BRL 5219
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Assessment Directive

For the KOMO®-(technical-approval-with-) product certificate for ‘Plastics piping systems intended for closed geothermal energy systems'

Validated by the BoE Plastics Piping Systems on ..-..-202.

Accepted by the KOMO Quality- and Assessment Committee on ..-..-202.

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Preface

This KOMO® Assessment Directive (BRL) has been drawn up by the Kiwa Board of Experts Leidingsystemen van Kunststof (LSK), in which the relevant parties in the field of plastics piping and fittings are represented. This Board of Experts also supervises the certification activities based on this BRL and where necessary requires this BRL to be revised.

All references to the Board of Experts in this BRL pertain to the above-mentioned Board of Experts.

This BRL will be used by certification bodies who have a license agreement with the KOMO® Foundation in connection with the established certification procedures. This BRL details the requirements an applicant or an existing holder of a KOMO® certificate shall comply with, and the method employed by the evaluating certification body. The certification procedure established by the certification body includes a description of the working method as employed by the certification body in the implementation of:

- (pre)certification tests required for granting and renewing a KOMO® product certificate based on the present BRL;
- periodic assessments for the maintenance of a previously issued product certificate based on the present BRL.

In the BRL the following changes have been made:

- In accordance with BRL SIKB 11000 and Protocol 11001 the:
  - various terms have been harmonised i.e., “closed geothermal energy systems” instead of “geothermal heat exchange in closed circuits” and “soil heat exchanger” instead of “geothermal probe”;
  - mechanical connections and metal couplings are no longer applicable.
- A classification has been introduced for the flow resistance at the foot of the soil heat exchanger.
- Deletion of Annex B for the determination of the density of connections after freezing.
- Addition of Annex D which contains an overview of approved heat transfer agents that can be used without additional chemical resistance tests.

NOTE: THIS IS AN ENGLISH TRANSLATION OF THE DUTCH VERSION OF THIS ASSESSMENT DIRECTIVE. IN CASE OF A DISPUTE, THE DUTCH VERSION SHALL BE BINDING.

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1. Introduction, general provisions and general requirements

1.1 Introduction

Based on the prerequisites specified in this KOMO® BRL, a KOMO® (technical-approval-with-)product certificate is issued for the plastic piping systems intended for closed geothermal energy systems. This (technical-approval-with-) product certificate enables the certificate holder to establish that an independent authorized certification body supervises the certificate holder's production and quality control processes and the quality of the product produced under certificate. Therefore, it may be assumed that the product has the characteristics as established in this BRL.

Certification bodies that have been accredited for this product scope by the Dutch Accreditation Council (or have applied for such accreditation) and have a license agreement with the KOMO® Foundation shall use the requirements of this BRL for processing an initial application and for the further maintenance of a KOMO® KOMO® technical-approval-with- product certificate for plastic piping systems intended for closed geothermal energy systems.

In addition to the requirements of this BRL, certification bodies impose additional requirements concerning the general certification procedure detailed in their Regulations for Product Certification.

1.2 Scope and field of application

1.2.1 Scope

The scope of certification in this assessment directive are vertical and horizontal geothermal energy systems made of plastic, in which the pipe systems form closed circuits with supply and returnpipes that together form part of the said vertical and horizontal geothermal energy systems. It concerns systems up to the connection with the distribution manifold. The distribution manifolds are not part of this assessment directive. A further explanation about these systems is given in Annex C.

1.2.2 Field of application

The products are intended to be used in vertical or horizontal geothermal energy systems made of plastic piping. These systems are divided into 2 different classes:

- Class "cold" (PE);
- Class "cold and hot" (PE-X, PB en PE-RT type II).

See also Table 1a and Table 1b.

For class "cold" a design pressure (= maximum working pressure) of at least 1.6 MPa (16 bar overpressure) or higher with an MRS of at least 10 N/mm^2 in accordance with NEN-EN 12201 (PE).

For class "cold and hot" a design pressure (= maximum working pressure) of at least 0.8 MPa (8 bar overpressure) is in used in accordance with the standards NEN-EN-ISO 15875 (PE-X), NEN-EN-ISO 15876 (PB) and NEN-EN-ISO 22391 (PE-RT type II).

The piping systems are suitable for the transport of monopropylene glycol /water mixtures. Other liquids can also be used in accordance with § 4.2.

The certified geothermal piping system has a life expectancy of at least 50 years.

Table 1a Classification of vertical and horizontal systems

Class	Material	Lifetime Expectancy	Temperature profile *1)	Maximum Depth
Cold	PE100 *3)	50 years	from -20 ºC to 40 ºC T=20 ºC with design coefficient C=1,25 for 50 years	200 m *2)
	PE-X PB PE-RT Type II	50 years	from -20 ºC to 40 ºC T_{design} = 40 ºC with design coefficient C = 1,5 for 50 years	200 m *2)
Cold and Hot	PE-X PB PE-RT Type II	50 years	from -20 ºC to 70 ºC T_{design} = 70 ºC1) with design coefficient C = 1,5 for 50 years	200 m *2)

1) The relation of temperature and design pressure can be found in table 7, 8 and 9.
2) Larger depths are possible if the maximum pressure is not exceeded or soil heat exchangers for higher pressure levels are used. The maximum pressure, i.e. the differential

pressure between inner and outer pressure and vice versa, has to be observed during installation and grouting of the soil heat exchangers.

3) At this moment the requirements for PE 100 RC are under development. Therefore, marking with “RC” is for Guideline BRL 5219 not (yet) possible. Any “RC” in the marking in combination with the KOMO marking is not allowed on the pipe.

Table 1b Classification nominal pressure for systems of PE-X, PB and PE-RT type II for class cold and hot

	Pd [bar]					
	PE-X		PB		PE-RT type II	
S- value 1)	Class cold 40 ºC	Class hot 70 ºC	Class cold 40 ºC	Class hot 70 ºC	Class cold 40 ºC	Class hot 70 ºC
5	8	-	15	10	10	-
4	10	8	-	-	-	8

1) a S-value of at least S5 for class cold and hot can be used if the system working pressure in an object is lower than the calculated design pressure Pd, see table 7, 8 and 9.

The certification is for the geothermal piping system including the connection(s) on the distribution manifolds. The distribution manifold itself is not a part of this BRL.

All the piping, including supply and return pipes, are underground.

The geothermal piping systems are suitable to be applied as part of a closed geothermal energy system as described in BRL SIKB 11000.

1.3 Validity

This BRL replaces the version of 15 October 2021.

The KOMO® certificates issued on the basis of that version of the BRL lose their validity after six months of publication of this BRL.

Based on the abovementioned previous version of this BRL new (technical-approval-with-)product certificates may be issued up to three months before the current (technical-approval-with-)product certificates must be replaced.

The validity of the KOMO (technical-approval-with-)product certificate is unlimited. The validity may be limited (terminated), among other reasons, because of:

- A modification of this BRL,
- Failure of the certificate holder to comply with his obligations.

1.4 Relation with Legislation and Rules and Regulation

1.4.1 European Regulation construction products (CPR, EU 305/2011)

There are no harmonized European standards applicable to the products referred to in this BRL.

1.4.2 Soil Quality Directive (Besluit Bodemkwaliteit)

The Soil Quality Directive (Besluit Bodemkwaliteit) is not applicable to the products referred to in this BRL.

1.5 Requirements to conformity reviewing institutes

With regard to the requirements laid down in this BRL, the applicant may submit, in the scope of external inspections, reports issued by conformity assessing institutions to prove that the requirements of this BRL are being satisfied. It shall be demonstrated that the inspection/analysis/test and/or evaluation reports have been drawn up by a body that complies with the respective applicable accreditation standard with regard to the subject matter i.e.:

- NEN-EN-ISO/IEC 17020 for inspection bodies;
- NEN-EN ISO/IEC 17021-1 for certification bodies certifying management systems;
- NEN-EN-ISO/IEC 17025 for laboratories;
- NEN-EN-ISO/IEC 17065 for certification bodies certifying products, processes and services.

An organization will be considered as compliant with these criteria if an accreditation certificate for the respective subject matter can be submitted, issued by the Board of Accreditation (RvA) or another

accreditation organization which has been accepted as a member of a multilateral agreement on the subject of mutual recognition and acceptance of accreditation, which have been drawn up within the EA, IAF and ILAC. If no accreditation certificate can be submitted, the certification body itself will assess if compliance is given to the accreditation.

1.6 KOMO® (technical-approval-with-)product certificate

Based on this BRL the following can be issued:

- KOMO® technical-approval-with-product certificates and
- KOMO® product certificates.

A technical-approval-with-product certificates can be issued for the following systems:

- Closed geothermal piping systems in accordance with chapter 3 and 4 in which the soil heat exchanger and horizontal supply and return pipes and other fittings have been assessed in their combination and as a unique system.

Product certificates can be issued for the following types of products:

- Pipes for soil heat exchangers and the horizontal supply and return pipes according to chapter 3 and § 5.1 and § 5.2;
- Feet and fittings for soil heat exchangers according to chapter 3 and § 5.1 and § 5.3.

The (technical-approval-with-) product certificate to be issued is to be in accordance with the product certificate template published for this version of the BRL on the KOMO® website (www.komo.nl).

1.7 Marking and identifications

The products and the packaging shall be indelibly and clearly marked.

Pipes for soil heat exchangers and horizontal supply and return pipes

The pipes of the soil heat exchangers and the horizontal supply and return pipes shall be marked at a mutual distance of no more than 2 metres as follows:

- KOMO® word mark;
- Name of the certificate holder, factory name, trade name or company logo;
- System name;
- Class Cold and / or Class Hot;
- Pipe material: “PE100“, "PE-X"; “PB” or “PE-RT-II”;
- Operating pressure: xx bar;
- SDR or S Class;
- Maximum temperature: 40 °C or 70 °C;
- Nominal outside diameter(s) of the pipe(s) in mm and wall thickness;
- Production code or production date;
- The tube for the soil heat exchanger must have a depth indication per metre. The value at the foot of the soil heat exchanger must be registered and counts as the zero point;
- If desired, the KOMO® logo may also be applied to the products.

Auxiliary parts and fittings for soil heat exchangers

The auxiliary parts and fittings shall be marked as follows:

- KOMO® word mark or KOMO® logo (if not possible the KOMO® word mark or KOMO® logo shall be affixed only on the smallest packaging);
- Name of the certificate holder, factory name, trade name or company logo;
- The nominal outside diameter of the corresponding pipe;
- The production code or production date.

The smallest packaging of the auxiliary parts and fittings are to be provided with at least the following information:

- KOMO® word mark or KOMO® logo;
- Name of the certificate holder, Factory name, trade name or company logo;
- The nominal outside diameter(s) of the corresponding pipe(s);
- The production code or production date.

The execution of the KOMO® logo is as follows:

The execution of the KOMO® word mark is as follows:

KOMO®

After issuance of the KOMO® (technical-approval-with-) product certificate the KOMO® logo may also be used by the certificate holder in his external communication with regard to the certified activities as stipulated in the “Rules and Regulations for the use of the KOMO® marks” as is published on the KOMO® website. The KOMO® mark with the certificate number may also be used on the delivery documents.

2. Terminology

For an explanation of the terminology used for certification in this assessment guideline, see the glossary on the website of the KOMO® Foundation (www.komo.nl).

2.1 Definitions

General definitions

- **Auxiliary parts:** Also called Y-pieces, which provide the connection between the soil heat exchanger and the horizontal pipework (supply and return pipes).
- **Butt weld fittings:** Fittings where the connection is made by means of a butt weld. These fittings have spigot-ends that can be welded with both electrofusion and butt welding fittings. The spigot end must be of sufficient length to allow butt welding.
- **Closed geothermal piping system:** The total of geothermal heat exchanger including any weight, horizontal pipework and joints until the connection to the manifold.
- **Dimension groups:** Two dimensions groups are distinguished in this BRL:

  Group 1: 12 mm $\leq$ dn $\leq$ 63 mm

  Group 2: 75 mm $\leq$ dn $\leq$ 250 mm
- **Distance holders:** Parts that ensures that a sufficient distance is maintained between the supply and return pipes of the soil heat exchanger.
- **Electrofusion fittings:** Fittings by which the connection is made by means of an electrofusion weld. The fittings ar provided with an integral heating element by which electrical energy is transformed into heat in order to realise a fusion joint. The following types of electrofusion fittings are included in this definition T-piece, bends and reducers. So-called electrofusion socket fittings also fall under this definition.
- **Fittings**: Connecting parts other than the foot, such as e.g. elbows and electrofusion fittings, butt welding fittings or socket welding fittings.
- **Flexible piping system:** A piping system where any bends in the piping can be made without mechanical aids such that the pipe is not deformed or the flow capacity is not reduced by any bends.
- **Prefab:** The manufacturing of products or combinations of products in conditioned, controlled conditions, such that the products meet the requirements of this guideline.
- **Product requirements:** Requirements specified in dimensions or numbers that focus on the (identifiable) properties of products and that contain a limit value to be achieved that can be calculated or measured unambiguously.
- **Socket fusion fittings:** Fittings where the connection is made by fusing the outer layer of the pipe and medium layer of the fitting. The melting of the material is made possible by a heating element that is brought into contact with the material to be melted for a certain time: socket-shaped for the tube and wedge-shaped for the fitting. The material is first melted, after which the pipe and fitting are pressed together until the desired joint is obtained.
- **Soil heat exchanger:** Part of the closed geothermal energy system that consists of the foot of the geothermal heat exchanger and the supply and return pipes.
- **Supplier:** The party responsible for ensuring that the design of products continuously fulfils the requirements of this BRL.
- **Weight of the base (foot) of the soil heat exchanger:** The weight that can be placed at the base (foot) of the soil heat exchanger to facilitate the introduction of the heat exchanger into the borehole (see § 5.1).

Geometrical terminology and definitions

- **Calculated pipe value (S_{calc}):** Value for a specific pipe calculated according to the following equation, rounded up to the nearest 0,1 mm.

  $$S_{calc} = \frac{d_n - e_n}{2 \times e_n}$$

  In which:

  d_n = the nominal outside diameter in millimetres;

  e_n = the nominal wall thickness expressed in millimetres.

- **Inside diameter (at any point) (d_i):** Measured inside diameter at any point, rounded up to the nearest 0,1 mm.
- **Maximum mean outside diameter ($d_{em,\ max}$):** Maximum value for the mean outside diameter as specified for a given nominal size.
- **Maximum wall thickness (e_{max}):** Maximum wall thickness around the circumference.
- **Mean outside diameter (d_{em}):** Measured outside diameter through its cross section at any point of a pipe or spigot end of a fitting in any cross section divided by π (=3,142), rounded up to the nearest 0,1 mm.
- **Minimum mean outside diameter ($d_{em,\ min}$):** Minimum value for the mean outside diameter as specified for a given nominal size.
- **Minimum wall thickness (e_{min}):** Minimum wall thickness around the circumference.
- **Nominal outside diameter (d_n):** Specified outside diameter, in millimetres, assigned to a nomial size DN/OD.
- **Nominal size (DN):** Numerical designation of the size of a component, which is a convenient round number, approximately equal to the manufacturing dimensions in millimetres (mm).
- **Nominal wall thickness (e_n):** Numerical designation of the wall thickness of a component, approximately equal to the manufacturing dimension in millimetres (mm).
- **Outside diameter (at any point) (d_e):** Measured outside diameter through its cross section at any point of a pipe or a fitting, rounded up to the nearest 0,1 mm.
- **Out-of-roundness (ovality):** Difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe or spigot end of a fitting, or the difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross-sectional plane of a socket.
- **Pipe series (S):** Dimensionless number for pipe designation conforming to NEN-ISO 4065.
- **Standard Dimension Ratio (SDR):** Ratio of the nominal outside diameter, d_n, of a pipe to its nominal wall thickness, e_n.

  NOTE In accordance with NEN-ISO 4065, the standard dimension ratio SDR and the pipe series S are related as SDR = 2 S+1.
- **Tolerance:** Permitted variation of the specified value of a parameter, expressed as the difference between the permitted maximum and the permitted minimum value.
- **Wall thickness (at any point) (e):** Measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm.

Terminology and definitions related to service conditions

- **Design pressure (p_D):** The maximum allowable pressure in the piping system that may occur during 50 years of continuous use.
- **Hydrostatic tension σ:** Stress in the circumferences direction of the pipe wall caused by internal water pressure. This stress is deduced from the internal pressure according to the following formula:

  $$\sigma = p \times \frac{(d_{em} - e_{\min})}{20 \times e_{\min}}$$

  In which:

  σ = the stress in the circumference direction of the pipe wall in MPa

  p = the internal pressure in bar;

  d_{em} = the mean outside diameter of the pipe in mm;

  e_{min} = de minimum wall thickness of the pipe in mm.
- **Lifetime:** The time during which the piping system has to function with a certain operating temperature.
- **LPL:** The lower confidence level. A statistical unit representing the point above which 97,5 % of all values are found.
- **Minimum required strength (MRS) (depending on the material):** Value of σ_{LPL} at 20 C and 50 years, rounded down to the next lower value of the R10 series when σ_{LPL} is below 10 MPa, or to the next lower value of the R20 series when σ_{LPL} is 10 MPa or greater. Note: R10 and R20 series are the Reynard number series conforming ISO 497

- **Overall service (design) coefficient (C):** Overall coefficient with a value greater than or equal to 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit, LPL.
- **Reference line:** By a group of experts determined minimum long-term strength hoopstress for a specific material. The refference lines are paralel to the s_{LTHS} for a specific temperature At least 97,5% of the individual measured values must be on or above the refference line.
- **σ_{LPL}:** An unit expressed in wall stress, that represents the value of the 97,5% lower confidence level of the predicted stress for a single value at a temperature T and a time t.
- **s_{LTHS}:** An unit expressed in wall stress, that represents the value of 50% lower confidence interval of the predicted stress for a single value at a temperature T and a time t.

2.2 Symbols

C	service (design) coefficient
d_e	outside diameter (at any point)
d_{em}	mean outside diameter
$d_{em,min}$	minimum mean outside diameter
$d_{em,max}$	maximum mean outside diameter
d_n	nominal diameter
e	wall thickness at any point
e_{max}	maximum wall thickness at any point
e_{min}	minimum wall thickness at any point
e_n	nominal wall thickness
p	pressure
p_D	design pressure
S_{calc}	calculated S-value
T	temperature
t	time
σ	hydrostatic stress
σ_{cold}	design stress at 20 °C
σ_D	design stress
σ_{DF}	design stress of the plastics fitting material
σ_{DP}	design stress of the plastics pipe material
σ_F	hydrostatic stress value of the plastics fitting material
σ_P	hydrostatic stress value of the plastics pipe material
σ_{LPL}	lower confidence interval of the long-term strength

2.3 Abbreviations

CI	Certification Institute
CPR	Construction Products Regulation
DN	nominal size
DN/OD	nominal size related to outside diameter
IQC	Internal Quality Control
MFR	melt flow rate
MRS	Minimum required strength
PE	Polyethylene
PB	Polybutene
PE-X	Crosslinked polyethylene
PE-RT Type II	Polyethylene raised temperature type II
S	S-value

3. Requirements for raw materials and the design of the geothermal energy systems

3.1 General

The raw materials and additives used in the production shall comply with the requirements of § 3.1.1:

The raw materials and additives to be used for the closed geothermal energy system shall be specified by the supplier in a technical specification (see § 3.2). The conformity of the raw materials and auxiliary materials used with the requirements set is determined by the CI.

Any intended change in the aforementioned parameters is reported to the CI. The CI shall assess whether the change can affect the certified performance(s), whereby a reassessment of the relevant performance(s) may be required.

3.1.1 PE, PE-X, PB and PE-RT type II raw materials

To the materials mentioned above only anti-oxidants and UV-stabilizers may be added in those quantities necessary for the manufacture and application of the pipes and auxiliary parts. Pigments may be added to achieve the desired colour. The added substances shall be equally dispersed in the raw material.

The PE, PE-X, PB and PE-RT type II raw materials to be used shall demonstrably meet the following standards:

- For PE: NEN-EN 12201, part 1;
- For PE-X: NEN-EN-ISO 15875, part 2, § 4;
- For PB: NEN-EN-ISO 5876, part 2, § 4;
- For PE-RT type II: NEN-EN-ISO 22391, part 2, § 4.

This can be demonstrated by submitting test reports issued by NEN-EN ISO/IEC 17025 accredited test laboratories. Test reports from the raw material supplier can also be accepted at the discretion of the CI.

Note: Co-extruded tubes are not eligible for reprocessing.

For the production of the pipes, the supplier is allowed to use clean and unused, but previously processed material, provided that the material to be reprocessed comes from its own pipe production.

The supplier shall demonstrate that the properties of the pipes manufactured from reprocessed material meet the requirements of this BRL.

The supplier shall record the use of reprocessed material in such a way that the traceability of the pipes can be identifiable by the CI.

Note: Co-extruded pipes are not allowed to be reprocessed.

3.2 Design of the closed geothermal energy system

In addition to recording the raw materials to be used (see § 3.1), the design contains a specification of the relevant diameters with the associated wall thicknesses of the pipes for geothermal energy systems and horizontal supply and return pipes and records of the geometrical characteristics including flow profiles of the feet and auxiliary parts used.

The conformity of the design to the requirements is determined by the CI.

3.3 Processing instructions

The raw materials, additives and semi-finished products to be used must be processed in accordance with to the corresponding written procedures and/or application conditions.

4. Requirements imposed on the performances in the application

This chapter contains the requirements as well as the methods for determining the performance pertaining to geothermal energy systems.

In case that a specific property or specification is applicable to the technical-approval-with- product certificate, it will be stated as such in the relevant section.

4.1 General

The closed geothermal energy system shall be designed for the specified nominal pressure and temperature for a life expectancy of at least 50 years in accordance with the requirements of § 4.2 and § 4.3.

A specification of the nominal pressure and temperature profile and the components to be used in the system is included in the KOMO® attest-with-product certificate.

The nominal pressure and the temperature profile and the parts to be used for the complete system shall be specified in the KOMO® technical-approval-with-product certificate.

4.2 Resistance to permeation

There shall no permeation of hazardous materials i.e. the heat transport medium through the pipe wall to the soil. In addition, the heat transport medium shall not have a detrimental effect on the mechanical properties of the piping system. If a medium in accordance with Annex D is used no additional testing is required.

In case the supplier uses other fluids than those listed in Annex D then the suitability is to be demonstrated by the supplier. In this case, permeation and chemical resistance testing can be necessary. Determination of the resistance to permeation is in accordance with annex A. For determining the chemical resistance, use can be made of known chemical resistance lists or by carrying out chemical resistance tests For these fluids a maximum absorption of 1% is allowable. The conformity of these other liquids shall be determined by the CI.

A specification of the heat transport media to be used shall be included in the KOMO® technical-approval-with-product certificate.

4.3 Requirements and test methods for the joints

4.3.1 General

For the connections in the closed geothermal energy system: only prefabricated and permanent or welded fittings are allowed, with at least the same SDR value as the pipe of the geothermal heat exchanger. Butt weld connections are permitted as well.

For the horizontal supply and return pipes: (between the soil heat exchanger and the manifold) the following is applicable:

- When the joint is inaccessible, only permanent, welded fittings and butt fusion welds are allowed;
- When the joint is accessible and can be serviced: replaceable fittings can be used.

A specification of the jointing techniques shall be included in the KOMO® technical-approval-with-product certificate.

4.3.2 Welding methods

In case of the use of welded joints, the methods in Table 2 shall apply.

Table 2 Welding methods

Pipes	Fitting	Jointing method	Welding according to [1)]
PE 100	PE 100	BW, EF, SW	DVS 2207-1
PE 100	PE-RT Type II	BW, EF, SW	DVS 2207-1
PE-RT Type II	PE 100, PE-RT Type II	BW, EF, SW	DVS 2207-1
PE-X	PE100	EF	DVS 2207-1
PB	PB	EF, SW	DVGW-W534
PE-RT Type II	PE-RT Type II	BW, EF, SW	DVS 2207-1

1) For PE butt welding NEN 7200 can also be applied.

BW = Butt welded joint

EF = Electro fusion joint

SW = Socket welded joint

4.3.3 Connections for systems of PE (class cold)

The connections for systems of PE shall comply with the requirements and test methods of NEN-EN 12201-5.

4.3.4 Connections for systems of PE-X (class cold and hot)

The connections for systems of PE-X shall comply with the requirements and test methods of NEN-EN-ISO 15875-5. For welded connections (electro weld, bottom weld and socket weld) only the joint tests “Resistance to thermal cycling” and “Resistance to internal hydrostatic pressure” are applicable. For the “Leak tightness under internal pressure for 1.000 h 95 °C” the values of Table 3shall apply.

Table 3 Test pressure leak tightness under internal pressure (1.000 h / 95 °C)

Type pipe and class	Test pressure Pd (bar)	
	Pd = 8 bar	Pd = 10 bar
PE-X class cold	7,1	8,8
PE-X class cold and hot	9,9	12,4

4.3.5 Connections for systems of PB (class cold and hot)

The connections for systems of PB shall comply with the requirements and test methods of NEN-EN-ISO 15875-5.For welded connections (electro weld, bottom weld and socket weld) only the joint tests “Resistance to thermal cycling” and “Resistance to internal hydrostatic pressure” are applicable. For the “Leak tightness under internal pressure for 1.000 h 95 °C” the values of Table 4 shall apply.

Table 4 Test pressure leak tightness under internal pressure (1.000 h / 95 °C)

Type pipe and class	Test pressure Pd (bar)		
	Pd=8 bar	Pd=10 bar	Pd=15 bar
PB class cold	6,2	7,8	11,7
PB class cold and hot	9,5	11,8	17,8

4.3.6 Connections for systems of PE-RT Type II (class cold and hot)

The connections for systems of PE-RT Type II shall comply with the requirements and test methods of NEN-EN-ISO 22391-5.

For welded connections (electro weld, bottom weld and socket weld) only the joint tests “Resistance to thermal cycling” and “Resistance to internal hydrostatic pressure” are applicable. For the “Leak tightness under internal pressure for 1.000 h 95 °C” the values of Table 5 shall apply.

Table 5Test pressure leak tightness under internal pressure (1.000 h / 95 °C)

Type pipe and class	Test pressure Pd (bar)	
	Pd = 8 bar	Pd = 10 bar
PE-RT type II class cold	5,7	7,1
PE-RT type II class cold and hot	8,5	10,6

4.3.7 Additional requirement for the connection of the foot and the pipes of the soil heat exchanger

In addition to the requirements mentioned above, for the base of the soil heat exchanger the “leak tightness under internal pressure test – 1.000 hours”- as stated in the parts 5 of NEN-EN 12201, NEN-EN-ISO 15875, NEN-EN-ISO 15876 and NEN-EN-ISO 22391 – is to be performed together with the soil heat exchanger to be certified.

4.4 Installation instructions

The supplier shall provide installation instructions in the Dutch language. A reference to these instructions shall be made on or in the packaging or included in the packaging. The instructions shall contain specific information regarding storage, safety, transport, processing temperature, heat transport medium, construction of the joints and specific installation guidelines and quality aspects that are permitted e.g. scratches. The installation instructions shall includethe measures to be taken to avoid buckling of the piping system. These aspects are checked by the CI. A reference to the installation instructions is made in the KOMO® technical-approval-with-product certificate.

4.5 Initial assessment and periodic assessment

The initial assessment of the geothermal energy system to be certified shall include a full testing to determine whether the requirements of this chapter are being met. The test matrix of § 7.7 (Table 11) details which tests and checks are applicable. This test matrix also details which tests and checks apply for the periodic assessments that are carried out after the attest-with-product certificate has been issued.

5. Product requirements

This chapter defines the product requirements for the individual parts of the geothermal energy system, as well as the test methods and the threshold values applicable.

In case that a specific property or specification is applicable to the product certificate, it will be so stated in the relevant paragraph.

5.1 General

The geothermal pipes and feet as part of the soil heat exchanger, the plastic supply and return pipes and plastic auxiliary parts are produced from PE, PE-X, PB or PE-RT Type II (see § 5.2 and § 5.3).

In case spacers are part of the system, then the relevant information shall be part of the installation instructions.

In case a weight is used when lowering the ground heat exchanger into the drill hole, the supplier shall reasonably demonstrate that the construction of the base is such that the foot does not deform during installation. The specifications of the weight shall be conform the guidelines of the supplier's manual. The construction (technical drawing) of the base is part of the approved system (see § 3.2). The conformity with this requirements is to be determined by the CI.

These products are to be stored and installed in in such a way that they are not exposed to direct sunlight.

A specification of the type(s) of plastic(s) to be used is included in the KOMO® product certificate.

5.2 Requirements and determination methods for the pipes of the soil heat exchangers and supply and return pipes

5.2.1 Pipes of PE (class cold)

The pipes of PE shall comply with the requirements and test methods of NEN-EN 12201-2.

In case the temperature of the heat transport medium or the area where the PE pipes are installed are higher than 20 °C, then the following reduction factors need to be considered in relation to the maximum nominal allowable pressure, see Table 6.

Table 6 Reduction factors for nominal pressure

Material	Reduction factors for the temperatures:		
	20 °C	**30 °C**	**40 °C**
PE 100	1	0,87	0,74

If PE multilayer pipes are used, the different layers need to be co-extruded such that the long term strength is not adversely influenced by this process. Furthermore, the wall thickness of the combined layers shall meet the specified SDR values.

5.2.2 Pipes of PE-X (class cold and hot)

The pipes of PE-X shall comply with the requirements and test methods of NEN-EN-ISO 15875-2.

Also, for determining the minimum wall thicknesses per diameter, the S-values in Table 7 shall be used.

Table 7 Design pressure and operating temperature in combination with the S-value

	S-value	
	Operating temperature	
Pd [bar]	**Class cold 40 ºC**	**Class hot 70 ºC**
8	5	4
10	4	3,2

5.2.3 Pipes of PB (class cold and hot)

The pipes of PB shall comply with the requirements and test methods of NEN-EN-ISO 15875-2.

For determining the minimum wall thicknesses per diameter, the S-value in Table 8 nshall be used.

Table 8 Design pressure and operating temperature in combination with the S-value

	S-value	
	Operating temperature	
Pd [bar]	**Class cold 40 ºC**	**Class hot 70 ºC**
10	-	5
15	5	3,2

5.2.4 Pipes of PE-RT Type II (class cold and hot)

The pipes of PE-RT Type II shall comply with the requirements and test methods of NEN-EN-ISO 22391-2.

For determining the wall thicknesses per diameter, the S-value in Table 9 shall be used.

Table 9 Design pressure and operating temperature in combination with the S-value

	S-value	
	Operating temperature	
Pd [bar]	**Class cold 40 ºC**	**Class hot 70 ºC**
8	-	4
10	5	3,2

5.3 Requirements and test methods for the auxiliary parts and feet of the soil heat exchanger

5.3.1 Flow resistance of the foot

The maximum flow resistance of the foot is 10 mbar at 1 m/s at 20 °C with water for Class 1 and a maximum of 20 mbar at 1 m/s at 20 °C for Class 2 (see Table 10 The testing is according to NEN-EN 1267. The foot shall be tested in combination with the pipes of the geothermal heat exchanger.

Table 10 Classes for the maximum permissible flow resistance

Class	**Maximum permissible flow resistance**
Class 1	≤ 10 mbar
Class 2	≤ 20 mbar

5.3.2 Auxiliary parts and feet of PE (class cold and hot)

The auxiliary parts and feet of PE shall meet the requirements and test methods of NEN-EN 12201-3.

5.3.3 Auxiliary parts and feet of PE-X (class cold and hot)

The auxiliary parts and feet of PE-X shall meet the requirements and test methods of NEN-EN-ISO 15875-3.

5.3.4 Auxiliary parts and feet of PB (class cold and hot)

The auxiliary parts and feet of PB shall meet the requirements and test methods of NEN-EN-ISO 15875-3.

5.3.5 Auxiliary parts and feet of PE-RT Type II (class cold and hot)

The auxiliary parts and feet of PE-RT Type II shall meet the requirements and test methods of NEN-EN-ISO 22391-3.

5.4 Initial assessment and periodic assessments

During the initial assessment It must be established f that the product requirements of this chapter are met by the products to be certified. This is detaild per paragraph in the test matrix of § 7.7 (Table 11). The test matrix also indicates which tests and checks are applicable during the periodic assessments after the product certificate has been issued.

6. Requirements certificate holder and internal quality control

6.1 General

The management of the certificate holder is responsible at all times for the quality of the production process, internal quality control, and the quality of the product. The internal quality control shall meet the requirements laid down in this chapter.

6.2 Internal quality control/quality plan

The certificate holder shall have implemented an internal quality control scheme (IQC-scheme).

This IQC-scheme shall clearly establish:

- Which aspects are subject to inspections carried out by the organization of the certificate holder or an external organisation contracted by them;
- Which methods are employed to carry out these inspections ;
- The frequency of these inspections;
- How these inspection results are recorded and archived.

The IQC-scheme shall at least include the following main groups:

- Control of measure equipment;
- Incoming (material) inspection;
- Process control;
- Product control;
- Internal transport and storage;
- Delivery;
- Procedures for:
  - Handling of complaints;
  - Handling of non-conformities and the follow-up of the corrective actions

This IQC-scheme shall be in accordance with the template in Annex B and detailed in such a way that it provides the CI sufficient confidence that the requirements laid down in this BRL are being continuously met.

6.3 Archiving

The in this assessment directive mentioned documents and registrations shall be archived for a period of at least 7 years or longer in case legally prescribed.

Remark:

In case products are delivered under the Dutch Law “Quality assurance” (Wet Kwaliteitsborging (Wkb), then the mentioned documents and registrations shall be stored for a period of at least 20 years.

7. External conformity assessments

7.1 General

For granting the KOMO® (technical-approval-with-) product certificate the CI shall carry out an initial investigation. After issuing the KOMO® (technical-approval-with-) product certificate the CI shall carry out periodic assessments.

7.2 Initial assessment for the KOMO® technical-approval-with-product certificate

The applicant of the KOMO® technical-approval-with-product certificate indicates which products are to be listed on the technical-approval-with-product certificate to be issued. The applicant provides all relevant information of these products for the purpose of drawing up the product specification and the product properties as they are to be included in the technical-approval-with-product certificate to be issued.

For granting the KOMO® technical-approval-with-product certificate the CI will carry out an initial assessment in the context of which:

- The CI shall initially determine the performance of the system in the application according to chapter 4,
- The CI shall assesses whether the applicant is able to continuously guarantee, by implementing his IQC Scheme, that the products have the properties or deliver the performance as specified in chapters 3 and 5 of this BRL . Assessment of the production process and the final product are part of this initial assessment. The CI evaluates if the operational methods of the internal quality assurance comply with the requirements of chapter 6 of this BRL.

Where applicable, the documents provided by the applicant pertaining to the product and/or the internal quality control and the results stated therein meet the requirements of this BRL

Based on the initial assessment a report is drafted on the basis of which a technical-approval-with-product certificate may or may not be granted.

The test matrix of § 7.7 details which aspects shall be assessed during the initial assessment.

7.3 Initial assessment for the KOMO® product certificate

The applicant for the KOMO® product certificate indicates which products are to be listed on the product certificate to be issued. The applicant provides all relevant information of these products for the purpose of drawing up the product specification and the statement of the product properties as they are to be included in the product certificate to be issued.

For granting the KOMO® product certificate the CI will carry out an initial assessment in the context of which:

- The CI shall assess whether the applicant is able to continuously guarantee, by implementing his IQC Scheme that the products that have the properties or deliver the performance as specified in chapters 3 and 5 of this BRL. Assessment of the production process and the finished product are part of this initial assessment;
- The CI evaluates if the operational methods of the internal quality assurance comply with the requirements of chapter 6 of this BRL.

Where applicable, the documents provided by the applicant pertaining to the product and/or the internal quality control and the results stated therein meet the requirements of this BRL.

Based on the initial assessment a report is drafted on the basis of which a product certificate may or may not be granted.

The test matrix of § 7.7 details which aspects shall be assessed during the initial assessment.

7.4 Nature and frequency of the periodic assessments

After certification the CI shall carry out periodic inspections at the certificate holder in order to verify compliance with their obligations. The Board of Experts decides on the nature, scope and frequency of the periodic assessments to be carried out..

At the time of validation of this BRL this frequency has been set at 4 inspections per year. If the certificate holder and/or manufacturer has a certified NEN-EN-ISO 9001 system, the frequency is set at 2 inspections per year.

The audit program includes the nature and frequency of the periodic inspections. These are related to:

- The product specification detailed in the certificate;
- The production process of the certificate holder;

- The IQC-scheme of the certificate holder;
- The results of the inspections performed by the certificate holder;
- The correct marking of the certified products;
- The compliance with the required procedures.

whereby it is checked whether the requirements of this BRL are being met.

The CI shall verifiably record the findings of each assessment in a report .

The test matrix of § 7.7 details which aspects shall be assessed during the periodic assessments.

7.5 Non-conformities

7.5.1 Weighting of non-conformities

When weighting a non-conformity, in the context of supervision after the (technical-approval-with-) product certificate has been issued by the CI, a distinction is made between:

- Non-conformities which directly could have an impact on the quality of the product (major non-conformity);
- “Other” non-conformities (minor non-conformity).

7.5.2 Follow-up on non-conformities

The follow-up of non-conformities by a CI is as follows: • Critical shortcomings must be handled by the certification body within the term set by the certification body, with a maximum term of 3 months

- Major non-conformities shall have to be resolved within the time frame set by the CI. Amaximum period of 3 months shall apply;
- Minor non-conformities shall have to be resolved within the time frame set by the CI A maximum period of 6 months shall apply.

7.5.3 Sanction procedure

7.6 Temporary production and/ or delivery stop

If no certified products are (temporarily) produced and/or delivered for a period longer than 6 months, the validity of his KOMO® (attest-with-) product certificate can be (temporarily) suspended at the request of the certificate holder. Such a suspension can be granted by the certification body for a maximum period of 3 years, whereby the production site shall be inspected annually but without sampling for the yearly testing.

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After the suspension has been granted, a certificate holder can request that its suspension be terminated earlier. Prior to the resumption of production and supply under product certificate, an additional assessment and sampling for the annual tests must be carried out to determine whether all requirements in this assessment guideline are still met and whether the suspended status can be converted into a valid status.

After the suspension has been granted the certificate holder can request that the suspension be terminated earlier. Prior to the resumption of the production and delivery under product certificate, an additional assessment and sampling for the yearly tests shall be carried out to ensure that all requirements of this BRL are still being met and that the suspended status can be converted into a valid status .

7.7 Summary of tests and inspections (test matrix)

Table 11 contains a summary of the tests and inspections to be carried out in the event of certification.

Table 11 Test matrix

Description of requirement	Paragraph BRL	Test within the scope of			When changing raw material
		Initial tests	Surveillance by CI after issue of the certificate[1)]		
			Inspection[2)]	Frequency	
Requirements for raw materials and the design					
PE, PE-X, PB and PE-RT Type II	3.1.1	X	X	1x year	X
Design of the system	3.2	X	X	1x year	X
Processing instructions	3.3	X	X	1x year	X
Requirements for the performances in the application					
General	4.1	X	X	1x year	X
Permeation	4.2	X	-	-	X
Sealants of rubber	4.3.2	X	X	1x year	X
Welding methods	4.3.2	X	X	1x year	X
Connections for systems of PE, PE-X, PB and PE-RT Type II	4.3.3 t/m 4.3.7	X	X[3)]	1x year	X
Installation instructions	4.4	X	X	1x year	X
Requirements for the product					
General	5.1	X	X	1x year	X
Pipes of PE, PE-X, PB and PE-RT Type II	5.2.1 t/m 5.2.4	X	X[4)]	1x year	X
Flow resistance	5.3.1	X	X	1x year	X
Auxiliary pieces and feet of PE, PE-X, PB and PE-RT Type II	5.3.2 t/m 5.3.5	X	X[5)]	1x year	X
Requirements for the quality system					
Internal Quality Control	6.2	X	X	1x year	X

1) In case the product or production process changes significantly, the performance requirements must be re-assessed.
2) All product properties are evaluated by the site assessor or by the supplier in the presence of the site assessor within the duration of the visit (maximum 1 day). In case this is not possible, an agreement will be made between the certification body and the supplier about how the inspection will take place.
3) The following tests are carried out during the annual inspection: “MFR comparison” for PE, PB and PE-RT, “degree of crosslinking” for PE-X and “resistance to internal pressure (1.000h)”.
4) The following tests are carried out during the annual inspection: “MFR comparison” for PE, PB and PE-RT and “degree of crosslinking” for PE-X.
5) The following test is carried out during the annual inspection: “resistance to internal pressure (1.000h)” (combination of foot and pipe).

7.8 Evaluation of the performance of the product in the application

The performance of the product in the application shall be re-assessed at least once every 5 years. Circumstances such as a design change, raw materials change, etc. can also result in the need for an interim reassessment of the performance(s) of the product in the application. The requirements as stated in chapter 3, 4 and 5 are fully applicable.

In addition, interim assessments can be made in connection with complaints received.

8. Requirements imposed on the certification body

8.1 General

8.2 Certification staff

The certification staff involved can be divided as follows:

- **Certification assessor/ Reviewer:** responsible for carrying out design and documentation assessments, assessment of applications and the review of conformity assessments,
- **Site assessor:** responsible for carrying out the external assessments at the supplier's works;
- **Decision-maker:** responsible for taking decisions based on the initial tests carried out and on the continuation of the certification based on assessments carried out.

8.2.1 Competency criteria for certification staff

The qualifying requirements of the certification staff are as listed in Table 12

The qualification requirements for the certification personnel consist of qualification requirements for the executive certification personnel as laid down in the table below. The competence of the relevant certification personnel must be demonstrably recorded

The competence of the relevant certification personnel shall be demonstrably recorded.

Table 12 Competency criteria for certification staff

Competence	Certification assessor/ Reviewer	Site assessor	Decision-maker
General competence			
• Knowledge of company processes • Competence for professional evaluation	• Higher vocational education level work and intellectual level • 1 year of relevant work experience	• Intermediate vocational education level work and intellectual level • 1 year of relevant work experience	• Higher vocational education level work and intellectual level. • 4 years of relevant work experience of which 1 year in certification
Audit skills	n/a	• Training audit skills • Participation of at least 4 inspection visits of which at least 1x independent inspection under super vision	n/a
Technical competence			
Relevant knowledge of: • The technology involved with producing the products to be inspected, the execution of processes and the provisioning of services. • The way products are used, processes are implemented and services are rendered; • Deficiencies that may occur during use of the product, during implementation of processes and during services	Knowledge of 1 of the following disciplines: • At least 1 year of experience in production, testing, inspection and or in the geothermal trade, • Or internal training course including: - 2x inspections under supervision	Knowledge of 1 of the following disciplines: • At least 1 year of experience in production, testing, inspection and/ or in the geothermal trade, • Or internal training course including: - 4x inspections under supervision	n/a
Specific technical competence	Detailed knowledge of the BRL	Detailed knowledge of the BRL	n/a

8.2.2 Qualification of certification staff

Certification staff shall be demonstrably qualified by testing their knowledge and skills against the above requirements. If qualification takes place on the basis of alternative criteria, this shall be documented in writing.

The authority for qualification of the certification staff shall be stipulated in the quality system of the CI.

8.3 Reporting of initial assessment and periodic assessments

The certification body records the results of the initial assessment and periodic assessments in an unambiguous report. The report shall fulfil the following requirements:

- **Completeness**: In the document a substantiated report is made of the established degree of conformity with the requirements of this BRL;
- **Traceability**: the findings on which these statements are based shall be recorded in a traceable manner.

8.4 Decisions regarding the KOMO® (technical-approval-with-) product certificate

The decision regarding the issue of a (technical-approval-with-) product certificate or the invoking of measures in regard of a (technical-approval-with-) product certificate must be based on the findings recorded in the dossier.

The results of an initial assessment and, in case of a major non-conformity, periodic assessments must be evaluated by a reviewer.

Based on the performed review the decision-maker determines if:

- The (technical-approval-with-) product certificate can be issued;
- Sanctions should be implemented;
- The (technical-approval-with-) product certificate shall be suspended or revoked.

The reviewer and the decision-maker are not involved in the preparations of the findings on which the decision is being made.

The decision shall be recorded in a traceable manner.

8.5 Report to the Board of Experts

The CI report at least annually to the Board of Experts about the activities performed and the results thereof regarding the product certificates based on this BRL. The report shall cover the following subjects anonymously:

- Number of assessments carried out in relation to the set frequency;
- Number of initial assessments;
- Results of the assessments;
- Measures imposed in case of non-conformities;
- Complaints received from third parties concerning the certified products.

8.6 Interpretation of requirements

The Board of Experts may lay down the interpretation of this BRL in one or more separate interpretation document(s). This/these interpretation document(s) is/are available for the members of the Board of Experts and the CI's that are active on the basis of this BRL. The interpretation document(s) is/are published on the website of the scheme manager.

Every CI using the BRL shall follow the interpretations as laid down in the interpretation document.

9. Document list

9.1 Public law and Rules and Regulations

CPR, EU 305/2011	European Products Regulation

9.2 Normative documents

This BRL references the following normative documents:

Number	Title
BRL SIKB 11000:2019	Ontwerp, realisatie, beheer en onderhoud ondergronds deel van Bodemenergiesystemen
Protocol 11001:2019	Ontwerp, realisatie, beheer en onderhoud ondergronds deel van bodemenergiesystemen
DVGW W534:2015	Rohrverbinder und Rohrverbindungen in der Trinkwasser-Installation
DVS 2207-1:2015	Schweißen von thermoplastischen Kunststoffen - Heizelementschweißen von Rohren, Rohrleitungsteilen und Tafeln aus PE-HD
ISO 497:1973	Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers.
NEN 7200:2017	Plastics pipelines for the transport of gas, drinking water and waste water - Buttwelding of pipes and fittings made of PE 63, PE 80 en PE 100
NEN-EN 1254-8:2021	Copper and copper alloys - Plumbing fittings - Part 8: Press fittings for use with plastics and multilayer pipes
NEN-EN 1267:2012	Industrial valves - Test of flow resistance using water as test fluid
NEN-ISO 4065:2018	Thermoplastics pipes - Universal wall thickness table
NEN-EN-ISO 9001:2015	Quality management systems - Requirements
NEN-EN 12201 series: 2011/2012	Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 1: General
NEN-EN-ISO 15875 series:2004	Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X)
NEN-EN-ISO 15876 series:2004	Plastics piping systems for hot and cold water installations - Polybutene (PE
NEN-EN-ISO 22391 series:2009	Plastics piping systems for hot and cold water installations - Polyethylene of raised temperature resistance (PE-RT)

Annex A. Determination of the resistance to permeation

Principle

Permeation measurements are performed on the pipe as well as fitting material by means of immersion tests. In case the fitting material is made from the same material as the pipe material, separate permeation tests are not required.

Permeation measurements with the chemical liquids to be transported (or components from these liquids) are – in principle – only significant under the following condition:

- when the corresponding liquids/components result in an absorption of at least 1%.

An absorption of 1% will result in a permeation rate of less than 1 g/m^2 (pipe surface)/day.

This low permeation is expected for almost all aqueous salt solutions. Moreover, water molecules are the permeating components in aqueous salt solutions. High absorption will occur for swelling agents.

Test pieces

Cut 3 rings of a representative pipe and/or fitting, Ø < 100 mm and wall thickness < 3 mm, with a thickness in axial direction of 1 mm.

Test method

- Dry the specimens for two days in an oven at 50 °C.
- Weigh the specimens.
- Immerse these specimens for 1 week in the declared liquid(s) at the highest declared operation temperature.
- Weigh the immersed specimens directly after this immersion and removal of droplets of the liquid.
- Check whether the weight increase is lower or higher than 1% by mass.

Annex B. Example IQC-scheme

Subjects	Aspects	Method	Frequency	Registration
Raw materials or supplied materials, half products: • recipe sheets • Incoming goods inspection raw materials	• recipe according to appendix to IQC • melt index • humidity • thermal stability (PE)	• comparison delivery certificate with agreement • NEN-EN-ISO 1133-1	Every delivery Every delivery	• Incoming goods inspection document
Production process, production equipment, plant: • Procedures • Working instructions • Equipment • Plant	• recipe sheets • input parameters • maintenance aspects • dimensions • appearance	• input parameters machine • maintenance schedule • measure • visual evaluation	• continuously • continuously • start-up new product	• “digital” • work sheet • inspection document
Finished products	• appearance • dimensions • resistance to internal pressure	• visual • measure • NEN-EN-ISO 1167	• continuously • each 3 hours • per day, per product, per machine	• final inspection document
Measuring and testing equipment • Measuring devices • Calibration	• proper functioning • accuracy within the scope of measuring	• during use • record deviations	• continuously • 1x year	• final inspection document • calibration document
Logistics • Internal transport • Storage • Preservation • Packaging • Identification or marking of semi-finished products and finished products	• On-site conditions • comparison with task	• comparison with procedure • visual inspection	• continuously	• keeping up to date of the logistical appendices

Annex C. Explanation in regard to the systems to be certified

The subject of certification in relation to this guideline are vertical and horizontal piping systems for the procurement of for geothermal heat, in which the systems form a closed circuit with forward and reverse conduits which both are part of the mentioned vertical and horizontal systems. Geothermal heat is gained by making use of heat exchange in the soil. It concerns systems up to the connection with the manifold.

Error! Reference source not found. provides an example of vertical and horizontal geothermal s ystems.

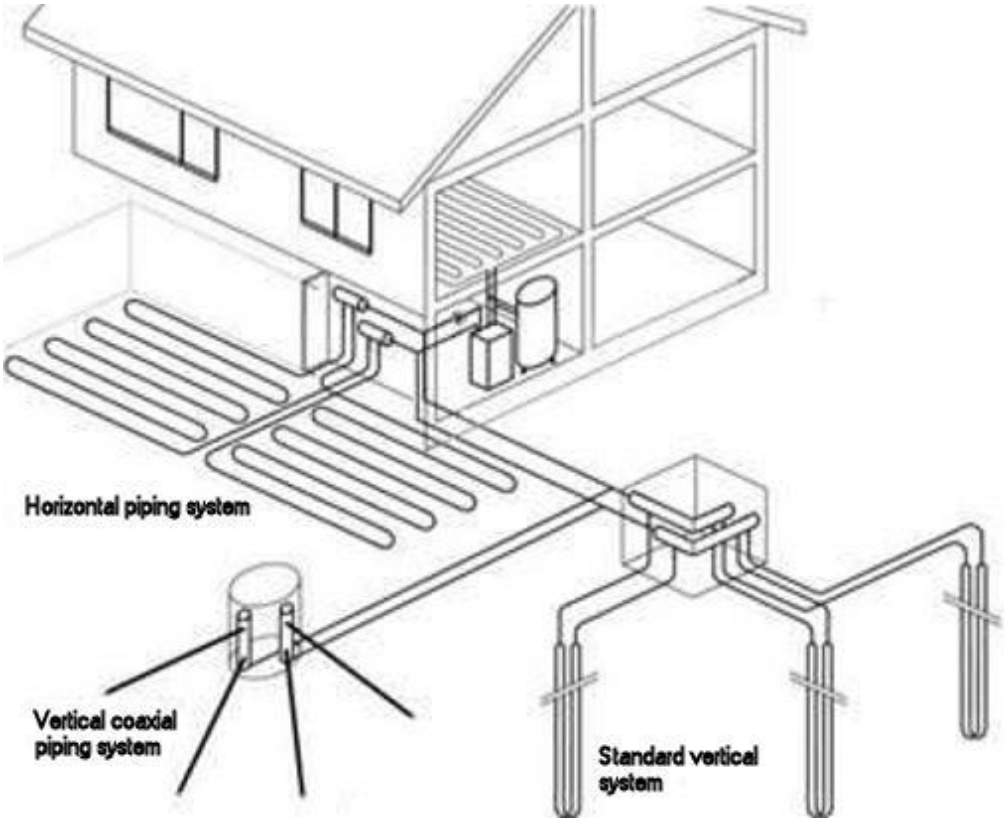

Figure 1 Vertical and horizontal geothermal systems

With vertical systems there is a difference to be made with standard vertical systems on the one hand and coaxial systems on the other.

Standard vertical systems

The system consists of a foot, which is connected to the forward and reverse pipe (the soil heat exchanger), these soil heat exchangers (reverse and forward) will be connected to a manifold (not part of this guideline).

Only complete systems will be certified, which consists of the following parts if relevant:

1) Connection to the manifold (part of auxiliary parts, see § 5.3);
2) Forward and reverse pipe (horizontal pipes, see § 5.2);
3) Headpiece/Y piece (connection of the soil heat exchanger with the horizontal forward and reverse pipes, are part of auxiliary parts, see definitions and chapter 5);
4) Soil heat exchanger (existing of pipes and feet, see § 5.2 and § 5.3);
5) Foot + protective cover if applicable (see § 5.3);
6) Weight for the soil heat exchanger (see § 5.1).

Coaxial vertical systems

This system consists of an inner and an outer pipe (pipe in pipe system), the forward pipe is the inner pipe which ends in the outer pipe (reverse pipe) or the forward pipe is the outer pipe which ends in the inner pipe (reverse pipe). The reverse and forward pipe will be connected to a manifold (not part of this guideline).

The coaxial vertical system consists of the following parts if relevant:

1) Connection to the manifold (part of auxiliary parts, see § 5.3);
2) Forward and reverse pipe (horizontal pipes, see § 5.2);
3) Soil heat exchanger (Coaxial) (existing of pipes and feet, see § 5.2 and § 5.3);
4) Foot + protective cover if applicable (see § 5.3);
5) Weight for the soil heat exchanger (see § 5.1).

Horizontal systems

The system consists of pipe loops which are installed at least 1.2 meter below surface, with a maximum installation depth of 5 meter below surface.

The loops will be connected to a manifold (not part of this guideline). See Figure 2.

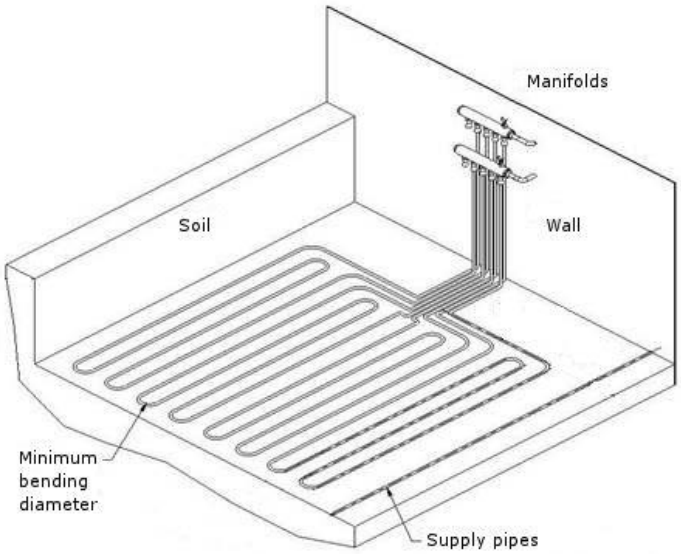

Figure 2 Horizontal systems

Horizontal supply and return pipes

Next to before mentioned vertical and horizontal geothermal systems there is also a distinction in the certified piping systems for horizontal forward and reverse pipes. These pipes start at the last connection of the soil heat exchanger and end at the manifold. In many cases the pipes for the soil heat exchanger and the forward and reverse pipes are identical.

Remark: When the connections are not (easily) accessible, it is preferred the connections are welded connections.

Annex D. List of van approved heat transfer liquids

Heat transfer liquid	Density at 0 °C	Frost protection up to °C
Ethylene glycol 20%	*1040 kg/m^3*	-10,4 °C
Ethylene glycol 20% @ 15 °C	*1037 kg/m^3*	-10,4 °C
Ethylene glycol 25%	*1050 kg/m^3*	-13,6 °C
Ethylene glycol 25% @ 15 °C	*1042 kg/m^3*	-13,6 °C
Ethylene glycol 30%	*1059 kg/m^3*	-17,1 °C
Ethylene glycol 33%	*1065 kg/m^3*	-19,3 °C
Propylene glycol 25%	*1033 kg/m^3*	-10,1 °C
Propylene glycol 30%	*1039 kg/m^3*	-13,5 °C
Propylene glycol 35%	*1044 kg/m^3*	-17,5 °C
Water 5°C	*1000 kg/m^3*	0,0 °C
Water 15°C	*1000 kg/m^3*	0,0 °C
Ethanol 20%	*969 kg/m^3*	-10,5 °C
Ethanol 25%	*961,5 kg/m^3*	-15,5 °C
Ethanol 30%	*954 kg/m^3*	-20,5 °C