GERES®
GES. F. REGENERATIVE ENERGIESYSTEME MBH

Configuration of the probe fields

Calculation of the volumetric flow meter:

The flow rate is measured by the following formula:

Q = m x c x Δt

The quantity circulated into the ground is calculated as follows.

Q	=	Heat quantity	kwh
m	=	Mass (circulated quantity)	kg
c	=	Heat capacity	$\frac{wh}{kg \times K}$
Δt	=	Temperature difference In our case the temperature difference between the ground input and output (please observe the specifications of the WP heat pump producer; usually 3-5 K).	K (Kelvin)

c: The specific heat capacity of the water is:

$$1.160 \frac{wh}{kg \times K}$$

As the probes generally operate on glycol/water mixture and glycol decreases the heat capacity, we calculate based on a simplified method:

$$1.00 \frac{wh}{kg \times K}$$

The heat quantity (required collection power) and the temperature difference are known;
We need the water quantity circulated underground. Therefore, we transform the formula as follows:

$$m = \frac{Q}{c \times \Delta t}$$

Calculation example:
Collection power 8 KW = 8000 W, considered temperature difference = 3,4 K

$$m = \frac{8000 \text{ wh x kg x K}}{1{,}0 \text{ wh x } 3{,}4 \text{ K}} = 2353 \text{ kg}$$

m = 2353 kg is the quantity circulated underground/hour = volumetric flow rate = 2353 L/h

Calculation of the minimum number of probes

Example of a 35.8 m probe configuration:

Adopted volumetric flow rate: 2353 L/h
Maximum volumetric flow rate / probe: 2353 L/h : 600 L/h = 3.92 probes
In this case minimum 4 probes would be assembled

Calculation of the collection power per probe:

8000 W / 4 probes = 2000 W/probe

Drilling depth to be determined:

The first 7.0 m will be configured as vertical pipe.
We consider a power of 25 W/m for this section,
That is 7.0 m x 25 W/m = 175 W.

The entire probe must collect 2000 W

2000 W – 175 W = 1825 W required for the collection power of the spiral pipe of the probe.

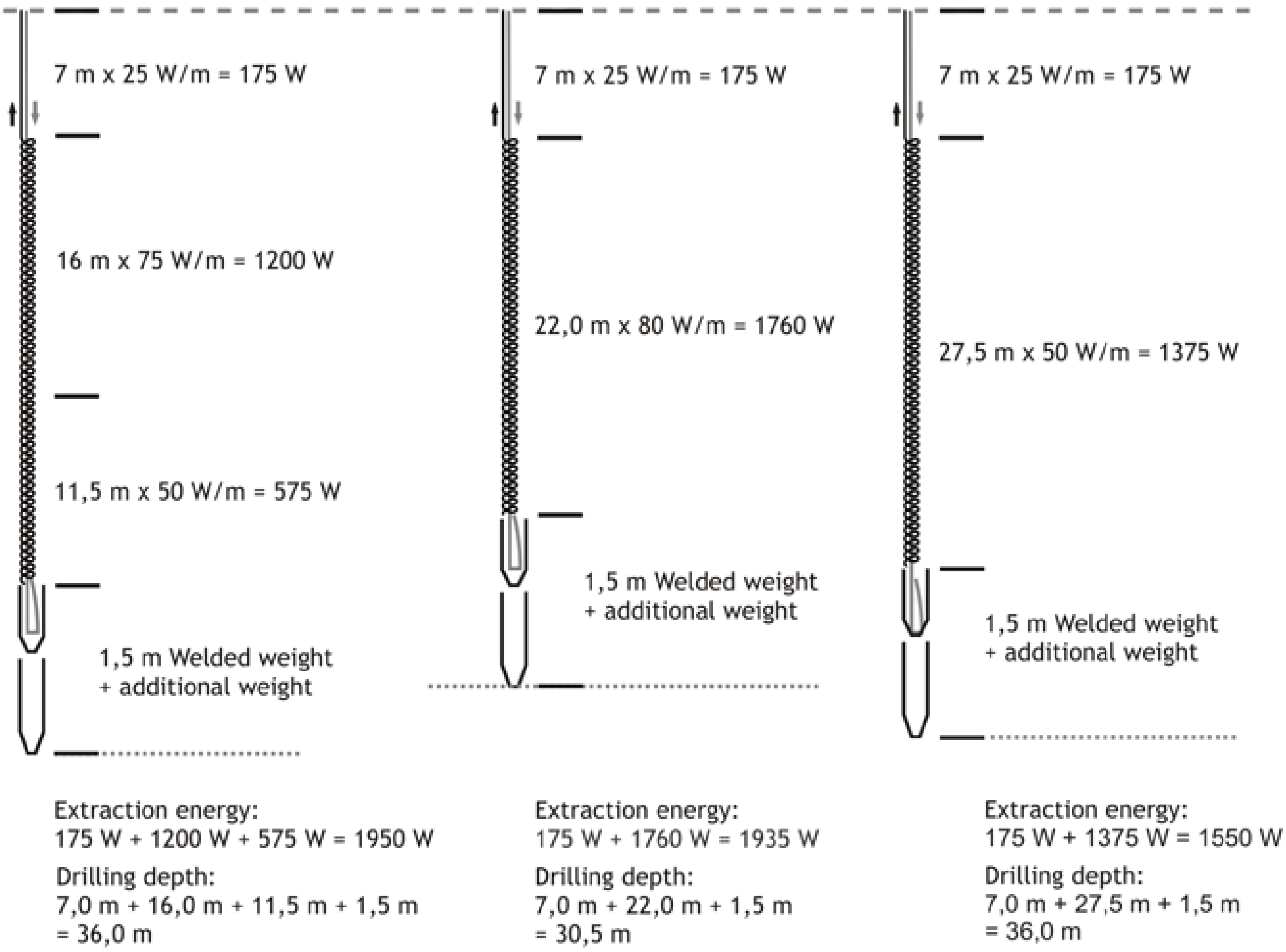
1825 W : 27.5 m spiral pipe = 66.3 W/m
In case of geological conditions with low collection power, you will have to assemble additional probes

The spiral probe pipe has 35 m, in maximum elongation state, it can collect energy up to 100 W/m (up to 85 W/m in case of the water/glycol mixture).

In case of geological strata with a higher collection power, you won't have to drill up to the maximum depth of 35.0 m anymore. However, you won't have to reduce the number of probes, as the circulated water quantity would be insufficient in this case.

[Please observe the information on the collection power included in the VDI 4640 provisions]

Examples for various geological conditions



Measurement of the pressure losses and the pipe diameter nominal

The constant pressure loss always depends water-ground pump of the heat pump. In case you want to build a probe installation you must consider and notify its developer, if necessary, the constant pressure loss for dimensioning the pipe linking the distributor to the heat pump. In case of GERES probes the advantage is that the pressure loss per probe is always the same, so that you don't have to measure it again.

The pressure loss will be indicated with the following measurement units:

Pa	(Pascal);
mbar	100 Pa = 1.0 mbar; 10,000 Pa = 100 mbar
m	Circulation depth (circulation pump) 100 mbar = 1 m

The pressure loss of a probe installation takes place on the following segments:

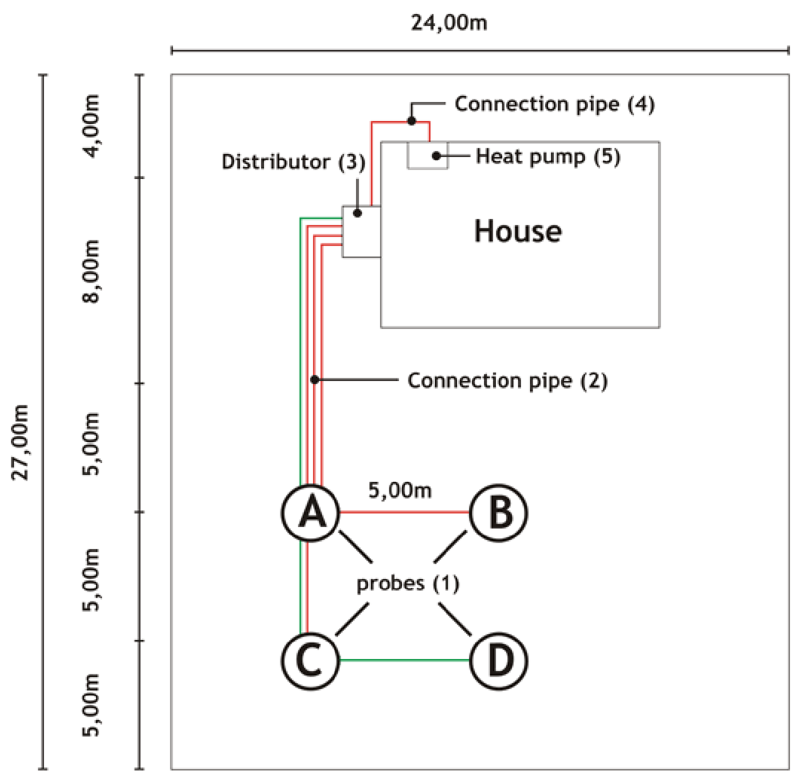
(1) GERES probe
(2) Pipe linking the GERES probe to the distributor
(only the length of the pipe located farthest from the probe must always be taken into consideration)
(3) Distributor
(4) The pipe linking the distributor to the heat pump
(5) Individual resistances in the heat pump
e.g. water/ground pump, block valves, pipes, U-bend pipes, vaporizer etc.

Example:

We shall take as example once again the heta pump system with thermal power of 10 kW, and a collection power of 8.0 kW. The volumetric flow rate is of 2353 L/h, in case of a temperature difference of 3.4 K.

2353 L/h	:	4 sonde	=	588 L/h/probe.

Example of field:



The probe located farthest from the distributor is probe **D**.

Length-calculation of the connection pipes (4)

Section		D – C		5.00 m
Section		C – A		5.00 m
Section	=	A – distributor		Cca.12.00 m
Simple pipe	=			22.00 m
Double pipe (return circuit)	2x	22.00 m	=	44.00 m

Explanations on the partial sections

Relating (1): pressure loss per probe = 300 mbar at 588 L/h

relating (2): pressure loss per meter of pipe length 25 x 2.0 mm la 588 L/h = 1.88 mbar /m
On the entire pipe length = 44.0m x 1.88 mbar/m ≈ 83 mbar

relating (3): pressure loss per distributor = 40 mbar
intermediate result: 300 mbar + 83 mbar + 40 mbar = 423 mbar
423 mbar = 42300 Pa = 4.23 m circulation height water/ground pump

relating (4): on the connection pipe between the distributor and the heat pump:

Available pressure of the water/ground pipe	=	550 mbar
Lost pressure 1 - 3	./.	423 mbar
Constant pressure	=	127 mbar
Required volumetric flow rate	=	2353 L/h

On 1.0 m of pipe with interior diameter of 20 mm, at a volumetric flow rate of 2352 L/h a pressure loss of approx. 5.7 mbar/m is produced. In case of a constant pressure of 127 bar, the calculation is as follows: 127 mbar: 5.7 mbar/m = 22.10 m maximum pipe length.

In case of a total pipe length of the connection pipe ranging from 0.0 up to 22.0 m, the diameter nominal DN 25 is sufficient. If you exceed this length, then the appropriate higher diameter must be selected

If the pipe between the distributor and the heat pump does not have to be configured by you, but by the manufacturer of the thermal installation, then simply notify him about the pressure loss up to the distributor, inclusively.

relating (5): The technical data of the heat pump manufacturer include in this section the "available pressure"" or "free pressure" or "residual circulation height".
This value already contains all incidental pressure losses of the heat pump.
In our example we have considered an initial available pressure of 550 mbar.
If these values are not mentioned, ask the heat pump manufacturer.

Centralization:

1. Measurement of the volumetric flow rate: 8000W : 3.4 K = 2352 L/h
2. Minimum number of probes: 2350 L/h : 600 L = 3,92 = 4 probes
3. Calculation of the pressure loss per sections / probe distributor (1-3) and distributor – heat pump (4)