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Technical Data Sheet

Terra FUTURA SLIM LAMELA geothermal probe

2 x 32 mm, 2 x 40 mm SLIM
4 x 32 mm, 4 x 40 mm fourGEO

V1.01/2025

The PRAWTECH **Terra FUTURA SLIM LAMELA geothermal probe is** one of the most important components of the ground source heat pump system. The heat exchanger consists of a plastic geothermal head with enhanced ergonomics, which forms a monolithic whole with the polyethylene high-density PE100RC pipes. The probe is designed to optimize the process of applying the heat exchanger to the borehole and to increase the safety of the ground source heat pump system's operation. The technology used to manufacture the probe is based on the highest quality materials and constant quality control of production and logistics processes.

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Fig. 1. FUTURA SLIM probe head

The **FUTURA SLIM probe head** is designed to guarantee ergonomics and safety during installation. The product is made of high-density polyethylene (PE100RC). The reduced external dimensions of the head allow for a smaller diameter of the drilled installation hole. The wedge-shaped design of the head's front facilitates the probe's passage through various soil layers and ensures its safe placement at the designed depth, as well as the removal of drilling slurry from the hole.

The head is equipped with accessories such as connectors and pushers in various configurations, depending on the need. If there is a desire to order a probe with additional specialised connector fittings (e.g. for using a weight, with threaded nut for a pusher), it is necessary to specify what type of connector should be mounted in the probe. The head of the probe optionally allows for bottom injection and filling of the annular space of the borehole.

The PRAWTECH probe head has a monolithic structure and is fully created during the automated production process. The production control system for PRAWTECH probes belongs to the MES (Manufacturing Execution System) group, which collects production data in real-time, allowing for production analysis and control of initiated production orders, taking into account planning optimization.

For the FUTURA SLIM probe head the following accessories are available:

- Connector for mounting weights to the probe head
- Pass-through pusher

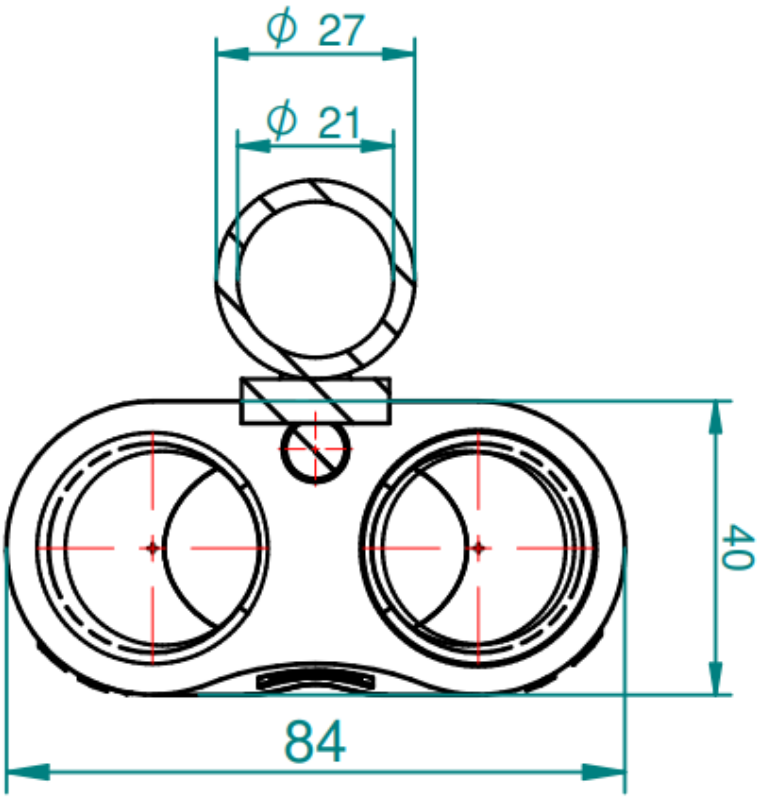

Fig. 2. Cross-section of the FUTURA SLIM geothermal head 2 x 32 mm with pass-through pusher.

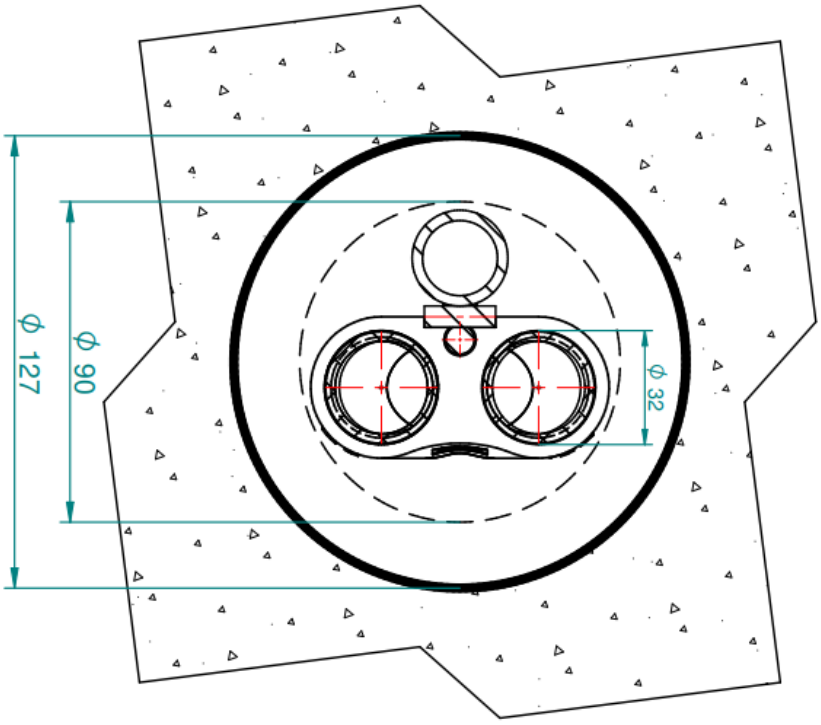

Fig. 3. Cross-section of the FUTURA SLIM 2 x 32 mm head in the borehole.

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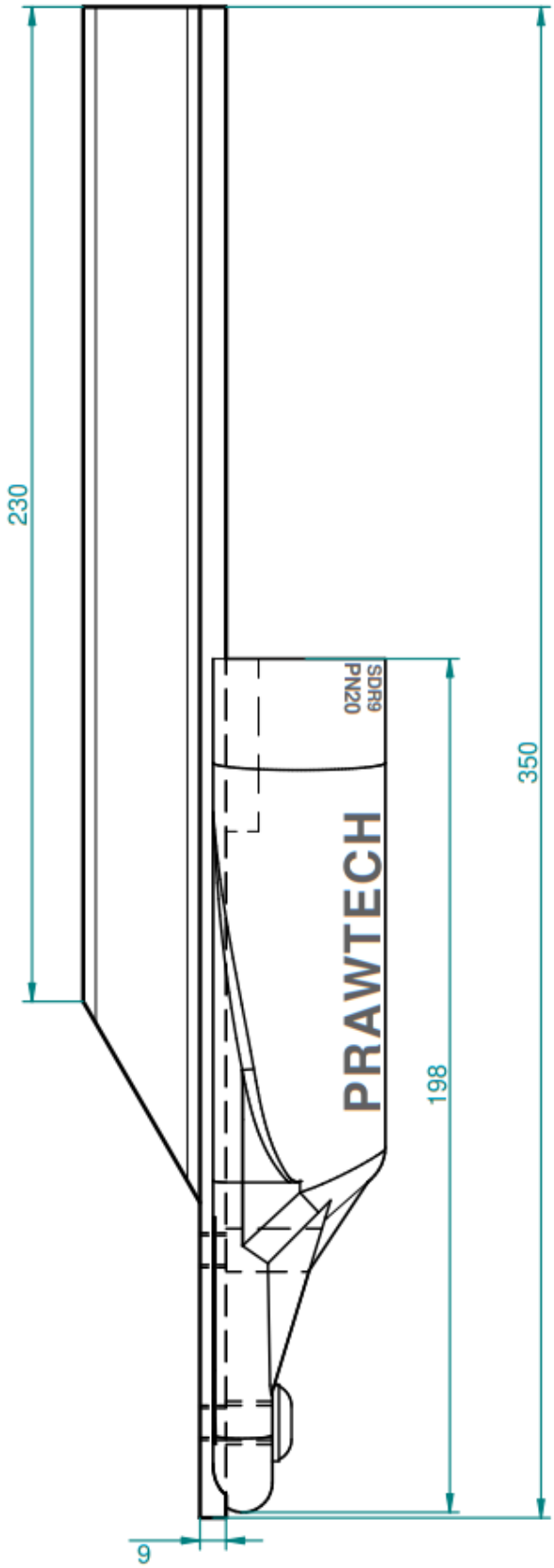

Fig. 4. Side view of the FUTURA SLIM LAMELA 2 x 32 mm head with installed through pusher

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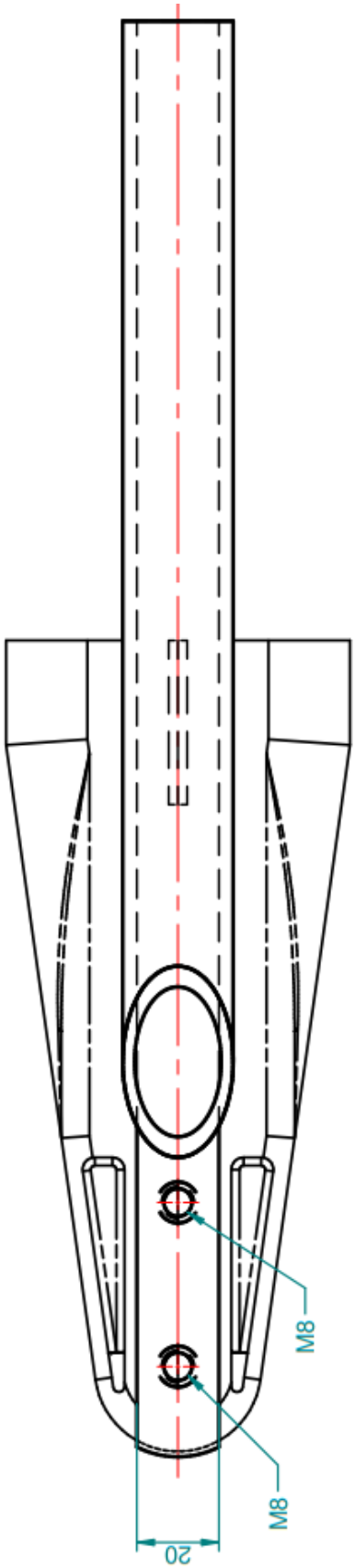

Fig. 5. Installation of the pass-through pusher set to the FUTURA SLIM LAMELA 2 x 32 mm head

2. LAMELA technology

The FUTURA SLIM LAMELA geothermal probe has an internally rifled structure. The new design of the heat exchanger contributes to increased circumferential strength of the geothermal probe and improves the safety of the heat exchanger's application, especially in challenging hydrogeological conditions. The stable operation of the probe in the ground allows the declared lifespan of the FUTURA probes to reach up to 100 years.

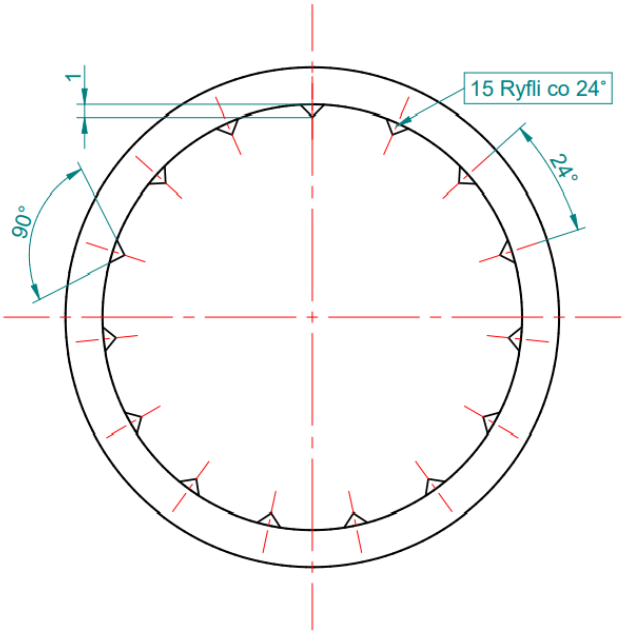

Fig. 6. Cross-section of the Terra FUTURA SLIM LAMELA probe pipes

Fig. 7. Terra FUTURA SLIM LAMELA probe pipes

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Depending on the ground conditions (including the thermal conductivity coefficient of the medium in which the heat exchanger operates) as well as the method and effectiveness of filling the annular space of the installation hole, the internally ribbed probe can contribute to optimizing the heat exchange process between the low-freezing fluid and the ground.

The rifles placed in the exchanger pipes effectively improve the heat penetration coefficient[1].

The LAMELA probe, depending on the type of flow (laminar, turbulent, transitional), is characterized by a high value of the coefficient α compared to a standard exchanger with a smooth surface.

$$\alpha_2 \geq 1{,}14 \cdot \alpha_1$$

where:

α_1 – heat penetration coefficient of a regular FUTURA SLIM

α_2 – heat penetration coefficient of a regular FUTURA SLIM LAMELA.

[1] *The absorption of heat is referred to as the heat exchange between the probe wall and the surrounding low-freezing-point fluid. The heat transfer depends on the fluid's velocity, the type, shape, and temperature of the heat exchange surface, as well as the thermophysical properties of the glycol.*

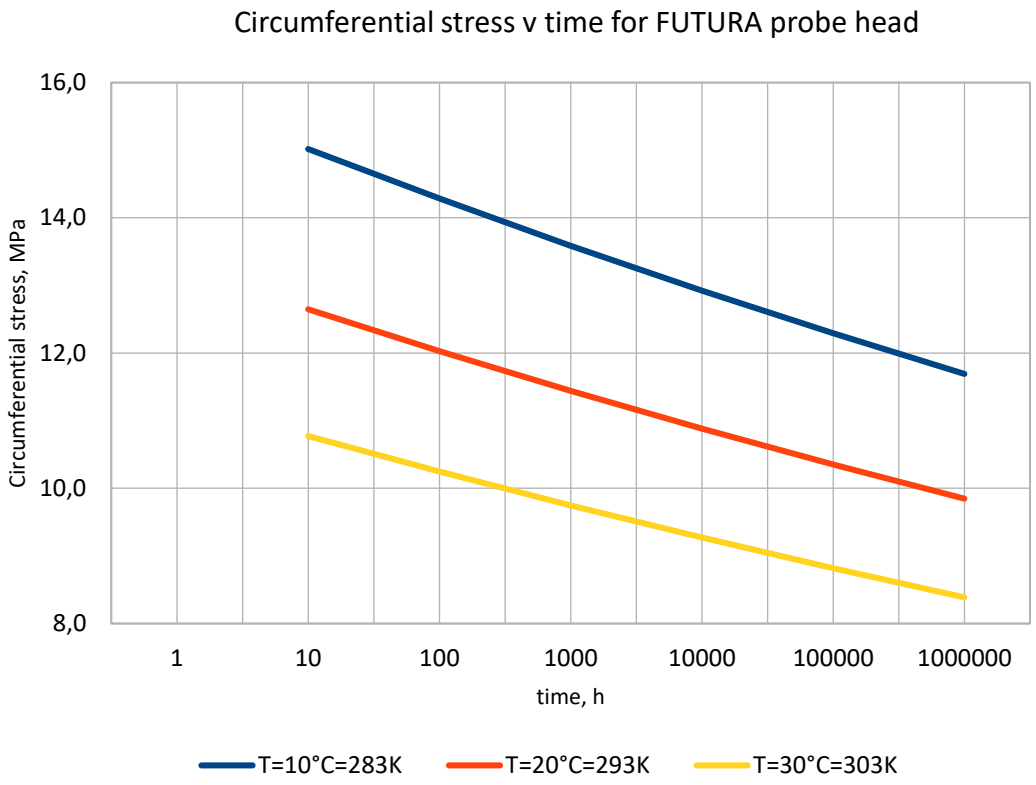

Fig. 8. Regression curves for PE100RC probes in LAMELA technology

When designing and using vertical ground heat exchangers of the Terra FUTURA SLIM LAMELA series, it is recommended to familiarize yourself in detail with the product characteristics, particularly the unit flow resistances provided for internally rifled probes. The rifles placed in the heat exchanger pipes may influence the increase in hydraulic resistance for a specific flow rate range of the fluid in the pipes (a phenomenon especially observed in relation to the non-freezing fluid system based on ethylene glycol).

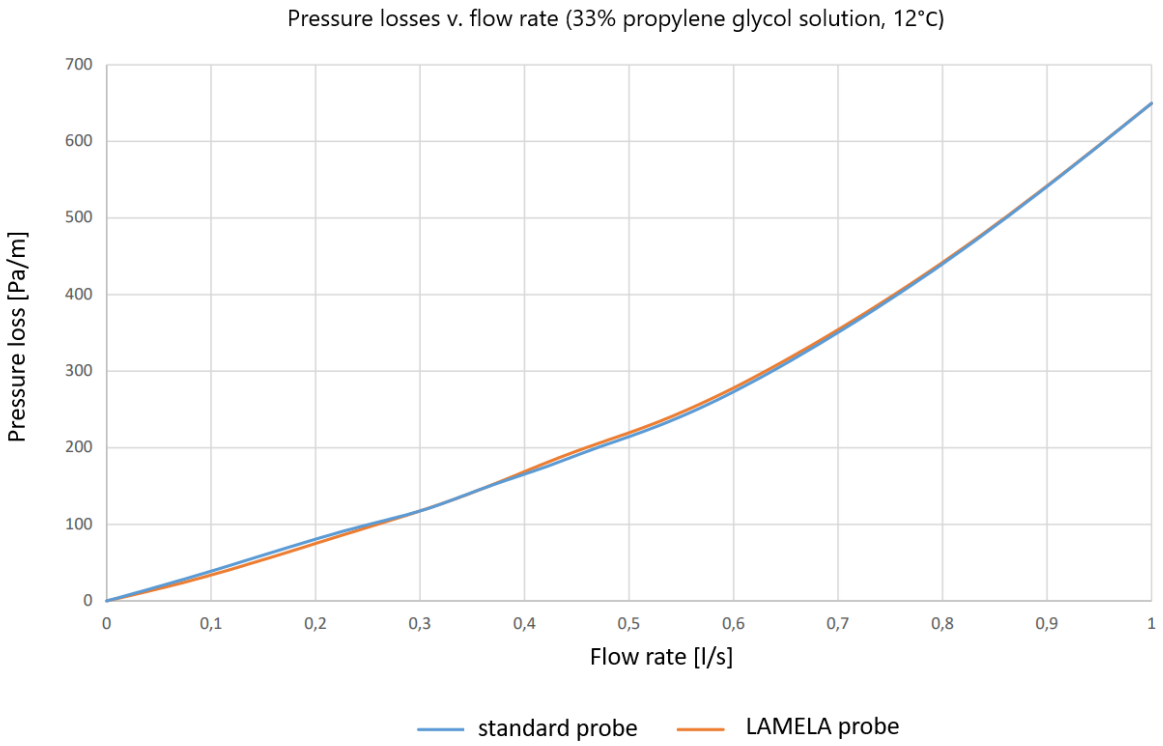

Fig. 9. Relationship between hydraulic resistance and flow for a 33% by weight propylene glycol solution. Terra LAMELA probe 2 x 40 mm

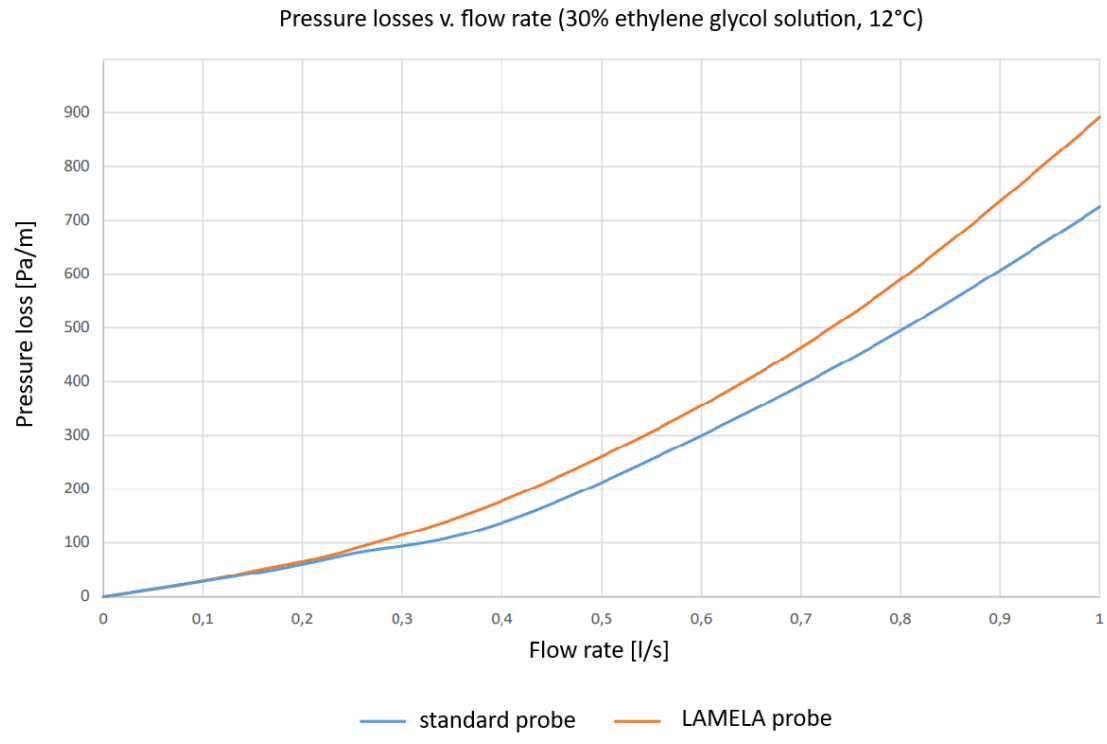

Fig. 10. The relationship between hydraulic resistance and flow for a 30% by weight ethylene glycol solution. Terra LAMELA probe 2 x 40 mm

3. Basic functions and work parameters

The geothermal probe is responsible for the balanced extraction of heat accumulated in the rock formation and for delivering medium at a stable temperature to the ground source heat pump. The PRAWTECH geothermal probe is designed for operation in both heating and cooling modes. In both cases, it is recommended to design the heat pump system so that the temperature of the low-freezing fluid remains within the range of 0 to 30°C. Short-term operation at sub-zero temperatures is acceptable, but in such cases, the parameters for the material filling the installation hole (the so-called frost resistance parameter) must be properly defined. Short-term operation at temperatures above the recommended standard is possible, provided the recommendations of the geologist, the heat pump manufacturer, and the limitations of the maximum operating temperature of polyethylene from the PE100RC group (max. +40°C) are adhered to.

WARNING!

Changing the temperature parameters of the probe's operation may affect the lifespan of the heat exchanger and should be consulted with the manufacturer during the design phase.

The FUTURA SLIM LAMELA geothermal probe is available in two standard sizes:

- **2 x 32 mm and 2 x 40 mm SLIM:** The probe's pipes are made from high-density polyethylene PE100RC resistant to crack propagation (Crack resistant) with an outer diameter of 32 mm or 40 mm each.
- **4 x 32 mm and 4 x 40 mm fourGEO**: The probe's pipes are made from high-density polyethylene PE100RC resistant to crack propagation (Crack resistant) with an outer diameter of 32 mm or 40 mm each.

The FUTURA SLIM LAMELA probe is offered in the following pressure rating series:

- PN 10 (SDR 17)
- PN 12.5 (SDR 13.6)
- PN 16 (SDR 11)

In individual cases, it is possible to use the probe for deeper boreholes after written consultation with the geologist, designer, and manufacturer.

WARNING!

Changing the pressure parameters of the probe's operation may affect the lifespan of the heat exchanger and should be consulted with the manufacturer during the design phase.

4. FUTURA LAMELA SLIM probe in the fourGEO configuration

The FUTURA LAMELA SLIM fourGEO 4 x 32 mm and 4 x 40 mm head has been designed to ensure ergonomics and safety during installation. The product is made of high-density polyethylene PE100RC. The head is offered with accessories that allow for the adaptation of the head to popular probe application techniques for installation into the borehole.

The FUTURA LAMELA SLIM fourGEO head consists of two individual FUTURA SLIM 32 mm or 40 mm heads connected into one unit via a steel connector. For the fourGEO probe, connectors are available in the following configurations:

- 2-hole
- 2-hole with M16 threaded nut
- 3-hole
- 3-hole with M16 threaded nut
- 2-hole with threaded rod

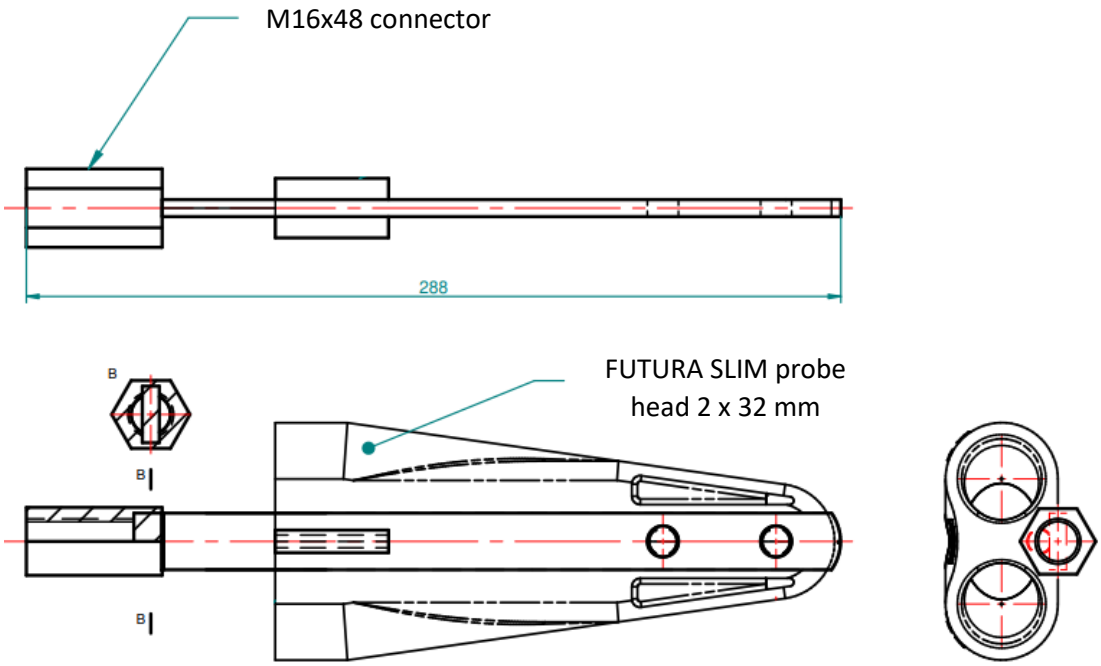

Fig. 11. 2-hole connector with M16 threaded nut

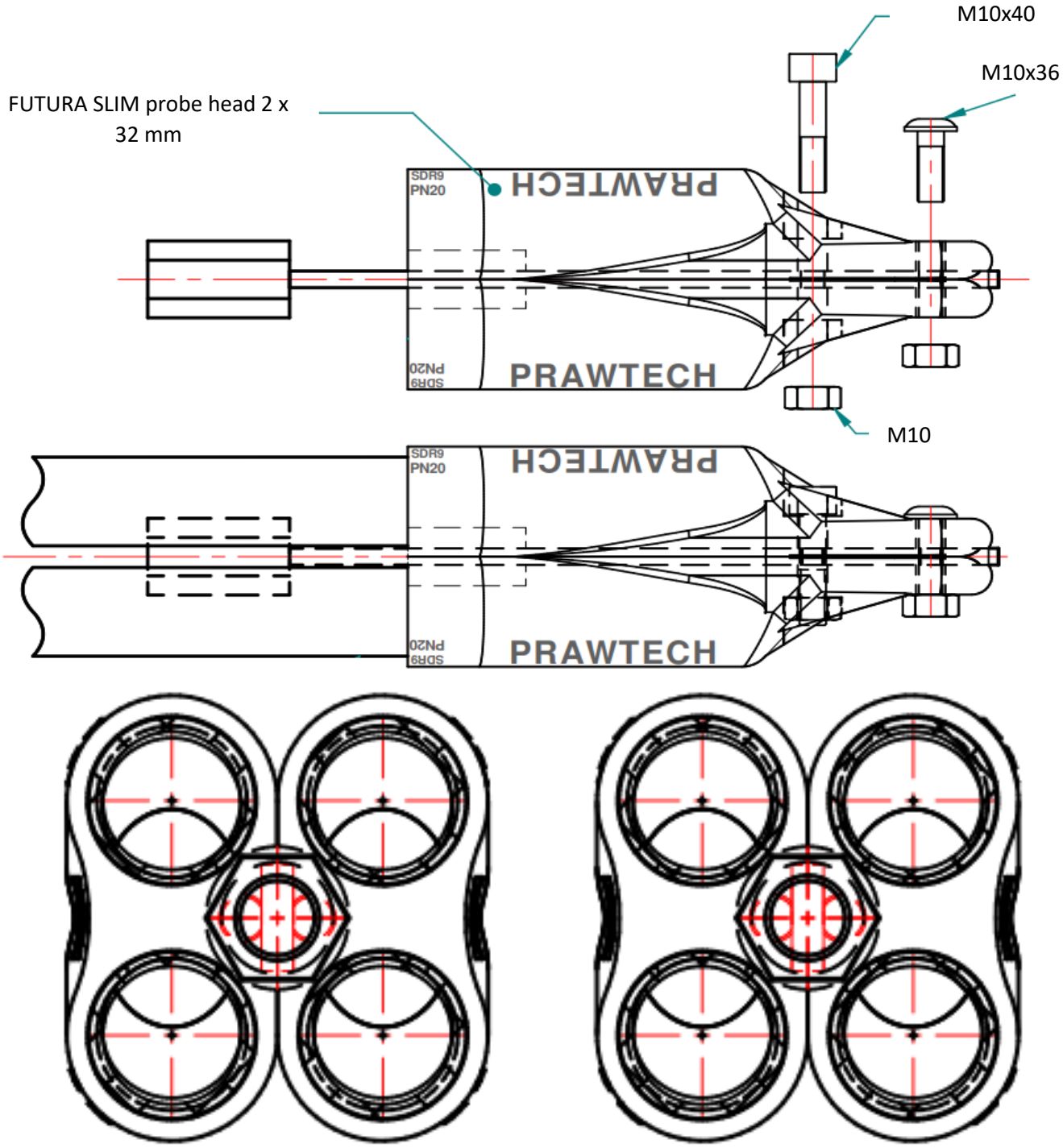

Fig. 12. 4 x 32 mm probe in fourGEO configuration

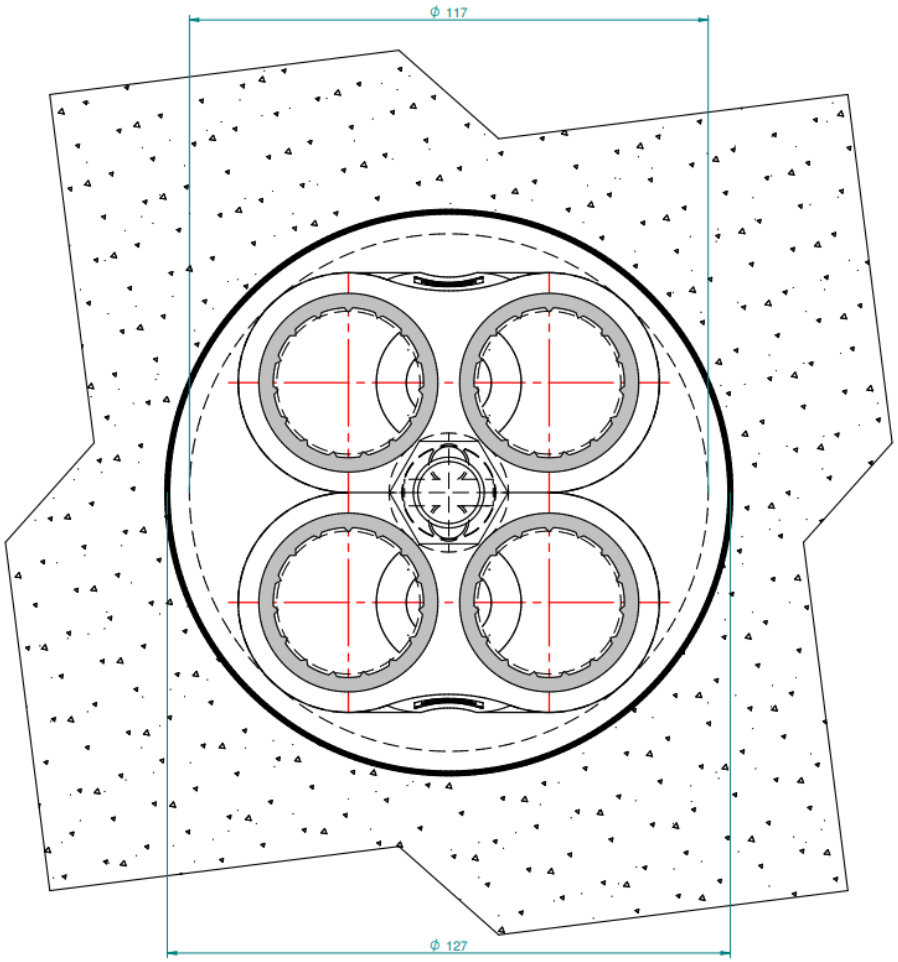

Fig. 13. Cross-section of the FUTURA SLIM LAMELA fourGEO 4 x 40mm head in the borehole

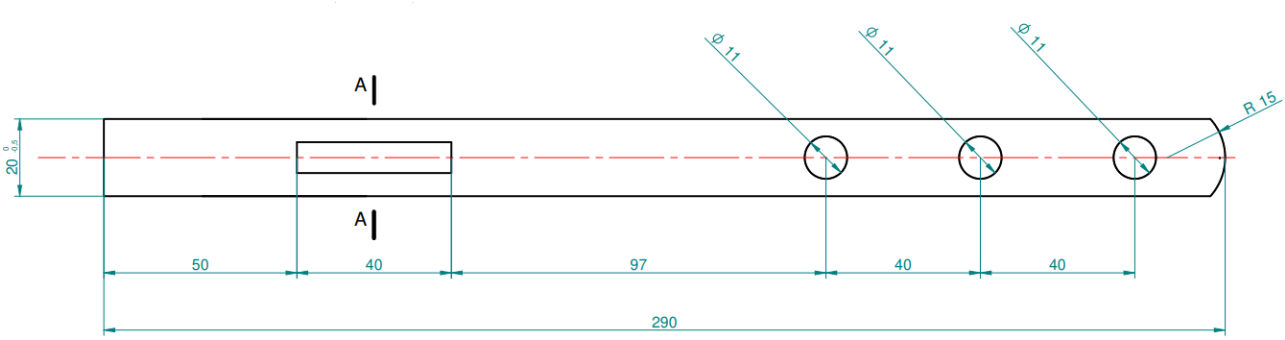

Fig. 14. 3-hole connector

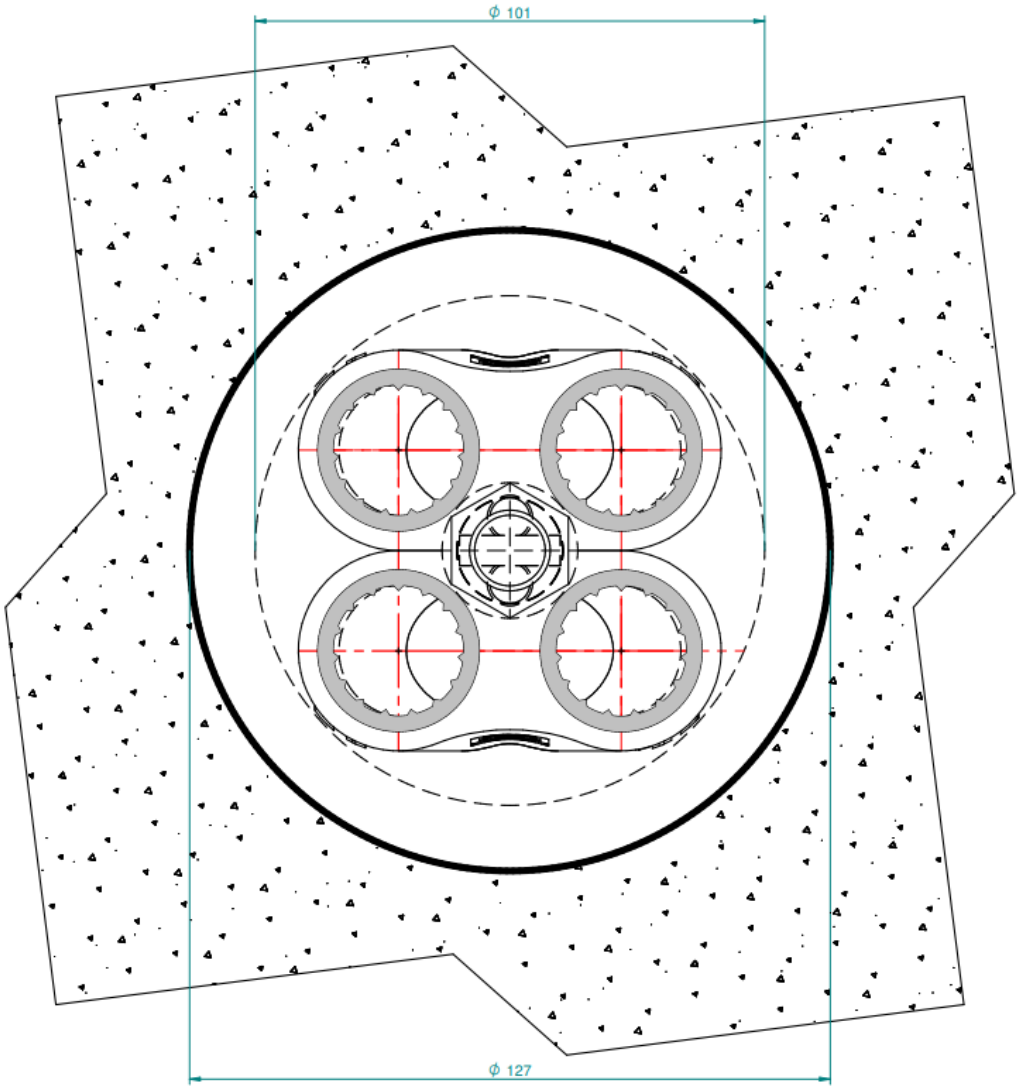

Fig. 15. Cross-section of the FUTURA SLIM LAMELA fourGEO 4 x 32mm head in the borehole

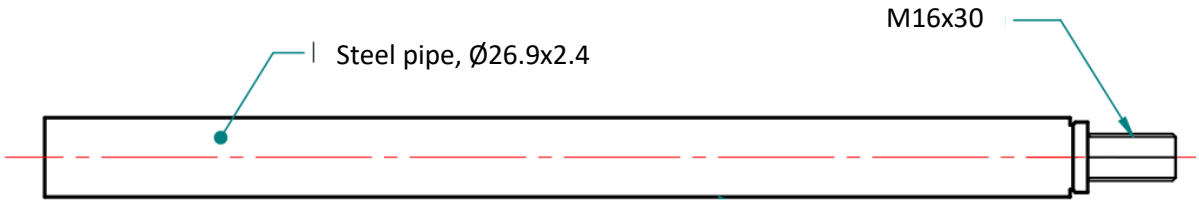

Fig. 16. Steel accessory application nozzle screwed into the connector with a threaded nut

5. Installation and usage

The geothermal probe is installed in a vertical installation hole/borehole for heat pumps. Before installing the heat exchanger, a visual inspection of the probe and a leakage and flow test must be conducted to eliminate any incidental cases of product damage during transport or storage.

The installation of the geothermal probe must be carried out in accordance with applicable legal requirements, safety regulations, and the guidelines of PORT PC. Drilling work should only be carried out by authorized personnel with the appropriate qualifications.

The manufacturer **DOES NOT ALLOW** the use of geothermal probes in areas of mining damage or landslide-prone areas.

All PRAWTECH geothermal probes are delivered to the customer only after passing pressure and flow tests according to the internal quality control procedure. The products are then carefully packaged and secured before shipment

Fig. 17. Probes ready for transport

Each heat exchanger has its own unique serial number. The manufacturer recommends using this number when registering the construction log/drilling log and in case of future contact with the supplier/manufacturer.

6. Connecting the probes and completion of ground heat source system

To connect PRAWTECH probes to distribution pipes and boreholes/distributors of the ground source, electrofusion fittings that meet the requirements of standards PN-EN 1555-3 and PN-EN 12201-3 are used. The fittings offered by PRAWTECH are made of PE100 polyethylene and are available in two size ranges – **SDR 11** and **SDR 17.**

During the use and installation of the fittings, the ambient temperature should be within the range of **0°C to 40°C**. When performing installation works in difficult weather conditions (e.g. fog, negative temperatures, high humidity, and rain), a protective tent should be used to ensure safe and stable conditions for the thermal fusion process.

The electrofusion fittings are designed for welding under a voltage of **39.5 V**, which is indicated on the individual labels placed on the products, along with other necessary data for performing the weld, including welding time, cooling time (i.e., the time after which the fitting can be disconnected from the electrofusion welding machine). The individual label also includes a barcode compliant with ISO 13950, which is used for the automated welding process, as well as a traceability code for full product identification. The electrofusion welding is socket-type. The electrofusion fittings feature two optical indicators to verify the correctness of the weld and internal depth limiters. The exception are end caps, which have only one optical indicator.

Given the declared 100-year service life of PRAWTECH probes, the following electrofusion connection principles must be strictly adhered to, and the sequence of installation steps must be **STRICTLY** followed.

6.1. Pipe preparation

- Cut the pipe perpendicular to its axis;
- Chamfer the edges of the pipe from the inside to remove any unevenness, and round off the edges from the outside;
- Insert the pipe into the fitting until it hits the internal limiters and mark the insertion depth on the pipe with a marker;
- Pull the pipe out of the fitting and carefully remove the outer oxidized layer of the pipe to a depth of at least 0.2 mm. The scraping marks of the oxidized layer should be visible on the pipe after it is inserted into the fitting to be welded;
- Clean the pipe thoroughly inside and outside with an appropriate cleaner, such as isopropyl alcohol, using an absorbent, smooth, and non-dyeing material;
- Wait for the alcohol to evaporate and for the pipe surface to be completely dry;
- Re-insert the pipe until it hits the internal limiters and mark the insertion depth on the pipe with a marker;
- Remove any ovality of the pipe using appropriate clamps.

WARNING!
Failure to properly remove the oxidized layer and inadequately cleaning the pipe surface may result in a DEFECTIVE CONNECTION.

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6.2. Fitting preparation

- Remove the fitting from the polyethylene bag, which serves as the unit packaging protecting the product from damage and contamination;
- Thoroughly clean the inner surface of the fitting by rinsing it with isopropyl alcohol using an absorbent, smooth, and non-dyeing material;
- Wait for the alcohol to evaporate and for the inner surface of the fitting to be completely dry.

WARNING!
Inadequate cleaning of the fitting surface may result in a DEFECTIVE CONNECTION.

6.3. Positioning

- Insert the pipe into the fitting until it reaches the internal stop, ensuring co-axiality. (If the depth insertion mark has been removed, it should be marked again for position control within the fitting);
- Secure the connection elements in the mounting clamp to ensure the position remains stable during heating and cooling.

6.4. Welding

- During welding, the instructions of the welding machine manufacturer should be followed. Only welding machines with a CE Declaration of Conformity and calibrated at least once a year should be used for electrofusion welding.

WARNING!
Each fitting has a label that contains all the necessary welding parameters and a barcode used for automatic welding. The cooling time on the label indicates the time after which the fitting can be detached from the electrofusion welding machine. The time after which a pressure test can be performed depends on the diameter of the pipe and fitting used, and is listed in Table No. 1.

Table 1. Minimum cooling times for electrofusion fittings and time to pressure testing

Diameter [mm]	Cooling time [min]	Pressure test duration [min.]
20-63	5	30
75-110	10	60
125-160	15	75
180-225	20	90
250-400	25	150

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7. Material properties

Table 2. Properties of PE100RC material.

Properties	Value	Unit	Compliance basis
Color	Black	-	-
Melt flow rate at 190°C and 5 kg	0.2	g/10 min	ISO 1133
Density	956-962	kg/m³	ISO 1183
Soot content	2.25	%	ISO 6964
Tensile modulus	1000	MPa	ISO 527-2
Tensile strength at yield	23-35	MPa	ISO 527-2
Elongation at yield	≥8	%	ISO 527-2
Notch test	>8760	h	EN ISO 13479
Shore Hardness (D)	62	-	ISO 868
Melting temperature	124-128	ºC	DIN 53765
Oxidation Induction Time (OIT) at 210°C	>20	min	ISO 11357-6
Thermal conductivity	0.42	W/m·K	-
Absolute roughness	0,03	mm	-
Circumferential stiffness (SDR 13.6)	>41.7	kN/m²	PN-EN 12201