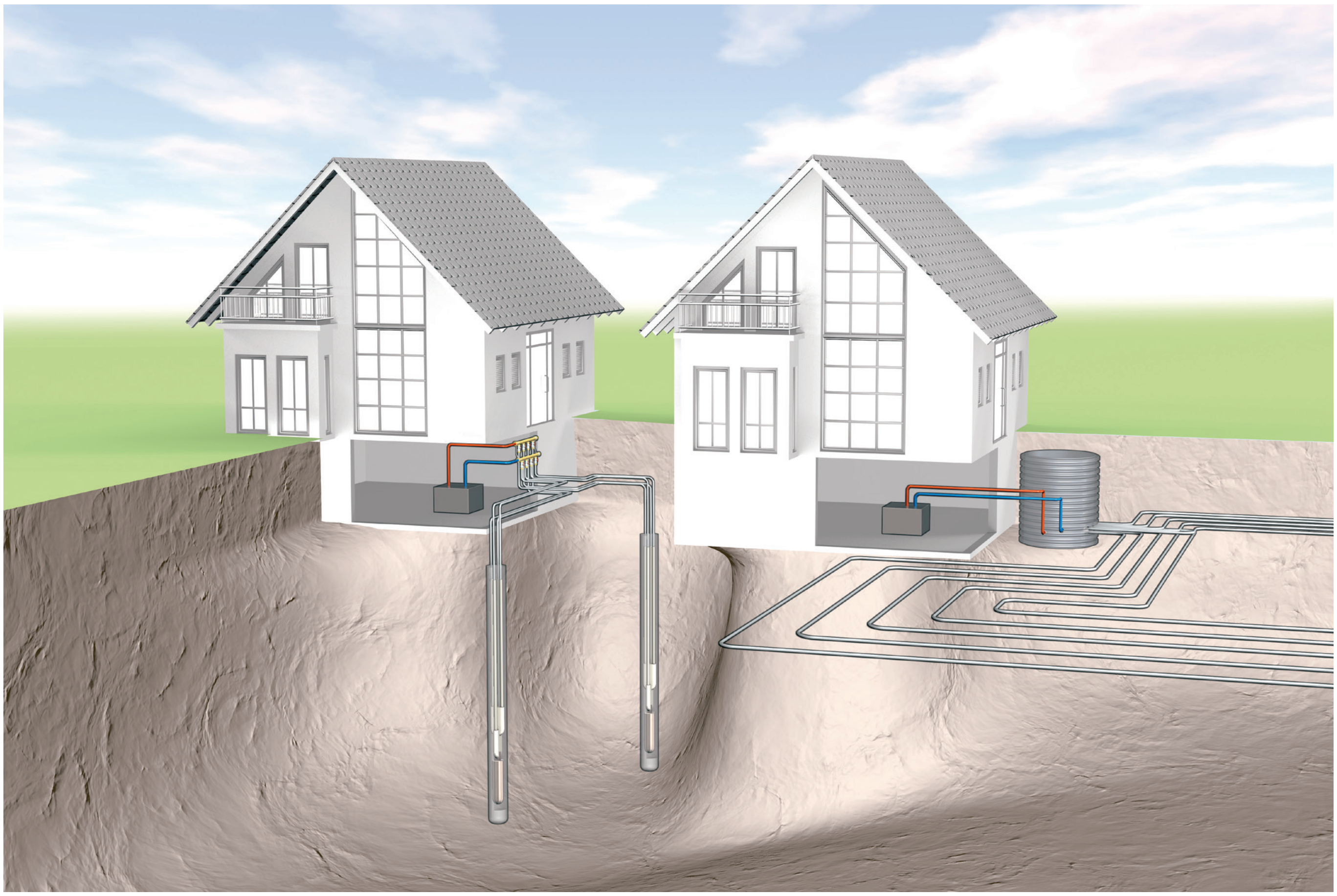
Unlimited Polymer Solutions



RAUGEO™ GROUND LOOP HEAT EXCHANGE SYSTEM

TECHNICAL MANUAL

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International Ground Source Heat Pump Association

INTERNATIONAL ASTM F 876 / F 877 ASTM F 2023 / F 2080

QUALITY MANAGEMENT REHAU ISO 9001 2000 SYSTEM

PLASTICS·PIPE·INSTITUTE™

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1. SCOPE

This technical information applies to the planning, installation and connection of the RAUGEO ground loop heat exchange system including the fittings, accessories and tools as described below.

This information gives direction to design and specification professionals, as well as appropriately licensed installation professionals who have a working knowledge of local codes. Persons using this manual must have an understanding of the principles and practices for design and installation of ground loop heat exchange systems. It is the responsibility of the licensed engineer and installer to check the prevailing local codes and verify that the technical information presented in this manual is appropriate for the application.

2. FIELD OF APPLICATION

RAUGEO pipes and compression-sleeve fittings are recognized by the International Ground Source Heat Pump Association's (IGSHPA) "Design and Installation Standards 2008 Edition" guide as an accepted piping system for ground loop heat exchangers.

The RAUGEO ground loop heat exchange system is used to convey water or a water glycol fluid to capture ground energy for cooling, heating or energy storage purposes. In general, the following applications can be supported:

Radiant Heating
- Floor or wall heating
- Concrete core tempering

Radiant Cooling
- Ceiling or floor cooling
- Concrete core tempering

Forced Air Heating or Cooling
- Improves the energy efficiency of traditional heating and cooling methods

Advantages of Using Ground Energy

Ground energy offers:
- An economical source of energy largely independent of the weather or season
- A substantial reduction of CO_2 emissions
- Energy savings of up to 50% over traditional HVAC systems

The RAUGEO systems are provided in the following configurations for these purposes:
- RAUGEO U-bends (vertical loop). See Fig 1.
- RAUGEO Collect (horizontal loop). See Fig. 2.

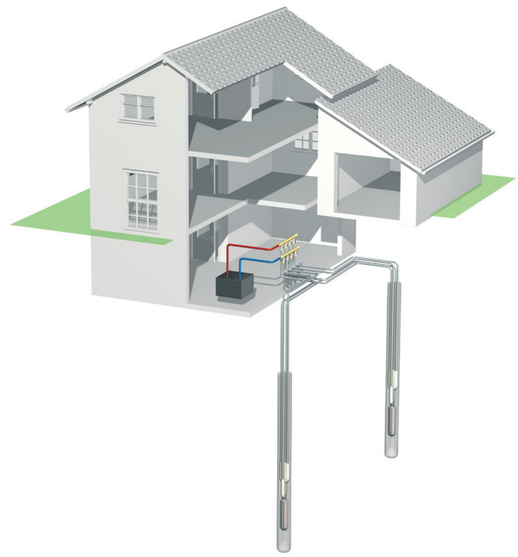


Fig. 1: Vertical ground loop, RAUGEO U-bend

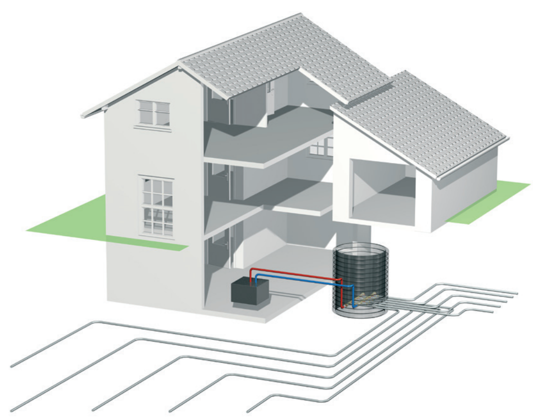


Fig. 2: Horizontal ground loop, RAUGEO Collect

3. PROPERTIES OF RAUPEX PIPE

RAUGEO systems are made from REHAU's high-pressure cross-linked polyethylene (PEXa) pipe, marketed under the tradename RAUPEX. The superior properties of RAUPEX pipe give the RAUGEO system the following advantages over conventional systems using high density polyethylene pipe:

- Resists slow crack growth, withstanding nicks and abrasions during installation or rock impingement after installation.
- Eliminates the need to cut out kinks; the pipe can be brought back to its original shape by simply applying heat with a heat gun.
- Useable for heat storage applications for temperatures above 100°F (38°C).
- Flexiblity allows a continuous piece of pipe to be bent in a tight 180° radius to create the 1 in. RAUGEO U-bend; no underground connections are required.

Mechanical Properties of RAUPEX Pipe

Material	High-pressure peroxide crosslinked polyethylene (PEXa)
Compliant with standard ASTM F876, CSA B137.5	Pipes 1" SDR9 CTS + 1 1/4" SDR9 CTS
Long-term temperature/pressure ratings according to ASTM F876	160 psi @ 73.4°F (1055 kPa @ 23°C) 100 psi @ 180°F (690 kPa @ 82.2°C)
Constant operating temperatures	-4° to 180°F (-20° to 82.2°C)
Peak temperature	200°F (93.3°C)
Minimum laying temperature	-40°F (-40°C)
Thermal conductivity	2.84 Btu in./(ft^2°F hr) [0.41 W/(m°K)]
Minimum bending radius	1" U-bend - 5.75 in. (144 mm) 1 1/4" U-bend - 7.00 in. (178 mm)
Notch impact strength	Very high
Crack growth during full notch creep test	No failure
Filling material[2]	Surrounding soil
Pipe roughness	0.00028" (0,007 mm)
Average thermal coefficient of longitudinal expansion	9.33 x 10^{-4} in/ft°F (0.14 mm/m°C) @ 68°F (20°C)
Chemical resistance[1]	Wide range of chemicals
Density	58 lb/ft^3 (926 kg/m^3)
IZOD impact strength according to DIN 53453	No break
Requirement on material for piping zone[2]	Excavated material (usually has higher thermal conductivity than sand filling)
Suitability for heat storage	Unrestricted [operating temp. up to 180°F (82.2°C)]
Suitability for cooling with chiller	Yes [operating temp. to -4°F (-20°C)]

Table 1

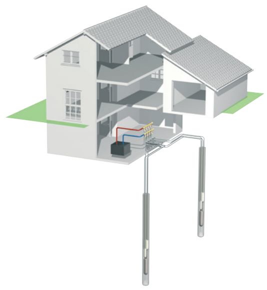
[1] The PEXa used for RAUGEO ground loop heat exchange systems is resistant to a wide variety of chemicals. However, while some chemicals may not harm PEXa, chemical concentration, temperature, pressure and other parameters can influence the suitability and service life of the PEXa application. Do not bury PEXa in contaminated soil. If you have questions regarding chemical compatibility, please contact your REHAU sales representative.

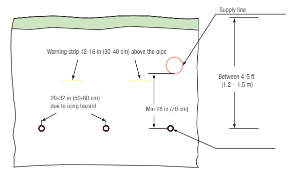
[2] Native excavated material can be used for piping zone and backfill if: (1) material can be well compacted; (2) maximum grain size does not exceed 2 1/2 in. (63 mm); and (3) no stones that could pinch the pipe are laying on RAUPEX.

4. PRODUCT RANGE DESCRIPTION

4.1 Overview

Table 2 describes the RAUGEO range and its applications.





Application		
System designation	RAUGEO U-bend	RAUGEO Collect
Fields of application	Vertical borehole	Horizontal loop field
Material	PEXa	PEXa
Color (surface)	Gray	Gray
UV Protection	UV stabilized outer sheath	UV stabilized outer sheath
Laying methods	Borehole	Excavated material
Dimensions	1" CTS (SDR9) probe base diameter 3.94 in (100 mm); 1 1/4" CTS (SDR9) probe base diameter 4.79 in (127 mm)	3/4" CTS, 1" CTS, 1 1/4" CTS (SDR 9)
Use in	- Restricted space - High efficiency requirements, primarily cooling	- Ample space - Low requirements on cooling efficiency
Suitable field of application	Heating and cooling with heat pump and/or direct cooling	Heating and cooling with heat pump and/or limited direct cooling Direct cooling usually with very low efficiency (exception: e.g. flowing ground water)

Table 2

4.2 RAUGEO U-bend

4.2.1 Description

The RAUGEO double U-bend is made up of two single U-bends connected using attachment hardware. To create the base of the 1" U-bend, RAUPEX pipe is formed into a 180° angle, eliminating any joints along the length of the U-bend. The angled section of the U-bend is then cast in fiberglass-reinforced polyester resin, providing an extremely strong U-bend leading edge that helps provide resistance to handling or installation damage*. RAUGEO single U-bends are also available.

RAUPEX pipe is equipped with a UV-stabilized outer sheath for protection during installation.

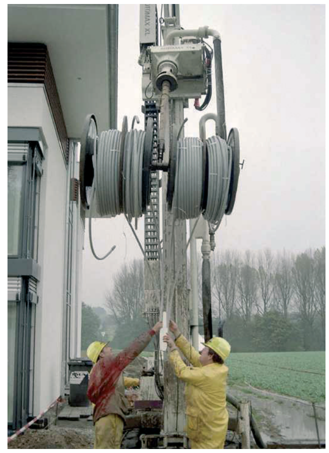


Fig. 4: Installation of a RAUGEO U-bend

Fig. 5: Base of the RAUGEO U-bend with weight

4.2.2 Properties

The excellent material properties of RAUPEX pipe and the design of the RAUGEO U-bends offer the following technical advantages:

- Reliability: there is little danger of leaks at the base of the U-bend
- Durability: the effect of notches and grooves incurred during borehole installation is greatly reduced since RAUPEX pipe is extremely resistant to slow crack growth
- Security: the U-bend leading edge is resistant to damage due to its encasement in a special, high-strength polyester resin, or stainless steel material
- Tight bending radius: 1" CTS RAUPEX has a 10 in (25 cm) bending radius (at 68°F (20°C))
- Highly resistant to abrasion
- Cold weather installation: stays flexible and is easy to install
- Years of use even under high operating loads

4.2.3 Packaging

- Coil Lengths: see price list; up to 360 ft for 1" or 510 ft for 1 1/4"
- Double U-bend delivery package: two single U-bends on a pallet, in black shrink film, including fastening screws
- Single U-bend delievery package: individually wrapped in black shrink film with a cardboard disk on top and bottom

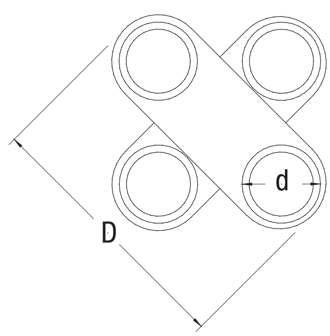


Fig. 6: Cross section of U-bend

4.2.4 U-bend Base Assembly

Each pallet delivered to the jobsite will have two single U-bends stacked one atop the other. Before insertion into the borehole, the two single U-bends are bolted together with two socket head cap screws. Additionally, to aid in borehole insertion, a weight can be attached to the base of the U-bend with two socket head cap screws.

A set of two socket head cap screws is supplied with each U-bend and each weight.

**To create the case of the 1 1/4" U-bend, RAUPEX pipe is assembled onto a prefabricated stainless steel tip. The tip section is then covered in a rubber dip. The process takes place in a facility that is controlled by ISO 9001 procedures.*

4.3 RAUGEO Collect

4.3.1 Description

RAUGEO Collect is an extremely rugged horizontal ground loop heat exchange system made of RAUPEX pipe. This PEXa pipe is equipped with a UV-stabilized outer sheath for protection during installation.

4.3.2 Properties

The excellent material properties of RAUPEX pipe offer the following technical advantages:

- Very durable: the effect of notches and grooves incurred during installation is greatly reduced since RAUPEX pipe is extremely resistant to slow crack growth
- Resistant against rock impingement
  - Excavated material can be used as the filling material
- Tight bending radius: 1" CTS, 5.75 in (144 mm) bending radius [at 68°F (20°C)]
- Highly resistant to abrasion
- Cold weather installation: stays flexible and is easy to install
- Years of use even under high operating loads

4.3.3 Delivery Package

- Supplied lengths: see price list, up to 800 ft depending on pipe dimensions
- Special lengths available upon request
- Individually packaged coils

Fig. 7: RAUGEO Collect building site

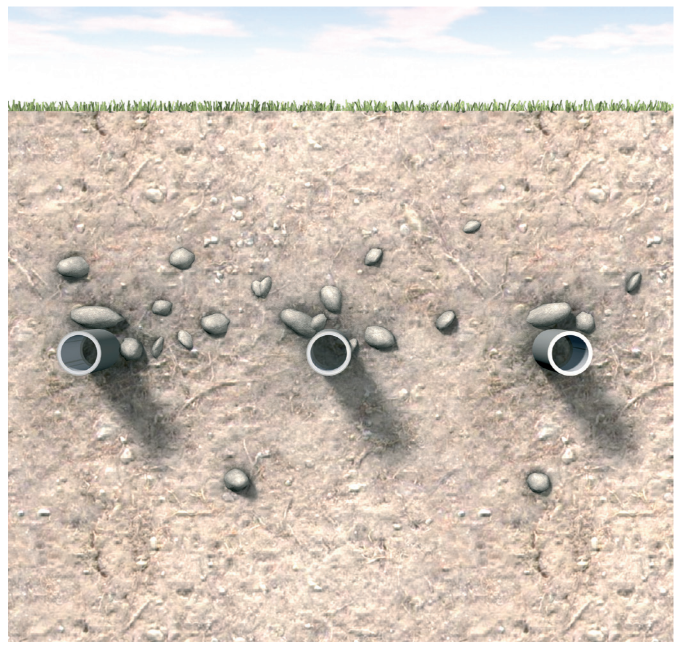


Fig. 8: RAUGEO Collect in excavated material

4.4 RAUGEO Manifold

4.4.1 Description

The RAUGEO manifold provides geothermal installers with an engineered distribution solution for geothermal ground loop fields.

4.4.2 Properties

The high-quality manifold solution together with the excellent properties of RAUPEX pipe offers the following technical advantages:

- Easily accessible
- All connections are made above ground
- Secure mechanical connections
- Each circuit is easily purged individually with circulation pump
- Circuit flow adjustment allows for varying borehole depths
- Allows installation and design flexibility based on location geology
- High security through easy isolation of each connected pipe

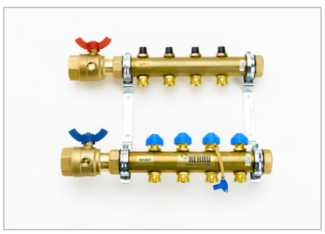


Fig. 9: Brass manifold

4.4.3 Manifold for the Ground Loop

The supply and return lines can be routed to a manifold. It is recommended that each U-bend length is within 5% of the others to minimize the balancing required. If there are U-bends with lengths greater than 5% of the others, then the flow can be easily balanced using the balancing valves on the 1 1/4" PRO-BALANCE Brass Manifold.

4.4.4 Manifold Installation

4.4.4.1 Manifold Position

The manifold should be positioned at the highest point of the ground loop heat exchange system. The pipe should be laid at a slight gradient to the manifold so that purging air from the system will be effective. The manifold can be installed horizontally or vertically.

4.4.4.2 Manifold Location

Since condensation will often form on the above-ground portion of the ground loop heat exchanger, manifolds should be insulated. If insulating is not possible, we recommend that it should be installed outside of the building in a protected enclosure.

If the manifold is installed inside the building, it must be ensured that the RAUPEX pipes are not in contact with the house wall. Applying 1.5 in (4 cm) thick rigid foamed polyurethane sleeves prevents the wall from becoming damp with condensation and the pipes from being damaged by changes in length. In-house installations of uninsulated metal manifolds should allow for condensate collection.

4.4.4.3 Manifold Pipe Connection

Pipes should be bent to a 90° angle before the connection to the manifold. This prevents the forces in the pipes caused by thermal expansion and contraction from being applied to the manifold, and compensates for the forces in the pipe bend.

If not using a manifold, the pipes should be connected according to the grid (Tichelmann) principle to ensure an even flow through all pipes from the collector/U-bend to the manifold (see Fig. 10 and 11).

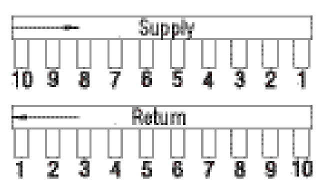


Fig. 10: Single-sided supply and return

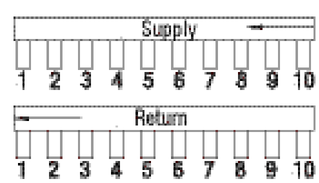


Fig. 11: Alternating supply and return

5. DESIGN OF A GROUND SOURCE HEAT PUMP SYSTEM

5.1 Principles of a Ground Source Heat Pump System

Ground source heat pumps are electrically powered systems that tap the stored energy of the greatest solar collector in existence: the earth. These systems use the earth's relatively constant temperature to provide heating, cooling and hot water for homes and commercial buildings (IGSHPA).

Fig. 12 shows the typical ground temperature for a mid-latitude location to a depth of 65 ft (20 m). Note that at the 4-6 ft (1.2-1.8 m) depth, the typical location for a horizontal ground loop, the temperature values are between 45°- 55°F (7°-13°C). At 65 ft (20 m), the temperature stays almost constant at 51°F (10°C) throughout the year. At depths past 65 ft (20 m), the ground temperature will increase between 1°-3°F per 100 ft (0.5°-1.6°C per 30.5 m).

5.2 Effects on the Environment

A horizontal loop ground source heat pump system, if not designed large enough for the heating load, can have an effect on vegetation by extending the “cold period” of the soil. For instance, when the loop is under-sized, the energy extracted during the winter heating operation of the heat pump will be greater than what can be replenished. This situation will cause the soil temperature near the buried pipe to stay colder than normal for a longer period of time.

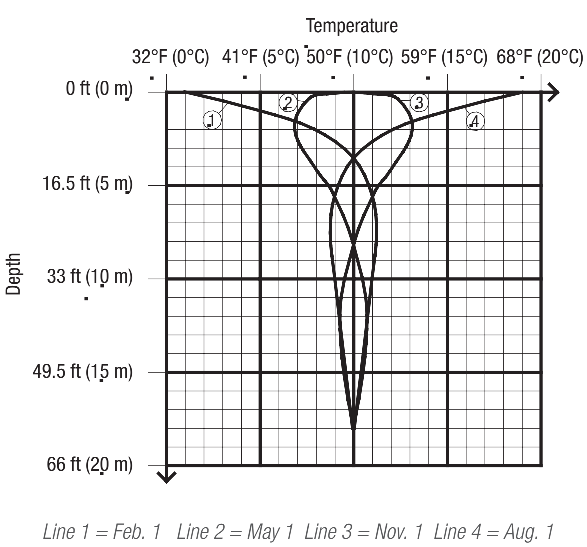


Fig. 12 Typical ground temperature for a mid-latitude location to a depth of 65 ft (19.8 m)

Under-sizing a horizontal ground loop can also have an effect on the efficiency of the ground source heat pump system. Through successive heating and cooling periods, an undersized system will tend to extract more energy than the ground can replace. Freezing or over-heating the soil will impact the efficiency of the system because the designed entering water temperature (EWT) will not be met, thus lowering the designed coefficient of performance (COP) of the system.

The licensed engineer and installer should identify the impact of any site-specific conditions on vegetation and system performance.

5.3 Design Basics

A well designed ground source heat pump system effectively integrates all elements of the system to minimize the initial investment and operating costs while maximizing system efficiency.

Since the ground loop heat exchanger is a component of a ground source heat pump system, steps must be taken to ensure that the exchanger and all other system components are well designed and operationally compatible. These steps include:

– Determining the building’s heating and cooling loads
– Sizing and selecting the heat pump
– Sizing and selecting the building heating / cooling distribution system
– Determining the building’s energy requirements
– Sizing the ground loop heat exchanger

For the design of smaller systems (8 tons or smaller) use the IGSHPA publication, “Closed Loop / Ground Source Heat Pump Systems, Installation Guide,” or “CSA C448.1 Design and Installation of Earth Energy Systems for Commercial and Institutional Buildings” as a guide.

For the design of larger systems (above 8 tons), use the American Society of Heating, Refrigerating and Air-Conditioning Engineers’ (ASHRAE) publication, “Ground-Source Heat Pumps, Design of Geothermal Systems for Commercial and Institutional Buildings,” or “CSA C448.2 Design and Installation of Earth Energy Systems for Residential and Other Small Buildings” as a guide.

5.4 Choice of Vertical or Horizontal or Heat Exchanger

One of the key considerations for any ground loop heat exchange system is the site conditions. The choice of the type of ground loop heat exchanger (vertical or horizontal) is based on the cost, ground conditions and the space available for the ground loop. Typically, due to excavation costs, a horizontal system will be less expensive to install than a vertical system.

In areas where the soil depth is adequate and the space is available (i.e. a home on a 1-acre lot), a horizontal system should be considered. In areas where space is limited or the subsurface conditions don't allow for a horizontal system, a vertical ground loop heat exchanger should be considered.

A good knowledge of the local geology and hydrogeology helps to determine the thermal and hydraulic properties of the ground, resulting in a more efficient ground loop heat exchange system design.

5.5 Design and Installation of RAUGEO Collect (Horizontal Loop)

5.5.1 Design

The design of horizontal ground loop heat exchangers is described in IGSHPA's "Closed Loop / Ground Source Heat Pump Systems, Installation Guide."

5.5.2 Installation

Typically, the pipes of a horizontal system will be laid at a depth of 4-6 ft (1.2-1.8 m) and at an interval of 20-30 in (51-98 cm). The exact pipe pattern will be affected by the site conditions including soil temperature and space available and can be determined through the design methodology given in IGSHPA's installation guide.

Since the regeneration of horizontal ground loops occurs mainly from above via solar radiation and rainfall, the loop must not be installed under sealed areas. Exceptions to this rule must be confirmed during planning. For example, an exception may be possible if a horizontal loop is used both for heating and cooling and each mode contributes equally to the regeneration of the soil. Caution must be used if the loop is installed under a building, because if the operating temperature approaches the freezing point of water, frost heaving may affect the foundation.

Either trench or open-field installation can be used for RAUGEO Collect. For trench laying, one side of the trench is made by an excavator. The pipes are laid and then filled with the soil from the other trench side (see Fig. 13).

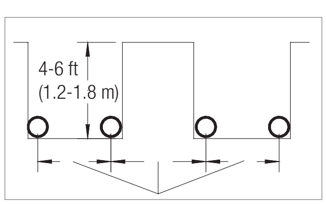


Fig. 13: Trench installation

Pipes can be laid in either a single or multiple layer configuration, depending on site conditions and energy load requirements.

For open-field installation, the entire collector area is exposed and leveled (see Fig. 17). Some common options are shown in Fig. 14-16. The spiral laying method can be used for open-field installation. The serpentine installation method in Fig. 15 and the Tichelmann method in Fig. 16 are particularly suitable for trench installation. In open-field installation, the pipes can be fastened using the REHAU laying aid. This allows pipe registers to be easily constructed.

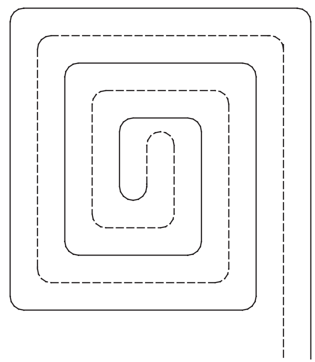


Fig. 14: Spiral method

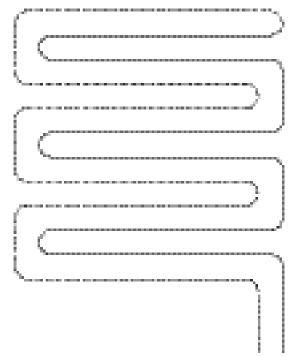


Fig. 15: Serpentine method

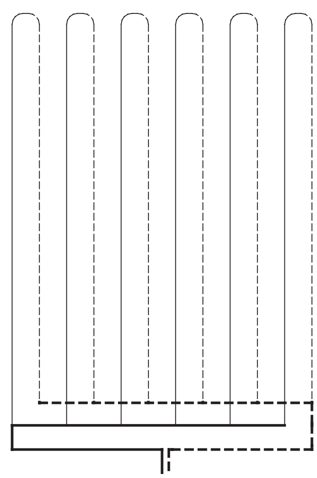


Fig. 16: Grid (Tichelmann) method

Note: Once large rocks are removed, the material excavated from the trench can be used with the RAUPEX pipes since they are highly resistant to crack growth. Pipes should not be laid in soil with large air gaps (such as gravel) since air cavities reduce the heat transfer between the pipe and the soil. If the pipe is to be buried in gravel, a fine soil should be used around the pipes to ensure effective heat transfer.

Fig. 17: Open-field installation

Installation Steps

Fig. 18: Uncoil pipe

Fig. 19: Stake pipe in place

Fig. 20: Pressure test system before burial

Step 1

– Choose a manifold location at the highest point of the loop system.
– The manifolds can be installed in a plastic or concrete vault. Alternatively, the manifold can be located in the basement of the building with the ground loop pipes penetrating the basement wall through a 4” or 6” PVC wall penetrator.
– Connect the collector pipes to the manifolds using the method chosen in Section 4.4.4.3.

Note: Vaults used to house manifolds must provide complete coverage of the components inside, as the RAUPEX pipe must be protected against UV radiation.

Step 2

Open-Field Installation

– Lay and align the pipes at the required distance and fasten with laying aids.
– Ensure that the bending radius of RAUGEO Collect is observed.

Step 3

- Connect a purging unit to the ground heat exchange system between the manifold or reverse-return header and the heat pump.
- Before starting the purging unit pump, make sure the valve allowing flow into the heat pump is closed.
- Using a flow velocity of at least 2 ft/sec, flush and purge the system of debris and air. If a manifold is used, each circuit can be flushed and purged individually.
- After debris and air are purged from the system, open the valve allowing a portion of the flow into the heat pump. This will flush any additional air or debris from the heat pump water heat exchanger circuit.
- The entire system is now ready for service.
- Use the purging unit to verify the ground heat exchanger flow and design. If the measured pressure drop in the system is in line with the designed pressure drop, then it can be assumed that the system is operating as designed and all flow paths are clear.

Step 4

- Use the purging unit to first charge the ground heat exchanger with an antifreeze solution, and then the entire system (including the water heat exchanger of the heat pump loop).
- Pressurize the system for closed-loop operation. System must be pressurized to a level that will prevent cavitation of the circulating pump and maintain closed-loop pressure during the heating and cooling temperature cycles. Initial system pressure should be between 20 to 30 psi.

Note: The ratio of water to glycol should be specified by the heat pump manufacturer and/or determined by min/max entering water temperatures (EWTs).

5.6 Design and Installation of RAUGEO U-bends

5.6.1 Design

The design of vertical ground loop heat exchangers is described in IGSHPA's "Closed Loop / Ground Source Heat Pump Systems, Installation Guide" and ASHRAE's "Ground-Source Heat Pumps, Design of Geothermal Systems for Commercial and Institutional Buildings."

5.6.2 Installation

Insertion of the U-bend into a vertical borehole is made easier if it is first filled with water, as the water reduces the U-bend's buoyancy. To further aid in the insertion of the U-bend, a weight can be added to its end to help pull the U-bend to the bottom of the borehole.

The tremie pipe is used to ensure that the grout mixture is conveyed into the borehole, filling it from the bottom to the top. It is installed into the borehole along with the U-bend. At greater depths, another tremie pipe may be necessary to ensure even filling. The U-bend is fed from an uncoiling device that is attached to a drill rig or other suitable heavy equipment. The U-bend can also be unrolled before it is inserted into the borehole since unrolling slightly reduces the residual curve of the U-bend pipes. In this scenario, the U-bend should be fed into the borehole over a drum or uncoiler to aid with the insertion of the U-bend.

After the U-bend has been inserted into the borehole, it should be tested to ensure that adequate flow and pressure values are obtained. A final pressure test according to REHAU Technical Bulletin TB211 "RAUPEX Pipe/Fittings: Pressure Testing" or IGSHPA's "Closed-Loop/Ground-Source Heat Pump Systems Installation Guide" should be conducted after the U-bend has been installed.

If, during the installation of the U-bend, there is a frost hazard, the U-bend should be drained to 6 ft (1.8 m) below grade to prevent the water from freezing. Draining the water can be done by attaching a compressed air fitting to one side of the U-bend and applying low pressure which forces the water out the other side. When the air pressure is released, the water column in each side of the U-bend will equalize. If the U-bends are not going to be attached to the manifold immediately, then they must be tightly sealed until they are connected to prevent contamination.

Upon installation, the U-bend pipes should be routed in parallel circuits to the manifold. The manifold should be installed at the highest point in the system to allow for air purging. Each circuit should be balanced using the flow setters and balancing valves on the manifold. Before the overall system is put into operation, a pressure test according to "REHAU Technical Bulletin TB211" or IGSHPA's "Closed-Loop/Ground-Source Heat Pump Systems Installation Guide" must be performed. It must be verified that water flows equally through all U-bends.

Installation Steps

Fig. 21: Inspect for damage

Fig. 22: Fastening the U-bend weight

Fig. 23: Compacting the annular gap with grout

Fig. 24: Pressure test U-bend

Step 1

- Check the coils for damage before borehole insertion.
- Fill the U-bends with water and test under pressure of at least 40 psi.
- Straighten the U-bend pipes.
- Fasten pipe spacers to the double U-bend every 4-6 feet prior to borehole insertion, if required based on design.

Step 2

- Insert the U-bend with the tremie pipe.
- Once the U-bend is at the bottom of the borehole, begin to grout the borehole with the appropriate grout mixture based on system design. It is important to grout from the bottom of the borehole to the top to insure that bridging does not occur.

Note: To simplify the insertion of the U-bends, particularly in wet boreholes, a weight can be used. The first 6 ft. (1.8 m) from the U-bend base can be fastened with strong adhesive tape.

Step 3

- If connection of the U-bend to the manifold or reverse-return header is going to be delayed, the U-bends should be flushed with water to remove any debris and their exposed pipe ends taped closed with end caps.
- Connect the pipes to the manifold or reverse-return header.

Step 4

- Connect a purging unit to the ground heat exchange system between the manifold or reverse-return header and the heat pump.
- Before starting the purging unit pump, make sure the valve allowing flow into the heat pump is closed.
- Using a flow velocity of at least 2 ft/sec, flush and purge the system of debris and air. If a manifold is used, each circuit can be flushed and purged individually.
- After debris and air are purged from the system, open the valve. This will flush any additional air or debris from the heat pump water heat exchanger circuit.
- The entire system is now ready for service.
- Use the purging unit to verify the ground heat exchanger flow and design. If the measured pressure drop in the system is in line with the designed pressure drop, then it can be assumed that the system is operating as designed and all flow paths are clear.

Step 5

- Use the purging unit to first charge the ground heat exchanger with an antifreeze solution, and then the entire system (including the water heat exchanger of the heat pump loop).
- Pressurize the system for closed-loop operation. System must be pressurized to a level that will prevent cavitation of the circulating pump and maintain closed-loop pressure during the heating and cooling temperature cycles. Initial system pressure should be between 20 to 30 psi.

5.7 Heat Transfer Fluid

If the ground loop heat pump system's operating temperature is below freezing, then glycol must be used to prevent system damage. Antifreeze is supplied in concentrated form and should be mixed with water according to the glycol supplier's recommendations.

Glycol often contains anticorrosive additives to protect steel components in the system. For the glycol to contain sufficient anticorrosive elements, the antifreeze-to-water ratio recommended by the antifreeze supplier should be carefully followed.

To ensure thorough mixing of the glycol water solution, mix the glycol and water in a vessel before filling the system. If the system is filled with water and glycol separately, good mixing may not occur and frost damage may result. The adjusted temperature must be verified with an antifreeze tester.

Each circuit can be individually purged until free of air using a common pump module. An open vessel must be used for this.

5.7.1 Filling U-bends

Since RAUGEO U-bends are usually filled with water during the installation process, it must be ensured that before the water/glycol mixture is added to the U-bend, the water is completely discharged. If this is not possible, a correspondingly higher concentration of glycol must be added to the U-bend to achieve the proper ratio of glycol to water.

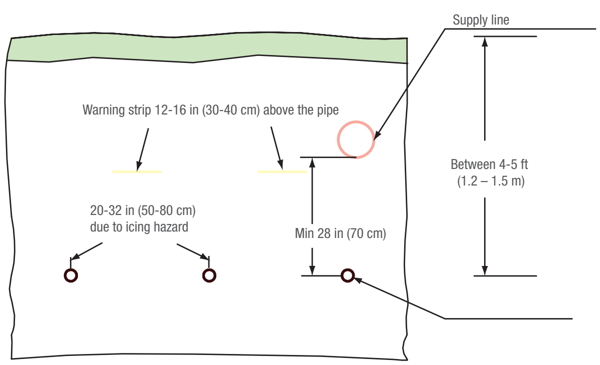


Fig. 25 Laying intervals with warning strip position

5.8 Backfilling the Pipe Trench

5.8.1 General

If the pipe temperature is substantially higher (due to sunlight) than the trench temperature, the pipe must be lightly covered to help relieve internal pipe stress before the pipe trench is finally backfilled.

The excavated material can be reused for the piping zone and to backfill the remainder of the pipe trench with RAUPEX pipes if:

– the excavated material can be well compacted
– the maximum grain size does not exceed 2.5 in (63 mm)
– no stones which could pinch the pipe are lying on the pipe

Note: RAUPEX pipes must not be used as earth conductors for electrical equipment.

5.8.2 Outdoor Installation and Storage

RAUGEO pipe is shipped in packaging which protects it from sunlight, rain, dirt and other hazards. Keep pipe in the original packaging until it is required for installation.

RAUGEO pipe contains stabilizers to protect the pipe from short-term exposure to ultraviolet radiation (UV) from sunlight. However, REHAU recommends that precautions must be taken to avoid continuous exposure to ultraviolet light once the pipe is removed from the original packaging. RAUGEO pipe must not be stored outdoors.

If a skylight is used on the manifold vault, grating must be covered to stop UV radiation, as the plastic pipes are UV stabilized for limited outdoor storage only, not for permanent use.

6. ENTRY TO BUILDINGS

6.1 Insulation

Because the fluid temperature is usually cooler than the ambient temperature of the heat pump location, pipes must be insulated against condensation. Pipe clips must be equipped with pipe holders as insulators to prevent cold bridging between the pipe clip and the insulation.

6.2 Entry to Houses

Pipe entering a house through the wall should be insulated against condensation. The REHAU wall socket consists of a wall sealing flange which will not only prevent moisture from entering the house, but it will also withstand the force of pressurized water.

To seal the pipe flush at the outer wall (see Fig. 26), the pipe passing through the conduit is insulated, thereby providing a vapor seal. The medium pipe is laid through the conduit. The wall sealing flange must be tightened to the appropriate torque (see Table 3). The insulation is then pushed from the inside over the pipe towards the wall flange. The end of the insulation is adhered to the wall sealing flange (see Fig. 26).

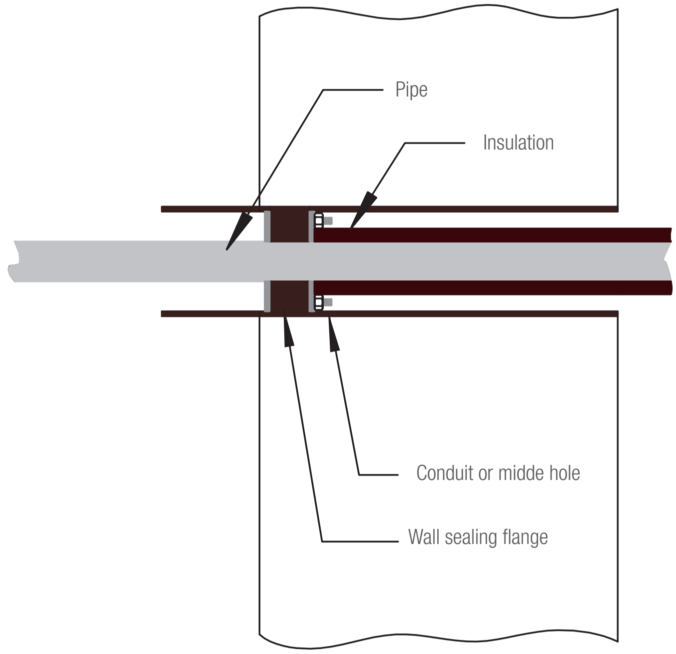


Fig. 26 Entry to house

Maximum torque	Screw	Wrench size
5 Nm	M 6	10 mm
10 Nm	M 8	13 mm
15 Nm	M 10	17 mm

Table 3: Torque

7. HEAD LOSS CALCULATION

7.1 General

Heat pump systems must be operated with a mixture of water and glycol. This prevents the heat conveying medium from freezing. The lowest temperature occurs in the heat pump. Depending on the model, this is between 14°F (-10°C) and -4°F (-20°C). For the frost protection adjustment of the water/glycol mixture, ask the heat pump manufacturer.

7.2 Design

A water/glycol mixture has a higher viscosity and density than water. The proportion of glycol in the water must therefore be taken considered in the pressure loss calculation. To determine the pressure (head) loss in a system, pressure loss through all equipment must be taken into account. Include pipe, fittings, manifolds and the heat pump heat exchangers. Pressure loss data for REHAU products can be found at na.rehau.com/resourcecenter.

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