DISTRIBUTION WELL ASSEMBLY GUIDLINES

EN.OZE-PS:20-19.01.

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1. INTRODUCTION

The subject of this document is distribution well guidelines which is the element of ground source heating system for heat pumps.

All design and assembly work shall be performed in accordance od this document principles, proper standards, rules and good building practice.

2. DICTIONARY

GSHPSE – Ground Source Heat Pump System Element

Geothermal distribution well – GSHPSE, it is built of manifold covered in plastic chamber (well). Assembled in ground, outside of the building.

Exchanger pipes – GSHPSE, form of polyethylene pipes

Geothermal manifold – GSHPSE, build of two cylindrical bars with collector sections spreaded radially. Its purpose is to distribute liquid between heat pump and ground or water exchanger.

Distribution pipes (RR) – GSHPSE, transport fluid between manifold and ground or water exchanger

Return and supply pipes (RD) – GSHPSE, transport fluid between manifold and heat pump machine-room.

Collector section (SK) – element of the geothermal manifold (spigot) which passes through distribution well chamber walls and enables direct connection of distribution pipes.

Supply and return section – configuration element of geothermal manifold, characterized by flow of liquid:

- From manifold to exchangers – return section
- From exchangers to manifold – supply section

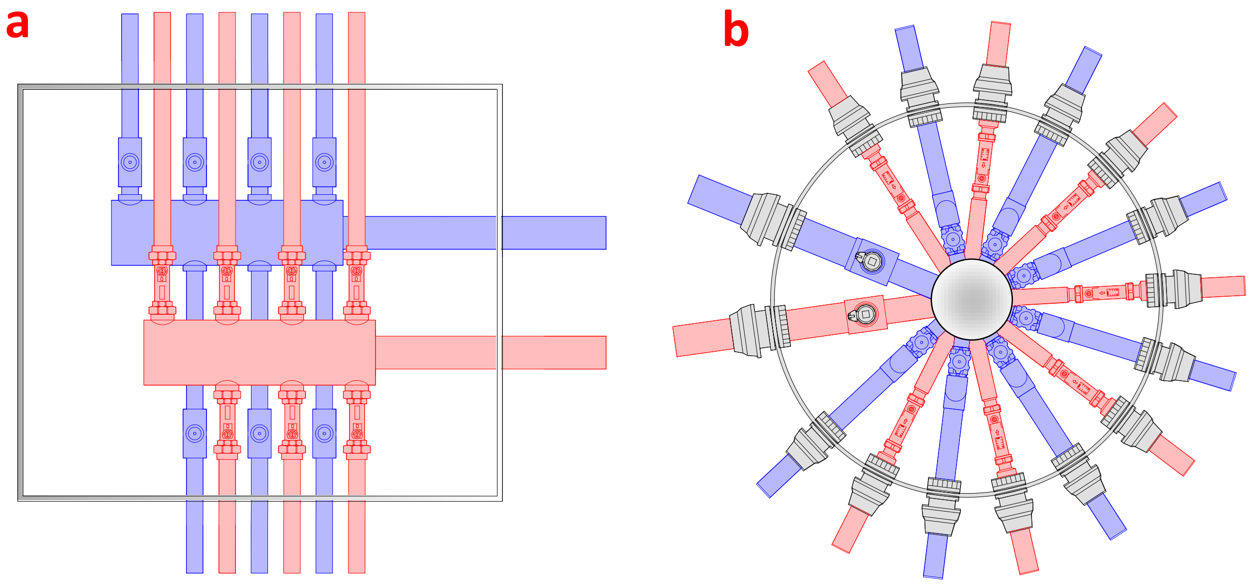
Distribution well manhole/topping – element which secures distribution well chimney by covering it from the top. The form of manhole depends on well's place of assembly and estimated outer load capacity.

3. DESIGN SOLUTIONS

3.1. DESIGN OF GEOTHERMAL MANIFOLD AND ITS COVER

Considering present technical solutions geothermal manifolds which are assembled in the ground and securely covered, exists in several configurations. Basic are:

- Inline manifold in plastic cover of rectangular section
- Cylindrical manifold in plastic cover of circular section

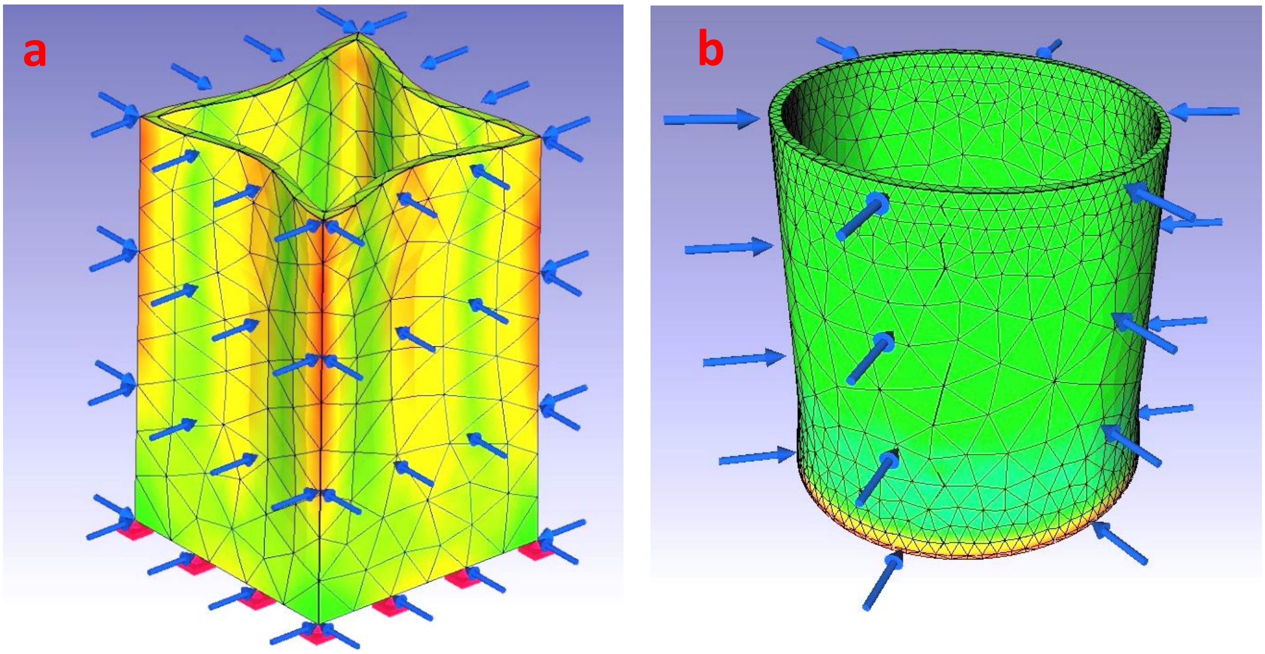


Graph 1. *Example of distribution well of rectangular section (a) and circular (b); View from above.*

In rectangular section shaped distribution wells, soil pressure affecting the cover can result in its major malformation (Graph 2a). In such solution, central part of distribution chamber wall can be damaged. Consequently it increases the risk of destroying built-in geothermal manifold.

In circular shaped distribution wells, pressures are being distributed evenly on chambers walls. The risk of damaging walls and the manifold has been minimalized (Graph 2b).

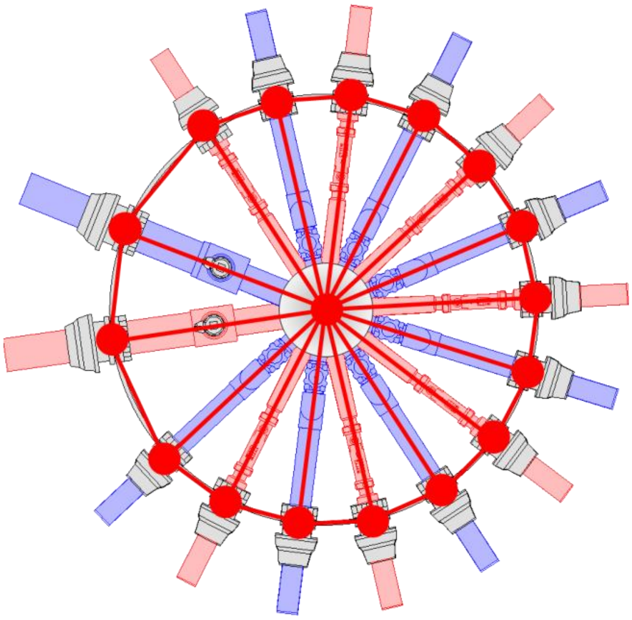
Radially spreaded collector sections enhances the cover and protects from malformation due to fixed point connections which are stiffening the construction.



Graph 2. *Distribution well model with rectangular (a) and circular (b) sections subjected to numerical simulation.*

3.2 BUILT-IN GEOTHERMAL MANIFOLD ASSEMBLY

Radially spreaded collector sections forms triangle geometrical surfaces which are properly connected and supported. It is the feature of one of the most durable types of construction.



Graph 3. *Example of circular section distribution well with radially spreaded collector sections and marked fixed*

points.

The usage of fixed point connections where collector sections passes through distribution well cover, minimalizes the risk of damaging the manifold by soil pressure.

3.3 COLLECTOR SECTIONS THROUGH DISTRIBUTION WELL COVER

Soil compaction process is based on increasing soil's density and decreasing it's porosity. It results in elimination of ground settlement, cover malformation and protection of built-in manifold.

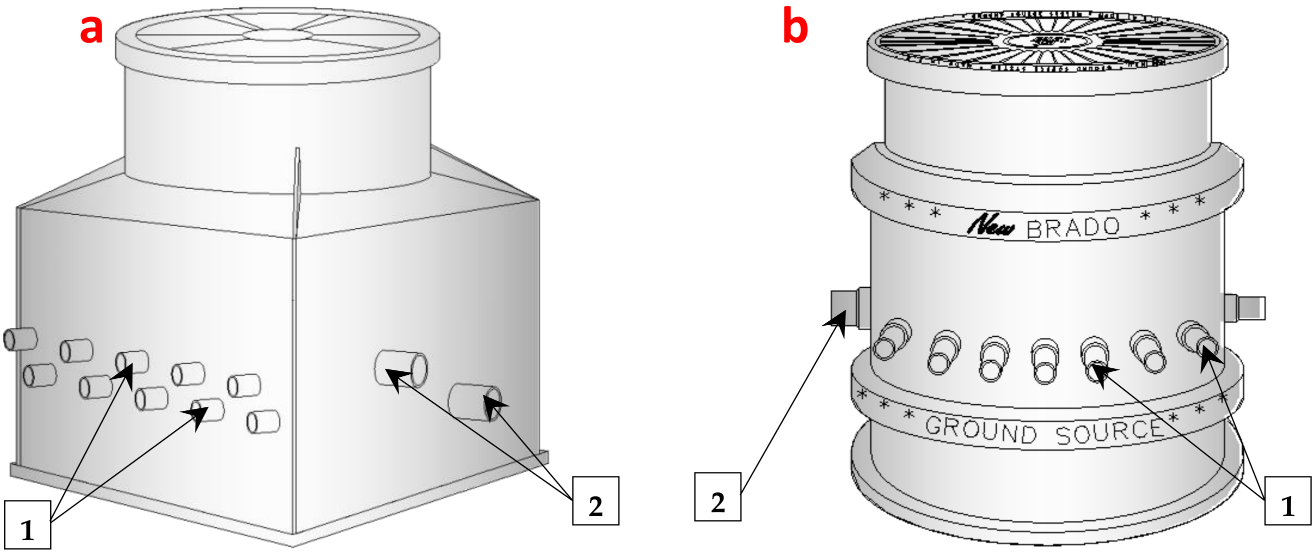
The basic condition which enables to compact the soil around distribution well properly, is placing collector sections (SK) horizontally in one row. Application of more than one row causes risk of damaging ground source installation during field work, performing soil compaction process and later on while exploitation in improperly thickened soil.

Supply and return sections are settled in pairs next to each other and allows connection of distribution pipes (RR) in grade-separated way, preventing them of crossing one another around distribution well.

Connection of distribution pipes (RR) and collector sections (SK) shall be done In a way that guarantees their perpendicular settlement in relation to distribution well cover. Extra attention should be focused on length compensation of pipes without tilting collector sections (SK).

Before connecting distribution pipes (RR) to distribution well, flushing process must be done. Skipping this process can result in manifold and its inner parts malfunction which can be observed as jamming flowmeter measurement system or inability to close valves.

Adjusting filter size/type during flushing process is essential in terms of securing fittings, through which fluid will flow.



Graph 4. *Example of rectangular section distribution well (a) with connections on two levels and circular (b) with connections on one level; 1 – SK, 2 – RD*

4. SOIL CONDITIONS EVALUATION AND ASSEMBLY

4.1. GROUND MATERIALS

Ground materials used in the foundation zone (backfilling) must ensure stabilization, safety and load-bearing capacity of the distribution well as well as other elements of the installation. At the stage of assembling geothermal well it is possible to apply subsoil (if it is compatible with the design requirements and there is a possibility of its compacting) or material supplied from outside the excavation. Materials that have a negative impact on the wells exploitation, in particular tree roots, rubbish, organic products, lumpy soils, snow and ice should be avoided.

Soil classification and its ability to use as backlifting or gravel pack is presented in **table 1.**

Table 1. The classification of soils and the possibilities of their use in accordance with DIN 18196

Soil classificatio n	Soil group	Possibility of backlifting/gravel pack	Examples
Non-cohesive	**1**	yes	Broken stone, river or sea gravel, moraine. Scoria, volcanic dust
	2	yes	Dune sands, drawn, valley and trough. Moraine, terrace and marginal sands
	3	yes	Weathered gravel, rock rubble, clay gravel. Sand hydrated, clayey, sand less. Clay sand, alluvial clay, marl
Cohesive	**4**	yes	Less, sandy loam. Alluvial alluvia, clay
Organic	**5**	no	Humus, chalk sand. Peat, sea chalk, humus. Silt, Less clay, sandy loam. Alluvial alluvia, clay
	6	no	Peat, unstable silts

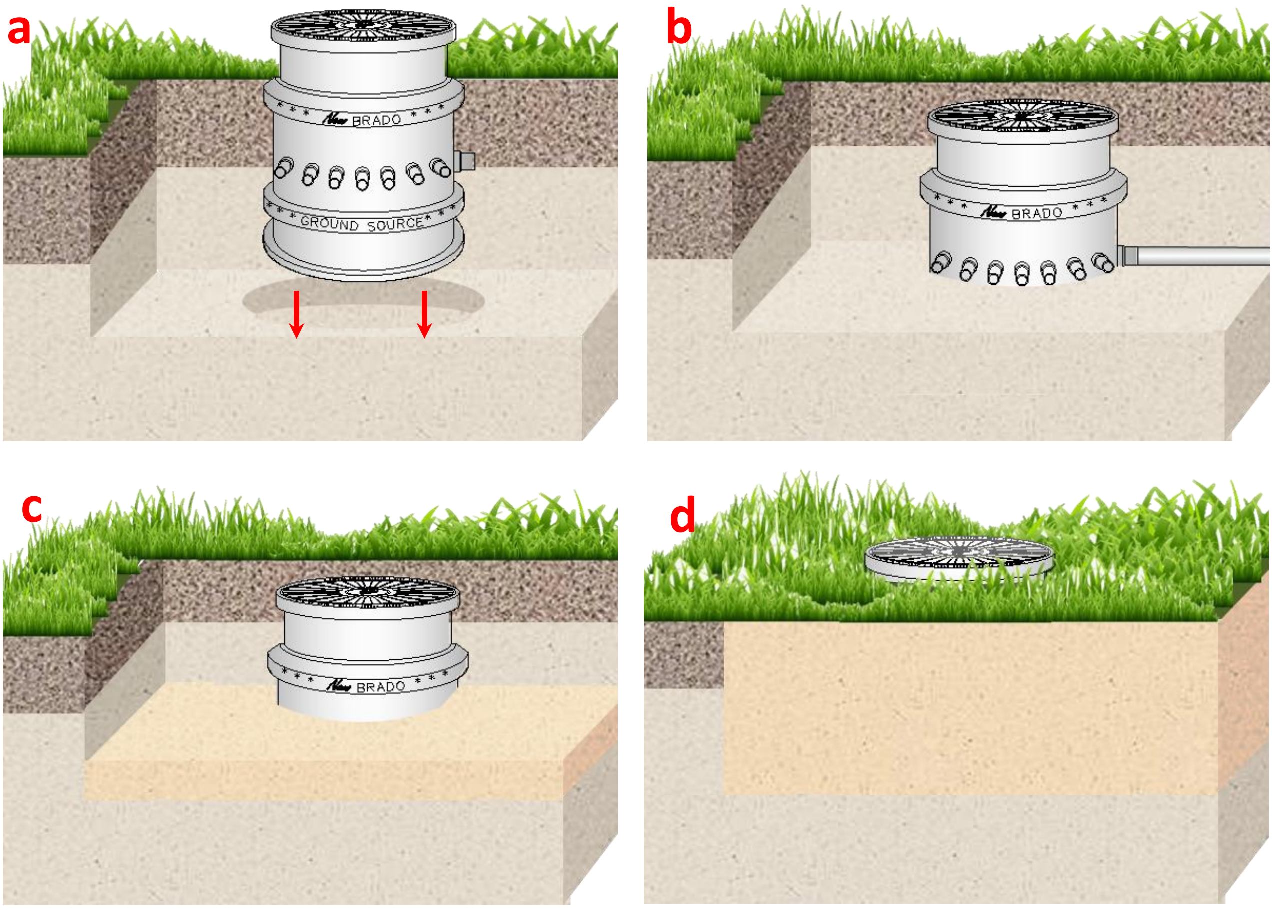
4.2 DISTRIBUTION WELL EXCAVATIONS

When carrying out excavation works for distribution wells, we should be ensured that previously accepted design assumptions are adequate to current at the investment site ground conditions. It is recommended the excavation to be deeper than the planned bottom of the chamber and wider than each of its external walls (in accordance with the technical card of the product). Distribution wells along with other elements of the installation can also be installed in a wide-open excavation.

When working with mechanized equipment, care should be taken not to allow excessive loosening of the subsoil and not to exceed the specified depth of the foundation of the lower source. If the well is installed on a prefabricated foundation bench, its size should be taken into account. It is not recommended to excavate the distribution well much earlier than just before its installation.

4.3 ASSEMBLING DISTRIBUTION WELL

The safety of the distribution well is affected by its construction, durability of the material from which it was made, proper method of its assembly and in particular the appropriate compaction of ground at the foundation (Table 1).



Graph 5. *Example of proper assemble of distribution well with collector sections spreaded horizontally in one row.*

The basic determinant of the proper method of setting the distribution well is soil and water conditions evaluation. The construction of the well should prevent it from moving, provide adequate peripheral stiffness and counteract the buoyancy force. Backfilling the excavation after performing required tests should be carried out in stages, starting from the wall of the well towards the excavation walls. It is recommended to compact the soil in layers to prevent over-ovalization of the distribution well. The first layer (about 30 cm) above the pipelines should be compacted by hand or with light equipment.

In case of backfilling a wide-span excavation and compaction of the soil directly next to distribution well, all stages must be carried out in compliance with the rules above while on all other remaining area, in accordance with the technical documentation of the construction site.

In the case of soils from groups 1-5 (Table 1), the procedures described below should be applied. In the case of grounds from group 6, assembling the distribution well directly in the ground without additional protection (e.g. retaining walls) should not be implemented.

4.3.1. ASSEMBLING DIRECTLY IN SUBSOIL

Stages of assembling distribution well in subsoil from group 1, 2, 3 (table 1):

- Construction of a thickened leveling layer with a thickness of 10-15 cm;
- Leveling the distribution well;
- Connecting the installation and performing leaking test;
- Stepwise backfilling of the trench and compaction of soil with ratio of at least 90% on the Proctor scale.

4.3.2. ASSEMBLING ON COHESIVE SOIL

Stages of assembling distribution well in subsoil from group 4, 5 (table 1):

• protection of the excavation against soil migration, e.g. geotextile;

• depending on the conditions, reinforce the ground with:

- compacted sand berm with a thickness of 15 - 25 cm;
- for a pressure-sand berm or compression-gravel berm with a thickness of 15 cm;
- a gravel-sand berm, press-sand or cement-sand berm with a thickness of 15 cm;
- 15 cm thick concrete or reinforced concrete slab;
- in the case of using a concrete / reinforced concrete slab, sand bedding should be used between the slab and the bottom of the well;
- leveling the well;
- connecting the installation and performing leaking test;
- stepwise backfilling of the excavation and compaction of the backfilling (one should use the easy-compacting material from group 1,2,3 from Table 1) with soil compaction index of at least 95 - 100% on the Proctor scale;

4.3.3. ASSEMBLING IN HIGH WATER LEVEL

Stages of the installation of the distribution well in subsoil with water level above distribution well bottom or with ground consisted of wet clay:

• drainage of the excavation - drainage should be carried out until the well is installed, the pipes are connected and the excavation backfilled up to the height which secure pipes against lifting or collapsing of the excavation;

• securing the excavation against soil migration e.g. geotextile (minimum to groundwater level);

• reinforcing the substrate e.g. with leveled concrete or reinforced concrete slab with thickness of 15 cm;

• between the concrete / reinforced concrete slab and the bottom of the well, apply sand bedding with a thickness of 10 cm;

• leveling the well;

• connecting the installation and performing leak test;

• stepwise backfilling of the excavation and compaction of the backfilling with a soil compaction index of at least 98 - 100% on the Proctor scale;

• distribution well chimney should be protected with a sand and cement backfill with a soil compaction ratio of at least 95 - 100% on the Proctor scale;

- distribution well chimney can be additionally secured with a concrete weight ring, which counteracts the buoyancy force.

5. CUSTOM DISTRIBUTION WELL HEIGHT

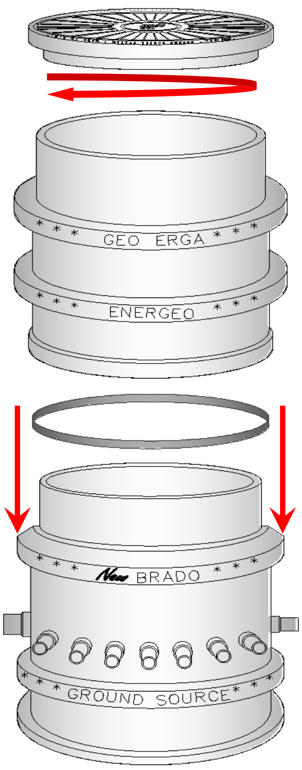
The height of the well can be adjusted to the ground level by shortening or lengthening its chimney. One should remember about the minimum (technical data sheet of the product) and the maximum (strength considerations included in the technical data sheet of the product) depth of the well foundation.

5.1 SHORTENING WELLS HEIGHT

In order to obtain the required height of the distribution well marked lines are placed on its outer cylindrical surface, according to which a cut should be made.

Note: Shortening the chimney of the distribution well makes impossible to close the manhole using the "twist-off" method. Then the method of imposition remains.

5.2 EXTENDING WELLS HEIGHT



The foundation of the well at a depth greater than its nominal height, should be carried out using a special dedicated gasket and extension. The gasket is evenly placed in specially contoured points of the well housing. After applying the extension, the pressure should be exerted from above in order to properly embed the combined elements. It is recommended to maintain this pressure when compacting backlift around the well.

It is unacceptable to use the same seal again.

It is required to remove it and then apply a new gasket before re-assembly.

The height of the extension can be adjusted to the ground level by shortening it.

NOTE: In order to close manhole using the "twist-off" method, the extension should be shortened from the bottom.

Graph 6. *Proper assemble of grease seal on distribution well*

6. INSTALLATION IN LOW TEMERATURES

Installation of the ground source for heat pumps, including geothermal distribution wells, at temperatures below 0 ° C is possible when appropriate rules and precautions are applied. In the case of making installation connections using thermal polyfusion method, protective covers or tents should be used in order to protect the place of welding against wind, moisture and low temperature. It is recommended electrofusion machines to be equipped with temperature compensation function that allows you to adjust the welding time to environment temperature.

7. WELL'S TOPPING

All pressures and micromotions that arise in the ground, mainly connected with dynamic load from vehicular traffic and seasonal temperature changes are compensated by means of the appropriate well top.

Table 2. *Well topping class A15.*

TOPPING CLASS	A15
TOPPING TYPE	PE manhole with thermal insulation
MAX LOAD CAPACITY	10kN
ASSEMBLE	Directly on well
APPLICATION	Surfaces for pedestrains and bicycle traffic
TOPPING CHARACTERISTICS	Consist of manhole made of high density poliethylene RC 100

Table 3. *Well topping class B125.*

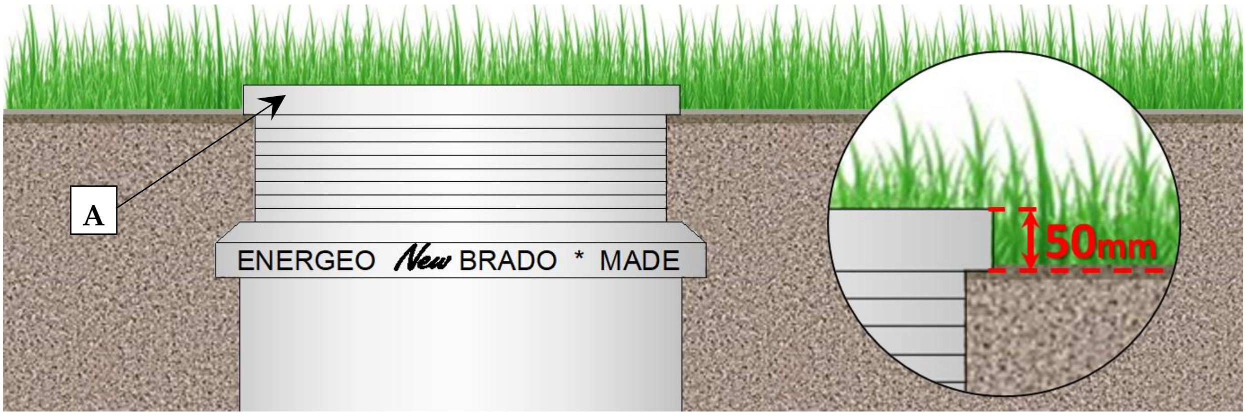
TOPPING CLASS	B125
TOPPING TYPE	Polyester manhole with load relief
MAX LOAD CAPACITY	125kN
ASSEMBLE	With load relief
APPLICATION	Roads and areas for pedestrians, parking lots or parking areas for automobiles
TOPPING CHARACTERISTICS	It consists of a manhole made of polyester and a cone made of polymer concrete. The cone acts as a relief for the well from the transferred loads

Table 4. Well topping class D400.

TOPPING CLASS	D400
TOPPING TYPE	Cast iron manhole with load relief ring
MAX LOAD CAPACITY	400kN
ASSEMBLE	With load relief ring
APPLICATION	Roadways (including pedestrian road sections), paved roadsides and parking areas, for all types of road vehicles
TOPPING CHARACTERISTICS	It consists of a cast iron manhole and a relief ring made of reinforced concrete. The ring acts as a relief for the well from the transferred loads.

7.1 TOPPING CLASS A15 - STAGES

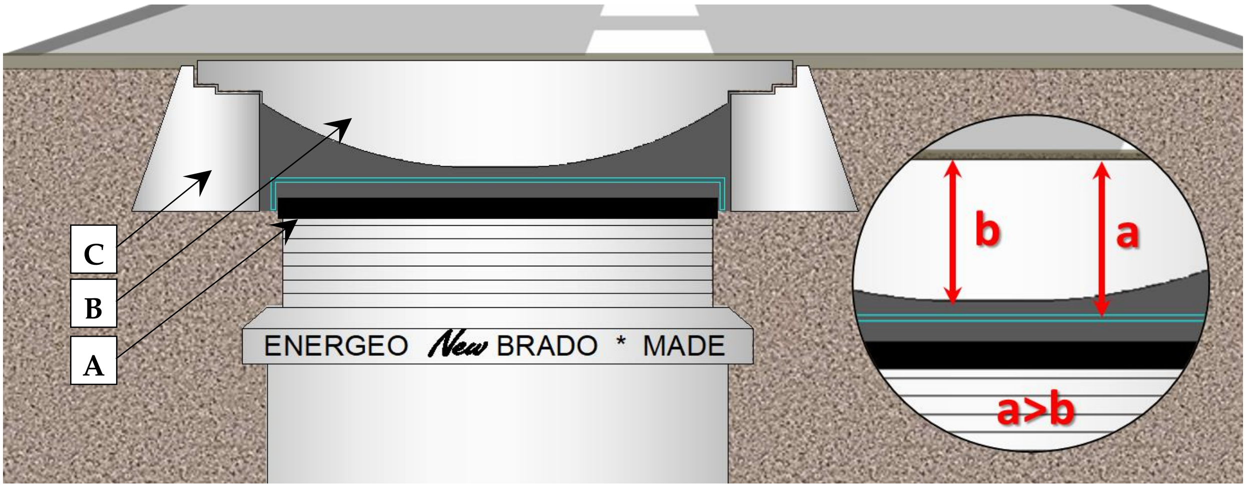
- Assembling the well and compacting the ground in accordance with chapter 3;
- Upper part of the well and bottom part of the manhole (in connection point) shall be cleaned;
- While placing manhole on the well it should be twisted until;
- It is recommended to maintain this pressure while compacting the backlift around the well;
- Manhole shall extend 5 cm above ground level;



Graph 7. *Example of topping class A15; A-PE manhole with thermal insulation.*

7.2. TOPPING CLASS B125 - STAGES

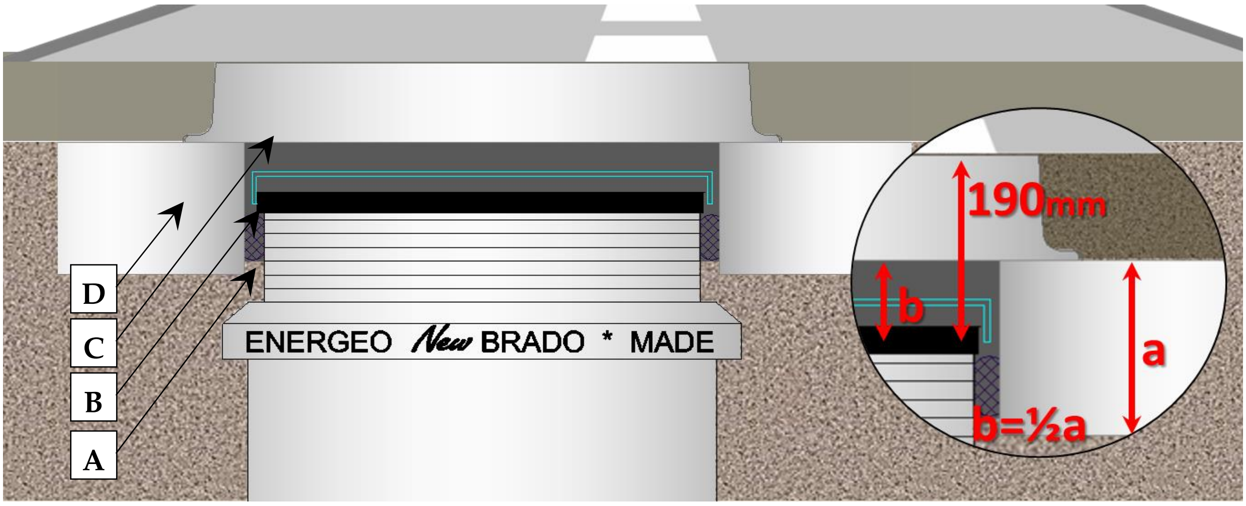
- Assembling the well and compacting the ground in accordance with chapter 3;
- Upper part of the well, bottom part of TUBONG sealing hood (in place of connection) and manhole type B shall be cleaned;
- Assembling grease seal and TUBONG sealing hood on the edge of well's chimney, than load relief cone;
- Distribution well should not have direct connection with;
- The height (a) between TUBONG hood and the upper edge of cone should fit in range of 13-15 cm. It should not be smaller than the height of manhole ribbing.
- Placing the manhole (should not lay on TUBONG hood. Backlifting and compaction around the cone



Graph 7. *Example of topping class B125;* **A** – TUBONG sealing hood with grease seal; **B** – PE manhole; **C** – load relief cone.

7.3. TOPPING CLASS D400 - STAGES

- Assembling the well and compacting the ground in accordance with chapter 3;
- Upper part of the well and bottom part of TUBONG sealing hood (in place of connection) shall be cleaned;
- Assembling grease seal and TUBONG sealing hood on the Edge of well's chimney, than reinforced-concrete ring;
- Distance (b) between well's chimney and the bottom edge of the manhole shall be half of the height of relief ring (a) – about 19 above ground ordinate;
- Fill with backlift material the gap between chimney of the well and load relief ring;
- Placing hatch body nad the manhole on properly mounted relief ring. Alignment of the soil's top layer.



Graph 8. *Example of topping class D400;* **A** – backlifting material; **B** – TUBONG sealing hood with grease seal; **C** – cast iron manhole; **D** – symmetrical/unsymmetrical load relief ring.

7.4 TOPPING SELECTION

***Table 6.*.** *Topping selection for NEW BRADO and ALTRA SCANDIC distribution wells.*

TOPPING CLASS:	CLASS A		CLASS B		CLASS D	
	STANDARD	*ERGA EXTENSION POT*	*STANDARD*	*ERGA EXTENSION POT*	*STANDARD*	*ERGA EXTENSION POT*
PE MANHOLE	+	+	-	-	-	-
POLYESTER MANHOLE	-	-	+	+	-	-
LOAD RELIEF CONE	-	-	+	+	-	-
CAST IRON MANHOLE	-	-	-	-	+	+
LOAD RELIEF RING (SYMMETRICAL)	-	-	-	-	+	+
GREASE SEAL	-	-	+	+	+	+
BAGELAN B SEAL	-	+	-	+	-	+
TUBONG SEALING HOOD	-	-	+	+	+	+
BACKLIFTING	-	-	-	-	+	+

MATERIAL						

Indications: (+) should mount; (-) should not mount

Table 7. *Topping selection for SPIDER distribution wells*

TOPPING CLASS:	CLASS A		CLASS B		CLASS D	
	STANDARD	*ERGA EXTENSION POT*	*STANDARD*	*ERGA EXTENSION POT*	*STANDARD*	*ERGA EXTENSION POT*
PE MANHOLE	+	-	-	-	-	-
POLYESTER MANHOLE	-	-	+	-	-	-
LOAD RELIEF CONE	-	-	+	-	-	-
CAST IRON MANHOLE	-	-	-	-	+	-
LOAD RELIEF RING (UNSYMMETRICAL)	-	-	-	-	+	-
GREASE SEAL	-	-	+	-	+	-
BAGELAN B SEAL	-	-	-	-	-	-
TUBONG SEALING HOOD	-	-	+	-	+	-
BACKLIFTING MATERIAL	-	-	-	-	+	-

Indications: (+) should mount; (-) should not mount

8. THERMAL INSULATION

It is required to insulate pipelines, fittings and other elements of the ground source system located in the ground frosting zone. In distribution wells, it is recommended to use an insulated manhole or dedicated thermal inserts.

9. STORAGE

Storage should take place in conditions that stored items are not exposed to damage. Wells should be stored at a temperature below 40 ° C, protecting against direct sunlight and contact with lubricants, oils, etc. It is not allowed to store pallets with wells on top of each other.

10. TRANSPORT

During loading, transport and unloading, the products should be protected from damage by special non-metallic ropes or belts. It is unacceptable to throw the well from the vehicle. In case of any doubts about the technical condition of the product, it must not be mounted and it is necessary to contact the technical department of the supplier.

11. DOCUMENTS/LEGAL ACTS RELATED TO THE PRODUCT

- **PN-EN 12201 - Plastic pipe systems for water and sanitary sewage - Polyethylene (PE)**
  - Part 1: General provisions;
  - Part 2: Pipes;
  - Part 3: Fittings;
  - Part 4: Armature.
- **PN-EN ISO 14688 – Geotechnical research – classification of soils –**
  - Part 1: Classification and description;
  - Part 2: Terms of classification.
- **PN-EN 124 – Wells topping for pedestrian and car traffic**
  - Part 1: Definition, classification, design principals;
  - Part 2: Toppings made of iron;
  - Part 6: Toppings made of polypropylene (PP), polyethylene (PE) or nonplastic poly(vinyl chloride) (PVC-U);
- **PN-EN 1267:2012 – Industrial armature – Water resistance research;**
- **PN-B-02481:1998 - Geotechnic – Basic terminology, symbols;**
- **PN-EN ISO 1167 - Pipes and fittings made of thermoplastic for water transport – labeling for outer pressure –**
  - Part 1: General method;
- **PN-ISO 9624:2001- Thermoplastic pipes for transporting water under pressure—Adaptation of dimensions of flange bushes and loose fixing flanges;**
- **VDI 4640 - Thermal use of the underground - Fundamentals, approvals, environmental aspects ;**
- **DIN 16842:2013-05 - Polyethylene (PE) pipes - PE-HD for pressureless applications - General quality requirements, dimensions and test;**
- **DIN 18196 - Earthworks and foundations - Soil classification for civil engineering purposes;**
- **DIN 18127 - Soil, investigation and testing - Proctor-test;**
- **BS 5930 – Code of practice for site investigation.**
- **PN-EN 13598-2:2016-09 - Plastic pipe systems for underground atmospheric pressure and sanitary sewerage-- Nonplastic poly(vinyl chloride) (PVC-U), polypropylen (PP) iand poliethylen (PE) –**
  - Part : Technical specification of auxiliary fittings with inspection wells.
  - Part 2: Specification of manholes and non-manholes
- **PN-EN 14830:2007 – Basis of plastic manholes and non-manholes—deformation resistance research**
- **Guidelines for the design, construction and commissioning of installations with heat pumps**
  - Part 1: Ground source.
- **EN.OZE.20-15.WW – Ground source performance requirements;**