^{plus}) for the egeplast SLA® Barrier Pipe. These materials must demonstrate a time to failure of at least 8760 h in the FNCT.

As an additional control, the quality of PE 100 RC^{plus} is monitored within the framework of the full quality testing cycle. The quality of these materials is such that their suitability for a 100 year service life for a pipe under point loading may be confirmed by structural testing. egeplast SLA® Barrier Pipes are subjected regularly to such structural testing: an internal pressure creep test lasting for one year, with additional point loading, at 80°C (+2% Arkopal N 100).
The PE 100 RC^{plus} materials perform distinctly better than the standard PE 100 types in both the notch and FNCT tests, with values that lie well above those stipulated for pipes with protective properties.

Continuous quality monitoring

Testing of the Material PE 100 RC^{plus}			
Property	**Requirement**	**Test Procedure**	**Frequency**
Melt index	as per specifications	EN ISO 1133:1999 Condition T 5 kg, 190°C 10 minutes	Min. 1 x per week as well as on every change of material and on every dimension check
Loss on drying	≤ 0.1%	Infrared method	per charge
Homogeneity	≤ grade 3	ISO 18553	per charge
Density	≥ 930 kg/m^3	DIN EN ISO 1183-2, DIN EN ISO 1872-1	per charge
Colour	as per DVGW GW 335 Part A2		regularly
Resistance to weathering	as per DVGW GW 335 Part A2 DIN EN 12201-1 DIN EN 1555-1	Black as per ISO 6964, blue and yellow as per DIN EN 921 and following DIN EN ISO 6259-1	regularly
Thermal stability	>20 minutes at 200°C	DIN EN 728	per charge
Microbiology	as per KTW recommendation as well as DVGW GW 335 Part A2	DVGW W 270	approval testing
Rapid crack propagation	as per DVGW GW 335 Part A2 DIN EN 12201-1 DIN EN 1555-1	ISO 13477	1 x annually
Gas resistance	as per DVGW GW 335 Part A2 DIN EN 12201-1 DIN EN 1555-1	DVGW GW 335 Part A2	approval testing
Hygiene	as per KTW recommendation as well as DVGW GW 335 Part A2		approval testing
Odour and taste	as per KTW recommendation as well as DVGW GW 335 Part A2		per charge
Slow crack growth	as per DVGW GW 335 Part A2 DIN EN 12201-1 DIN EN 1555-1	Notch test DIN EN ISO 13479	1 x annually
Slow crack growth	>8760 h as per Full Quality Testing Cycle	FNCT ISO 16770 80°C, 4 N/mm^2, 2% Arkopal	per charge

Tab 7-3

Additional Testing of the Finished PE 100 RC^{plus} Piping			
Property	Requirement	Test Procedure	Frequency
Labelling	as per DVGW GW 335 Part A2 DIN EN 12201-2 DIN EN 1555-2	visual inspection	regularly every 2 hours
Texture	as per DVGW GW 335 Part A2	visual inspection	regularly every 2 hours
Colour	as per DVGW GW 335 Part A2	visual inspection	regularly every 2 hours
Warm storage	as per DVGW GW 335 Part A2		1 x per week
Homogeneity	as per DVGW GW 335 Part A2	visual inspection	1 x per week
Thermal stability	>20 minutes at 200°C	DIN EN 728	1 x per week
Internal pressure creep test	as per DVGW GW 335 Part A2 DIN EN 12201-2 DIN EN 1555-2	80°C, 165 h; PE 80 σ = 4.6 N/mm^2 PE 100 σ = 5.5 N/mm^2	on every start at least 1 x per week
Melt index	max. 20% variation from the raw material	EN ISO 1133:1999 Condition T 5 kg, 190°C 10 minutes	on every change and on every dimension check at least 1 x per week
Hygiene	as per KTW recommendation as well as DVGW GW 335 Part A2	DVGW W 270	1 x annually
Labelling	as per DVGW GW 335 Part A2 DIN EN 12201-2 DIN EN 1555-2	visual inspection	regularly every 2 hours
Slow crack growth	>8760 h as per Full Quality Testing Cycle	FNCT ISO 16770 80°C, 4 N/mm^2, 2% Arkopal	6 x annually
Point loading test	>8760 h as per Full Quality Testing Cycle	HESSEL PA PLP 2.2-2 2004-05 80°C, 4 N/mm^2, 2% Arkopal	3 x annually

Tab 7-4

The egeplast SLA® Barrier Pipe is, as a consequence of its excellent resistance to stress-induced cracking, insensitive to point loads and therefore need not be bedded in sand. It is suitable for installation without a sand bed, and for trenchless installation.

HESSEL Ingenieurtechnik

Confirmation of continuous Quality Inspection

Subject: Inspection of pipes made from PE 100 RC^{plus} within the scope of the ***„Full Quality Testing Cycle"***

Product: egeplast **SLA® Barrier-Pipe** for drinking water, gas supply and waste water for non-conventional pipe installation

Manufacturer: egeplast Werner Strumann GmbH & Co. KG
Robert-Bosch-Str. 7, DE-48268 Greven, Germany

Scope of inspection:
(Full Quality Testing Cycle)

FULL QUALITY TESTING CYCLE – HESSEL Ingenieurtechnik GERMANY – DAP-PL-3760.00 – PE 100 RC^{plus} MATERIAL

1. Prove of the transfer-function from testing to service conditions
2. Inspection of the materials properties of all raw material batches designated as PE 100 RC^{plus} using the FNCT
3. Inspection of the materials properties after processing
4. Prove of the expected minimum service life using pipes under point load in type tests every year
5. Statistical validation of the minimum requirements of PE 100 RC^{plus}

This is to certify that due to the above mentioned inspections the following minimum requirements are fulfilled:

FNCT (PA FNCT 2.1-3 2004-03): 4 N/mm², 80 °C, 2% Arkopal N-100 testing time: >8760 h

Point loading test (PA PLP 2.2-2 2004-05): 4 N/mm², 80 °C, 2% Arkopal N-100 testing time: >8760 h

The egeplast SLA® Barrier Pipes made from PE 100 RC^{plus} are qualified for sandless and trenchless installation techniques.

HESSEL Ingenieurtechnik GmbH

Am Vennstein 1a
D-52159 Roetgen

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E-Mail: info@hessel-ingtech.de
Net: www.hessel-ingtech.de

Officially approved as a test, inspection and certification facility (NRW 37).

Deutscher Akkreditierungs Rat DAR

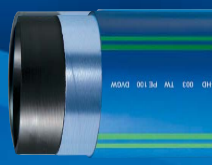
DAP-PL-3760.00

According to DIN EN ISO/IEC 17025 accredited Test-Laboratory by DAP Deutsches Akkreditierungssystem Prüfwesen GmbH

Date: 11.05.2007

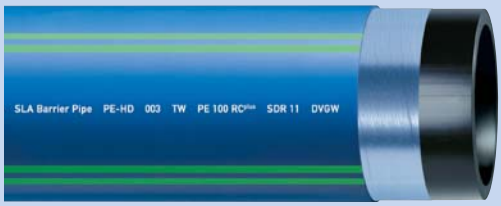
Authorized to sign: (Dr.–Ing. Joachim Hessel)

Fig 7-8



7.4 Technical Information

7.4.1 Product Data Sheet for egeplast SLA® Barrier Pipes for Drinking Water

Dimension:	OD 25 mm – OD 630 mm
Pipe construction:	 • Medium-bearing pipe black • Protective coating on the outside blue to identify the medium as drinking water with 4 green double stripes to signify a pipe with a protective coating SDR 17; SDR 11; SDR 7.4
Material:	Medium-bearing pipe: PE 100 RC^{plus} (Resistance to Crack) Barrier layer: Patented, diagonally overlapping and continuously wound aluminium foil with a defined degree of adhesion to the core pipe Protective coating: Patented, mineral-reinforced polypropylene coat, continuously extruded on during the manufacturing process
Approval:	DVGW*, KIWA *The approvals pertain to the medium-bearing pipe
Standards:	DVGW GW 335; DIN 8074/75; DIN EN 12201; KIWA BRL-K-545/01; BRL-K-533/03
Welding group:	003
Labelling:	With coloured metre marking on the medium-bearing pipe and additional marking of the protective coating
Delivery form:	• 6, 12 or 20 m straight lengths (up to max. 30 m) • Bundled coils of 100 m (up to OD 160/180 mm) • Custom lengths on request • Larger lengths on drums
Regulatory code / installation methods:	DVGW W400-1/2, GW 320, GW 321, GW 323; DIN EN 805; DIN 4124
Material testing:	HESSEL Ingenieurtechnik

7.4.2 Protection from Abrasion during Trenchless Installation

The egeplast SLA® Barrier Pipe is the result of consistent development of the well proven SLM® pipe. Confirmation of its improved quality has been provided by established, independent testing institutes.
The pressure bearing pipe wall consists of PE 100 RC^{plus} (optionally PE 80), which guards reliably against damage by virtue of its excellent crack resistance. The protective coating of polypropylene reliably protects the medium-bearing pipe against scratches and scoring from outside. In addition, point loads, such as those which can arise through stones or shards, are spread over a greater surface area by the protective coating, thus reducing the stress concentration.
The hardness of the pipe coating results from the special composition of the material. egeplast incorporates mineral microparticles into the polypropylene protective coating; these permit noticeably less scoring and abrasion.

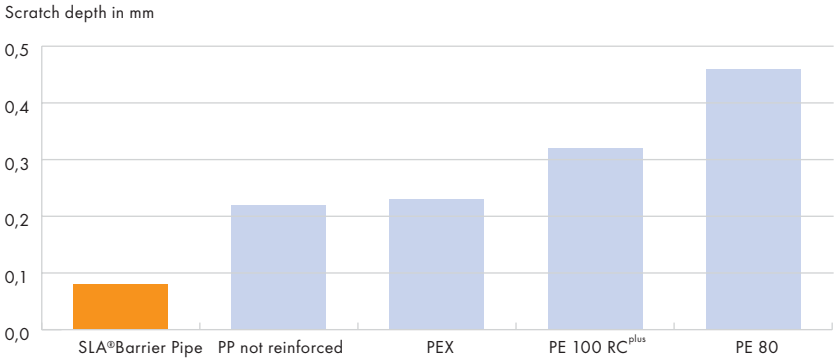


Fig 7-9: Results of scratch testing, official materials testing institute at the University of Hanover

These clear improvements in the product characteristics have been verified through scratch testing by the Materialprüfanstalt (Materials Testing Institute) in Hanover, amongst others (Fig 7-9).

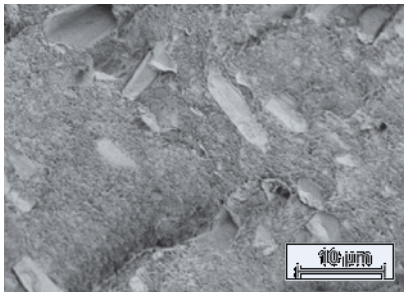


Fig 7-10: Mineral microparticles in the coating material

7.4.3 Double Protection against Point Loads

Pipes with protective coatings offer double protection against point loads:

- Like a "hard" shell, the protective coating keeps the direct load away from the pressure bearing pipe and distributes the additional stress. Analyses using the finite element method show what advantages a pipe with a protective coating has with regard to its resilience to point loading. No stress concentration acts on the core pipe in the immediate area of contact.
- The selected high-quality, extremely crack resistant PE 100 RC^{plus} polyethylene materials of the pressure bearing core pipe give crack formation no chance. For pipe bursting, the DVGW demands FNCT values of 2700 h for drinking water pipes and 3300 h for gas pipes in its Worksheet GW 323. All PE 100 RC^{plus}-materials are checked during the incoming goods inspection for >8760 h. These requirements are met by the core pipes of the egeplast SLA® Barrier Pipe.

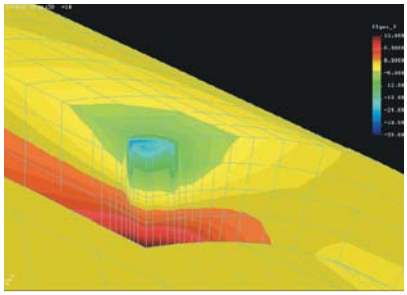


Fig 7-11: Finite element method (FEM) computational model, Muenster University of Applied Sciences, stress concentration: point and linear load safety line for coated pipe

Fig 7-12: Point load test using the Dr. Hessel method

7.5 Installation Guidelines for egeplast SLA® Barrier Pipes

Supplement to the installation instructions for PE pressure pipes A 135 and A 435 from the Kunststoffrohrverband e.V. in Bonn

7.5.1 General Information on Installation

The egeplast SLA® Barrier Pipe consists of a core pipe in accordance with DIN 8074/75, upon which a protective coating is additionally extruded in order to increase its scratch and abrasion resistance. A multiple layer aluminium foil is applied as a barrier layer between the medium-bearing pipe and the coating layer. The four green double stripes serve to identify it as a multiple layer pipe.

Scope of application

The installation instructions apply to soil covered egeplast SLA® Barrier Pipes with core pipes made of HDPE in accordance with DIN 8074 and DIN 8075 for use as drinking and domestic water pipelines, and as gas pipelines. The pipe joints and pipeline components must be rated for use with their respective operating pressures.

Installation, open trench method


Open with sand bed


Open without sand bed

egeplast SLA® Barrier Pipes are suited for installation without a sand bed because they are made of PE 100 RC^{plus}, which is highly resistant to stress-induced cracking. Their suitability for installation without a sand bed is verified by an independent testing institute on the basis of continual quality checks.

The excavated soil is suitable for backfilling if it can be compacted. egeplast does not make any provisos for its composition in terms of grain size. Considerable cost savings result from eliminating the need to dispose of the excavated soil.
For assessment of individual cases, it is necessary to determine the total cost of soil replacement and weigh that against the additional cost of the egeplast SLA® Barrier Pipe.

Installation, ploughing and milling


Ploughing


Cutting

The egeplast SLA® Barrier Pipe is flexible and manoeuvrable. These attributes make installation using the ploughing or milling procedures possible. The minimum allowable bend radius should be observed. The bend radius can, however, be under-stepped for a short time during the installation process, provided that the pipe string is supported by some mechanism, e.g. guide rollers, that makes kinking of the pipe impossible.
The increased stretching of the outer fibres which results from this is not critical for PE 100 RC^{plus}, the material used here.

Installation, trenchless method


Soil displacement


Relining


Water jet drilling


Pipe bursting

There is a higher risk of damage during trenchless installation and renovation procedures.
The extent of this damage to the pipe cannot be determined afterwards (black box installation)!
For this reason, pipes with a protective coating are essential. Multilayer pipes such as the egeplast SLA® Barrier Pipe constitute a practicable solution here: they allow continued use of the approved and tested egeplast gas, drinking water, and sewage pipes, while ensuring that the outer surfaces of the pipes are abrasion resistant for use with innovative installation methods. DVGW Worksheets GW 321 (horizontal directional drilling) and GW 323 (pipe bursting) recommend the use of pipes with protective coatings.
The DVGW regulations specify the maximum permitted tractive forces for trenchless installation procedures; these may not be exceeded. Overshooting these limits leads to permanent damage to the new pipeline. egeplast recommends the use of suitable data loggers for complete documentation of the construction project.
The minimum allowable bend radius should be observed.
Longitudinal force-locked joining procedures must be carried out according to the current regulatory codes of the DVGW and DVS.
The egeplast installation guidelines should be followed so as to avoid edges at the joints.

7.5.2 Joining Techniques

Open trench installation – electrofusion welding

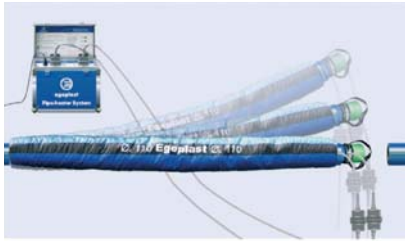


Fig 7-13: Straightening bundled coil and drum ends with the egeplast pipe-heater system

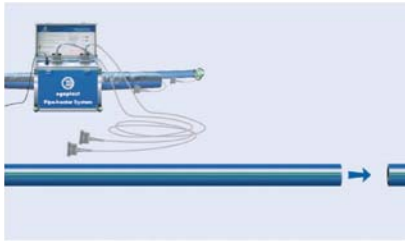


Fig 7-14: The pipe ends are prepared optimally for secure welding

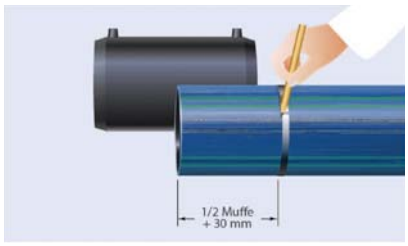


Fig 7-15: Marking the area from which the coating is to be peeled

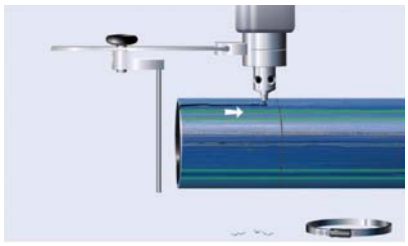


Fig 7-16: Removal of the protective coating with the egeplast coating cutter

Fig 7-17: Removal of the protective coating with the egeplast M10 peeling tool

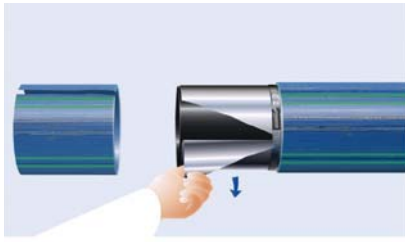


Fig 7-18: Removal of the aluminium coating with the help of a hose clip

Fig 7-19: Removal of the oxide layer using a rotary scraper

Fig 7-20: Welding in accordance with DVS 2207, Part 1

egeplast SLA® Barrier Pipes may be welded to all the commonly used moulded fittings made from PE 100 and PE 80 for electrofusion welding, after peeling the coating from the pipe ends. The guidelines and specifications given by the fittings manufacturers must also be followed.

Before electrofusion welding of egeplast SLA® Barrier Pipes the protective coating must be removed for at least half the length of the electrofusion coupler, plus 30 mm, using an egeplast coat peeling tool (Fig 7-15–17). Coat peeling of the pipe ends can be carried out by egeplast on request.

After removal of the protective coating has taken place, the aluminium coating is removed. A hose clip or similar simplifies the procedure. The clip is fixed to the remaining aluminium coating at a distance of exactly half the length of the weld fitting. The aluminium coating is then peeled carefully away from the core pipe, so that it tears off at the hose clip (Fig 7-18).
The contact surfaces must be prepared by scraping and cleaning before welding (Fig 7-19). For stress free welding of pipe supplied as bundled coils, egeplast recommends use of the egeplast pipe-heater system (Fig 7-13/14).
Once the electrofusion couplers have been mounted, the treated areas are heated to fusion temperature by passing electric current through integrated resistance wires (heating coil) in the electrofusion couplers, and thereby welded together (Fig 7-20). The welding process starts automatically if the device is set up appropriately. The assembly instructions given by the respective manufacturers are to be followed. Standards for workmanship are laid out in DVS 2207, Part 1.

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Continued: open trench installation – electrofusion welding

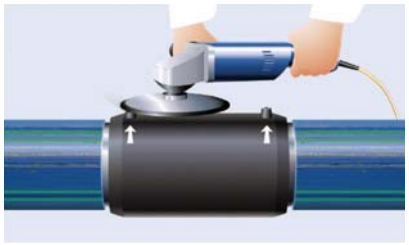

Fig 7-21: Removing the projecting wrap connectors

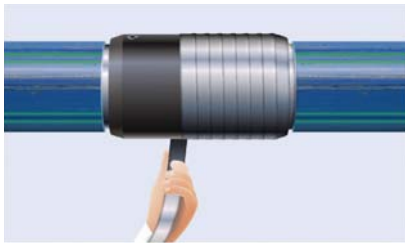

Fig 7-22: Wrapping the weld fitting with aluminium adhesive tape

Fig 7-23: Wrapping the weld fitting with Densolen Tape AS 40

Fig 7-24: Weld fitting protected with Densolen Tape AS 40

Once welding is finished, the wrap connectors projecting from the weld fitting are sawn off. Starting at one end on the now exposed aluminium foil, aluminium adhesive tape from the Stokvis company (or equivalent) is then wrapped three times around the fitting with at least 50% overlapping. The aluminium adhesive tape should be pressed on firmly. Only then is the welded joint guaranteed to be permanently diffusion proof (Fig 7-21/22).
For open trench installation, egeplast recommends wrapping with a self-sealing tape (e.g. Densolen Tape AS 40 plus from the Denso company, or equivalent) with 50% overlapping for mechanical protection of the aluminium foil.

Butt fusion welding

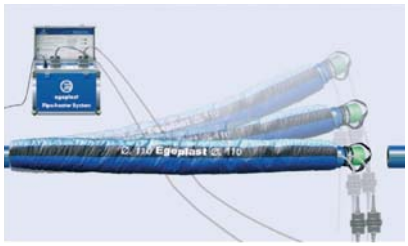

Fig 7-25: Straightening bundled coil and drum ends with the egeplast pipe-heater system

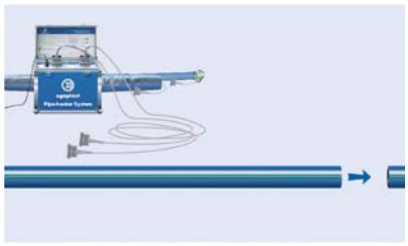

Fig 7-26: The pipe ends are prepared optimally for secure welding

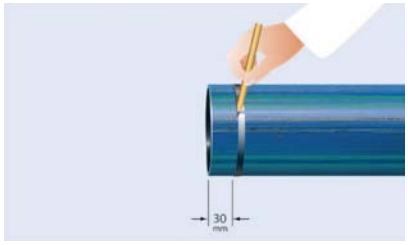

Fig 7-27: Marking the area from which the coating is to be peeled

Fig 7-28: Removal of the protective coating with the egeplast M10 peeling tool

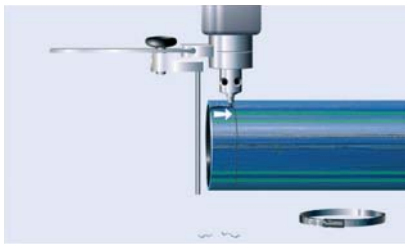

Fig 7-29: Removal of the protective coating with the egeplast coating cutter

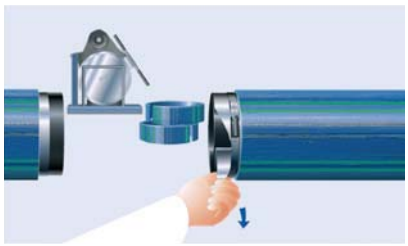

Fig 7-30: Removal of the aluminium coating with the help of a hose clip

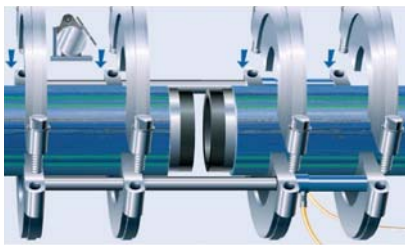

Fig 7-31: Fastening the special inserts available from egeplast (see Tab 7-6)

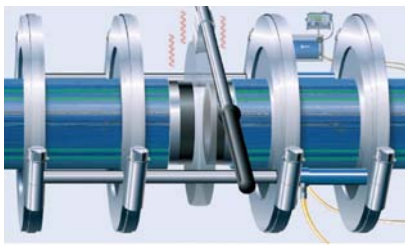

Fig 7-32: Welding in accordance with DVS 2207, Part 1

egeplast SLA® Barrier Pipes are manufactured from PE 100 RC^{plus} materials belonging to welding group 003. The protective coating is extruded onto the medium-bearing pipe, and is removed according to the egeplast installation instructions before joining. After this, welding with one another and with any other approved material is possible.

Before butt fusion welding of egeplast SLA® Barrier Pipes can take place, the protective coating must be removed over a length of 30 mm using an egeplast coat peeling tool (Fig 7-27–29). Coat peeling of the pipe ends can be carried out by egeplast on request.

After removal of the protective coating has taken place, the aluminium coating is removed. A hose clip or similar simplifies the procedure. The clip is fixed to the remaining aluminium coating such that about 10 mm of aluminium remains on the core pipe. The aluminium coating is then peeled carefully away from the core pipe, so that it tears off at the hose clip (Fig 7-30). Welding should be carried out in compliance with DVS 2207, Part 1 in standard welding machines, in which the use of inserts adjusted to the specific external diameter is recommended (Fig 7-31). Inserts suitable for welding machines from the Widos company can be supplied on a loan basis by egeplast (Tab 7-6).

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Continued: butt fusion welding

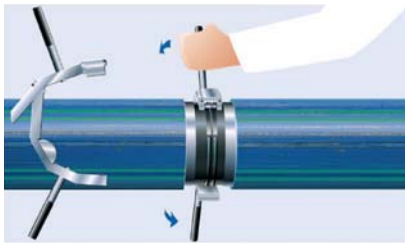

Fig 7-33: Removing of the weld bead with an external bead remover

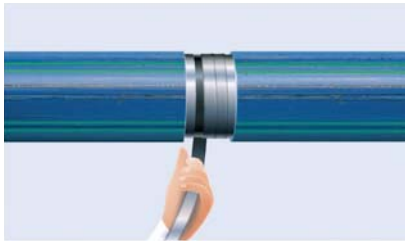

Fig 7-34: Wrapping the weld area aluminium adhesive tape

For the installation of the egeplast SLA® Barrier Pipe, it is mandatory to provide separate protection for both the area of the weld and the aluminium layer. The weld bead is to be removed with an external bead remove and the aluminium layer must be restored so that it is continuous again.

To do this, aluminium adhesive tape from the Stokvis company (or equivalent) is wrapped around three times with at least 50% overlapping, starting at one end on the exposed aluminium foil (Fig 7-34).

The aluminium adhesive tape should be pressed on firmly. Only then is the impermeability of the welded joint guaranteed to be permanent.

For open trench installation, egeplast recommends wrapping with a self-sealing tape (e.g. Densolen Tape AS 40 plus from the Denso company, or equivalent) with 50% overlapping for mechanical protection of the aluminium foil.

When installing the egeplast SLA® Barrier Pipe by means of trenchless methods, it is mandatory to provide separate protection to the area about the weld as described subsequently. The weld bead is to be removed in advance using an external bead remover.

The unprotected area between the peeled ends of the coating has to be evened out and protected. In this way, a smooth pipe surface is created which does not offer any point of mechanical contact. egeplast recommends the following alternative procedures for covering afterwards:

Alternative A: Covering with Densolid HK7

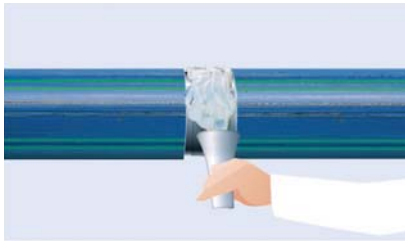

Fig 7-35: Coating with Densolid HK7

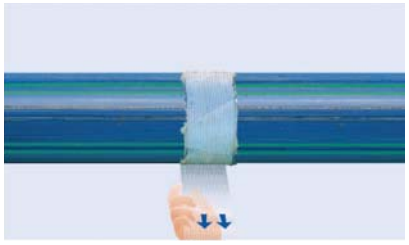

Fig 7-36: Laying down the fabric tape

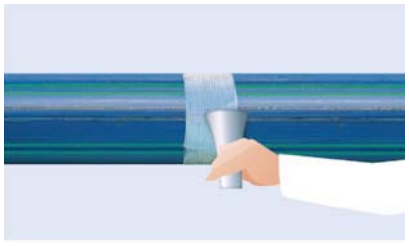

Fig 7-37: Smoothing out the filler material

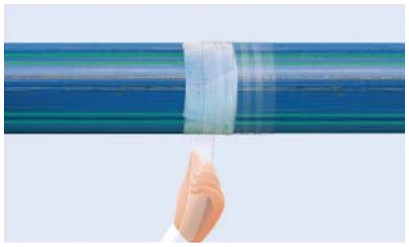

Fig 7-38: Smoother surface by wrapping with adhesive tape

Densolid HK7 is a fast curing, impact resistant two-component filler material based on polyurethane. To reduce the curing time at lower temperatures, the faster reacting Densolid HK7-W should be used in winter.
The filled ring should be reinforced additionally with polyester fabric mesh (e.g. Densolan ES) for external pipe diameters ≥ 110 mm (Fig 7-36). A single layer wrapping is sufficient for dimensions of 110-180 mm; for dimensions ≥ 180 mm, the fabric should be laid down in two layers in the filling coat before it has hardened. When using fabric tape, care should be taken to press the tape well into the resin so that the filler material permeates the mesh of the fabric well. The manufacturer's recommendations for handling are to be observed.

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Continued: butt fusion welding

Alternative B: Covering with resin-impregnated glass fibre wrapping

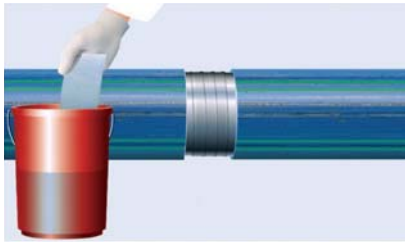


Fig 7-39: Soak the wrapping in clear water for 10-15 sec. according to the manufacturer's instructions

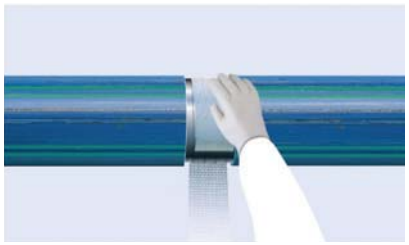


Fig 7-40: Wind the wrapping tautly around the weld area until it is flush with the protective coating

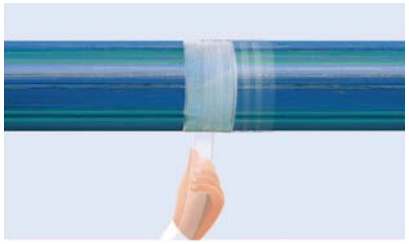


Fig7-41: Bind the covered area liberally with adhesive tape for a more even hardening

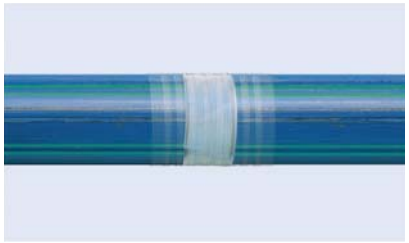


Fig7-42: Do not put any strain on the pipeline until the wrapping has fully hardened

As an alternative to Densolid HK7, egeplast offers resin-impregnated glass fibre wrappings. These are activated with water. After soaking in clear water for ca. 10-15 sec, the wrapping is wound around the area to be insulated. In doing so, care should be taken that this area is fully wrapped, and that it is wrapped until it is flush with the protective coating. The wrappings are obtainable in widths between 2.5 cm and 12.5 cm, according to the exposed area to be covered. The finished area is bound liberally with adhesive tape afterwards for a more even hardening of the wrapping.
No strain should be put on the pipeline until the wrapping has fully hardened. The manufacturer's instructions are to be followed in doing so.

The continuously flush external surface required for pipe strings intended for use in trenchless installation procedures is guaranteed by the covering process described above.

Screw-clamp joints

egeplast SLA® Barrier Pipes can be joined using clamp connectors made of plastic or metal. Clamp connectors made of plastic must conform to DIN 8076 Part 3; those made of metal must conform to DIN 8076 Part 1 or 2.

The pipe end must be flared when using clamp joints with support bushings. This is usually accomplished by driving in the support bushings.

When assembling clamp joints, the pipe end should be chamfered on the inside without notching.

Flanged joints

The following types of design are commonly used for making flanged joints (see DIN 16963 Parts 4 and 8):

- Stub end for electrofusion welding
- Stub end for butt fusion welding

The axes of the pipeline sections to be joined must be aligned when making flange joints. The bolts should be tightened evenly in a crosswise sequence. Lapped flanges should be used with steel inserts.


kiwa

Certificate

Product Certificate

egeplast SLA piping systems for the transport of drinking water

egeplast Werner Strumann GmbH & Co. KG

Fig 7-43: Kiwa certificate

Diffusion proof clamped joints

Worthy of special mention is the brass egeplast SLA® Barrier Pipe coupling from CONVAL.

The proof against diffusion of the joint has been authenticated in testing at the KIWA institute with test number BRL-K-534/01 and the attestation no. K5156/95.

Mounting onto the egeplast SLA® Barrier Pipe is carried out using suitably matched hydraulic pressing tools.

Fig 7-44: Coupling with ferrule

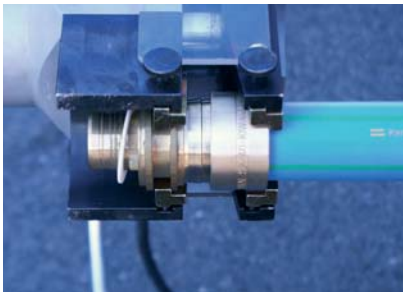


Fig 7-45: Pressing on using press tool type B

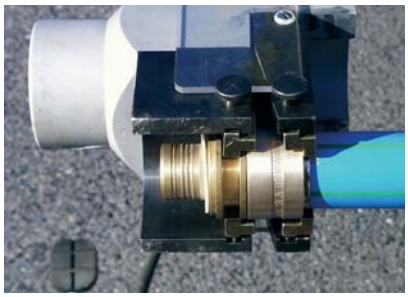


Fig 7-46: Pressing on using press tool type B

Fig 7-47: SLA® Barrier Pipe brass coupling

Welding of tapping fittings

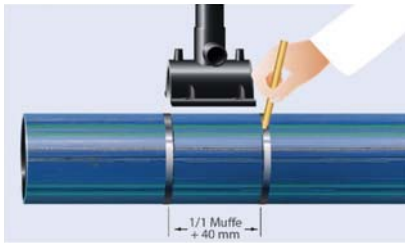


Fig 7-48: Marking the area from which the coating is to be peeled

Fig 7-49: Removal of the protective coating with the egeplast M10 peeling tool or with the egeplast coating cutter

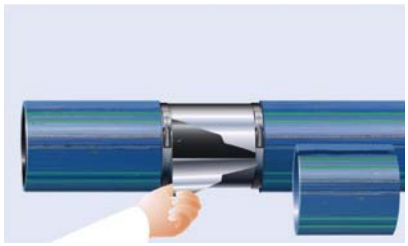


Fig 7-50: Removal of the aluminium coating with the help of a hose clip

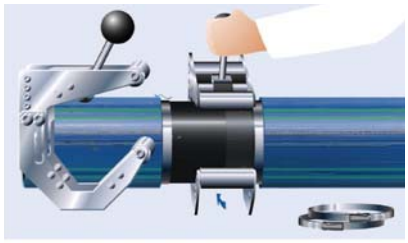


Fig 7-51: Removal of the oxide layer using a suitable scraping tool

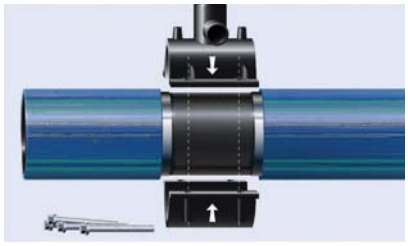


Fig 7-52: Attaching the tapping fitting

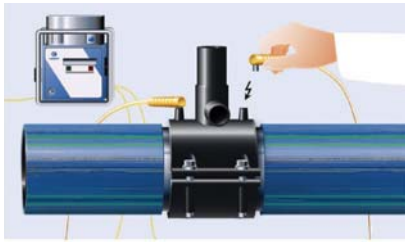


Fig 7-53: Welding in accordance with DVS 2207, Part 1

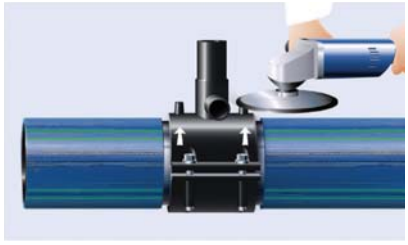


Fig 7-54: Removing the projecting wrap connectors with a suitable tool

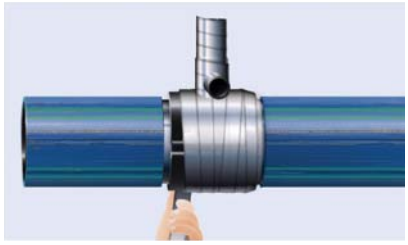


Fig 7-55: Wrapping the tapping fitting with aluminium adhesive tape

Fig 7-56: Wrapping the tapping fitting with Densolen Tape AS 40

Fig 7-57: Tapping fitting protected with Densolen Tape AS 40

There are, in general, two methods of mounting tapping fittings:

- Mounting of tapping valves with drill hole sealing bushes, System EWE for drinking water. These seal in the tapping hole and can therefore be used for pipes with multiple-layer protective coatings.
- Mounting of welded tapping fittings

Mounting of welded tapping fittings

When mounting welded tapping fittings, both the protective coating and the aluminium coating on the relevant length of pipe must be removed. We recommend the use of the egeplast coating cutter or the M10 peeling tool for this purpose. For OD above 160 mm, egeplast recommends the combined use both devices.

A starting point must first be formed when using the M10 coat peeling tool. This can be done e.g. using a standard file. Great care should be taken to only file a hole in the coating and not the damage the core pipe. It is then possible, beginning from the prepared starting point, to cut back a section for the tapping fitting using the peeling tools. Removal of the aluminium coating can be simplified by using, for example, a hose clip.

Welding of the tapping fitting is to be carried out in accordance with DVS 2207, Part 1 and the technical guidelines given by the manufacturer of the welded fitting.

After removal of the projecting wrap connectors, the continuity of the aluminium layer must be reconstituted. To do this, aluminium adhesive tape from the Stokvis company (or equivalent) is wrapped around the moulded fitting to cover it three times with an overlap of at least 50%. egeplast recommends using a self-sealing tape (e.g. Densolen Tape AS 40 plus from the Denso company, or equivalent) to protect the aluminium layer.

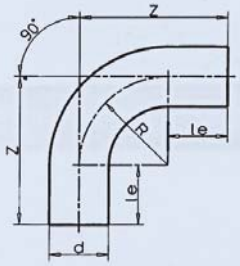
7.5.3 System Techniques

egeplast SLA® Barrier Pipes can be integrated into the pipeline network with all the moulded fittings and joining elements normally used in the trade. The manufacturers' instructions should be followed in doing so.

In order to establish diffusion protection afterwards, the aluminium barrier and mechanical protection must be constructed manually. Moulded fittings with integrated aluminium barrier layer, are also offered as part of the egeplast SLA® Barrier Pipe product range. A selection of available moulded fittings is shown for illustration below:

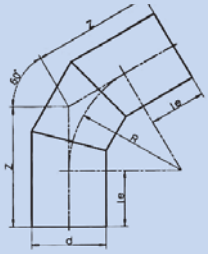
Seamlessly drawn elbow made of PE 100 RC^{plus}

Constructed according to requirements



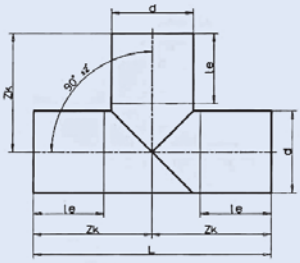
Segmented elbow made of PE 100 RC^{plus}

Constructed according to requirements



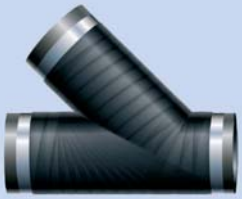
Segmented T-Pieces made of PE 100 RC^{plus}

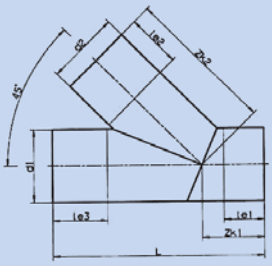
Constructed according to requirements



Branches made of PE 100 RC^{plus}

Constructed according to requirements





7.5.4 Tables

Coating backcut recommended

Before electrofusion welding or butt fusion welding of egeplast SLA® Barrier Pipes can take place, the protective coating must be removed with egeplast coat peeling tools. Coat peeling of the pipe ends can be carried out by egeplast on request. For this we need an indication of the welding procedure to be used.

Coating Backcut for the egeplast SLA® Barrier Pipe				
Medium-Bearing Pipe DIN 8074 OD [mm]	Butt Fusion Welding [mm]	Electrofusion Welding* [mm]	When Using Widos External Bead Removers [mm]	
25	30	70	-	-
32	30	75	-	-
40	30	80	-	-
50	30	85	-	-
63	30	95	-	-
75	30	100	-	-
90	30	110	-	-
110	30	120	35	Size 1
125	30	125	35	Size 1
140	30	130	35 40	Size 1 Size 2
160	30	135	35 40	Size 1 Size 2
180	30	140	40	Size 2 Size 3
300	30	145	40	Size 2 Size 3
225	30	155	40	Size 2 Size 3
250	30	165	40	Size 3
280	30	170	40 50	Size 3 Size 4
315	30	180	40 50	Size 3 Size 4
355	30	185	50	Size 4
400	30	195	50	Size 4
450	30	205	50	Size 4
500	30	215	60	Size 5
560	30	220	60	Size 5
630	30	235	5060	Size 5 Size 8

Long electrofusion couplers are not considered. Preferred equipment sizes for the Widos external bead remover are given

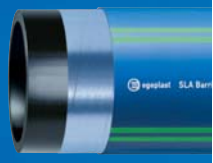
Tab 7-5* Dimensions specified for the product ranges of the Georg Fischer, Friatec, and Plasson companies

Overview of external and medium-bearing pipe diameters for egeplast SLA® Barrier Pipe – inserts for butt welding machines

For welding, the pipe ends are gripped with inserts* which are specially adjusted to the egeplast SLA® Barrier Pipe external diameter so that the pipe ends to be welded can be fixed securely.

Medium-Bearing Pipe DIN 8074 OD [mm]	Outer Diameter of the egeplast SLA® Barrier Pipe with Protective Coating [mm]
25	27.4
32	34.9
40	43.4
50	53.6
63	66.8
75	79.0
90	94.3
110	115.0
125	130.3
140	145.7
160	166.4
180	187.0
200	207.0
225	232.0
250	257.0
280	287.0
315	322.0
355	362.2
400	410.6
450	460.0
500	510.0
560	570.0
630	640.0
710	720.0
800	810.0
900	910.0
1000	1010.0
1200	1210.0
Subject to manufacturing tolerances	

Tab 7-6* Special inserts for WIDOS welding machines are available from egeplast for this purpose



Material requirements for covering with DENSOLID HK7/HK7-W, DENSOLAN ES, and DENSOLEN AS 40 plus

Densolid HK7/HK7-W

For a layer thickness of 3 mm, one dual pack is sufficient for an area of ca. 600 cm^2.
The requirements given are based on a backcut of 30 mm to the protective layer, on both sides, for the egeplast SLA® Barrier Pipes.

Densolan ES fabric tape

The approximate quantity of Densolan ES tape is given for....

...dimensions up to OD 160 mm by

OD 3.2 running metres

...dimensions from OD 180 mm by

OD 6.4 running metres

Densolan ES is supplied as rolls of 15 m in widths of 35 mm and 60 mm.

Densolen AS 40 plus sealing tape

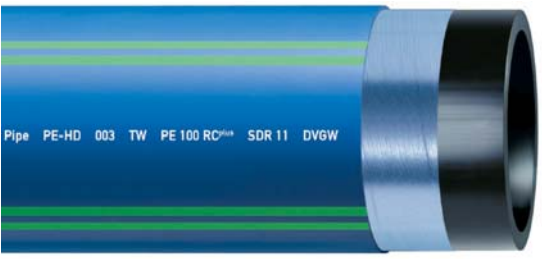
The required quantity of Densolen AS 40 plus is based on a supplied length of 15 m/roll and supplied width of 50 mm. The requirements given assume a backcut of 30 mm to the protective layer, on both sides.

OD [mm]	egeplast SLA® Barrier Pipe Quantity of HK7/HK7-W Units / Weld Seam	egeplast SLA® Barrier Pipe Quantity of Densolan ES Tape Metres / Weld Seam	egeplast SLA® Barrier Pipe Quantity of Densolen AS 40 plus Tape Metres / Weld Seam
25	0.25	-	1.0
32	0.25	-	1.0
40	0.25	-	1.5
50	0.25	-	1.5
63	0.25	-	2.0
75	0.35	-	2.0
90	0.50	-	2.5
110	1.00	0.40	3.0
125	1.00	0.40	4.0
140	1.00	0.50	4.0
160	2.00	0.60	4.5
180	2.00	1.20	5.0
200	2.00	1.40	6.0
225	2.00	1.60	6.0
250	4.00	1.60	7.5
280	4.00	1.80	7.5
315	4.00	2.10	10.0
355	4.00	2.30	10.0
400	5.00	2.60	15.0
450	5.00	2.90	15.0
500	5.00	3.20	15.0
560	5.00	3.60	15.0
630	7.00	4.10	30.0
710	7.00	4.60	30.0
800	9.00	5.20	30.0
900	9.00	5.80	30.0
1000	10.00	6.40	30.0
1200	12.00	7.70	30.0

Tab 7-7

7.6 RFP Forms

7.6.1 RFP Form for egeplast SLA® Barrier Pipes for Drinking Water



Preliminary note:
Drinking water pressure pipe in accordance with DIN 8074/8075, DIN EN 12201, made of PE 100 RC^{plus} with the highest resistance to slow crack growth (FNCT minimum requirement: ≥ 8760 h in accordance with DVS 2203-4; T=80° C, σ=4 $\frac{N}{mm^2}$, 2% Arkopal), pipe colour black. Verified in accordance with both DIN 8075 and DVGW GW 335 Part A2, with an additional, continuously extruded protective coating made of mineral-reinforced signal blue polypropylene akin to RAL 5005, with 4 green double stripes akin to RAL 6018, in accordance with the recommendations of DVGW Worksheets GW 321 and GW 323. A metallic permeation barrier is an integral part of the system.
Monitoring of constant material quality as well as regular structural testing is carried out by an independent testing institute which is accredited according to DIN EN ISO/IEC 17025 to perform such analyses.
The suitability of the product for installation without a sand bed, and for trenchless installation, is verified by an independent assessor.
All necessary pipeline joints created by means of either electrofusion welding or butt fusion welding are to be made according to the requirements of the applicable DVS technical guidelines. The pipeline junctions are to be completed according to the pipe manufacturer's current technical installation instructions. The piping is to be stored and transported on the building site in compliance with the KRV guidelines.

Product:

egeplast SLA® Barrier Pipes for Drinking Water
made of PE 100 RC^{plus} or equivalent

Manufacturer:

egeplast Werner Strumann GmbH & Co. KG
Robert-Bosch-Str. 7 48268 Greven, Germany
Tel.: +49.2575.9710-0 Fax: +49.2575.9710-110
e-mail: info@egeplast.de http://www.egeplast.de

Specification of services:

egeplast SLA® Barrier Pipes for Drinking Water
made of PE 100 RC^{plus} with dimensions:

_____mm, SDR_____

O delivered as straight lengths of 6 / 12 m

O delivered as bundled coils in lengths of _____m

Deliver _____running metres and install professionally according to DIN and appropriate installation guidelines as drinking water pipe: _____€ / running metre

7.7 Recycling and Environmental Protection

Fig 7-58

KRV
Kunststoffrohrverband e.V.

Fig 7-59: Recycling box

Polyethylene is an organic material and consists only of carbon and hydrogen. It has a wholly neutral impact on the environment. PE, being a thermoplastic, can be remelted an almost unlimited number of times and processed into new products. Pipe off-cuts and discarded plastic pipe material, which, for example, accumulate during the installation of plastic pipe systems, should therefore be recycled if at all possible.

At the start of 1994, the Kunststoffrohrverband (KRV), together with the Gütegemeinschaft Kunststoffrohre (GKR), had already introduced a national collection and recycling system for plastic materials, which is free of charge for the trade and its customers and incorporates an obligation to take back these materials. This environmentally conscious system eliminates dumping or incineration together with the high costs which arise from disposal by these methods.

Recycling boxes are provided on a loan basis to the customer as collection containers. The plastic pipe material, at least partially cleaned, is then thrown into these boxes. Once the boxes have been filled, their collection and exchange for empty boxes is arranged. Only boxes which are filled exclusively with plastic pipe material are taken. The recycling boxes are then brought, via regional collection points, to a recycling plant in which the collected pipe material is sorted, cleaned, and cut into small pieces to be employed subsequently for other uses.

7 Protecting Drinking Water in contaminated Soil

egeplast **SLA®** Barrier Pipe