

Geothermal Learning System 582383 (46126-00)

FESTO

LabVolt Series

Datasheet



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General Description

A compact workstation to teach the fundamentals of residential geothermal heat pumps

This system allows students to develop knowledge in heat transfer and air conditioning. The exercises are designed learn the skills required during installation, operation, and troubleshooting of geothermal heat pumps.

Geothermal heat pumps are among the most energy efficient systems available today for heating and cooling residences. Like solar and wind energies, geothermal is among the renewable energy sources whose utilization increases each year, meaning that more qualified technicians need to be trained.

The Geothermal Learning System is designed to maximize learning capabilities by regrouping every subsystem in geothermal home energy installations. It consists of a geothermal heat pump, ground-loop heat exchanger, pumping station, domestic hot water system, circulation pump, control panel, and the instrumentation required to measure the operating parameters of the system.

Students learn the fundamentals of heat transfer, refrigeration, and air conditioning applied to geothermal heat pumps. It is suitable for varied educational requirements: future system designers and builders, maintenance technicians, and students learning the concept of energy efficiency in general.

With its courseware containing detailed theory and practical exercises, the Geothermal Learning System is the most efficient and effective way to gain the knowledge and skills that are put into practice every day in the geothermal industry.

Geothermal Heat Pump



It is possible to safely look inside the heat pump cabinet through clear plastic panels while the system is running.

The geothermal heat pump is a commercial-grade heat pump that mirrors actual equipment installed in residential buildings. It allows flow, temperature, and pressure measurements at various important locations.

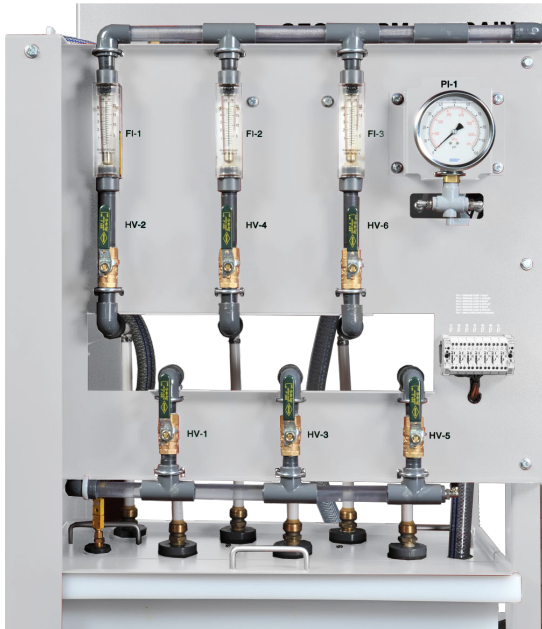


Pullout disconnect switch, thermocouple terminal blocks, and pressure gauges.

Parts of the cabinet of the geothermal heat pump are made from clear plastic panels, enabling users to safely observe the electronic control board and the mechanical components such as the heat exchanger, compressor, thermostatic expansion valve and blower while the system is in operation. The system also features a standard pullout disconnect switch used in HVAC equipment.

The above photo shows the pullout disconnect switch, thermocouple terminal blocks, and pressure gauges.

Ground-Loop Heat Exchanger



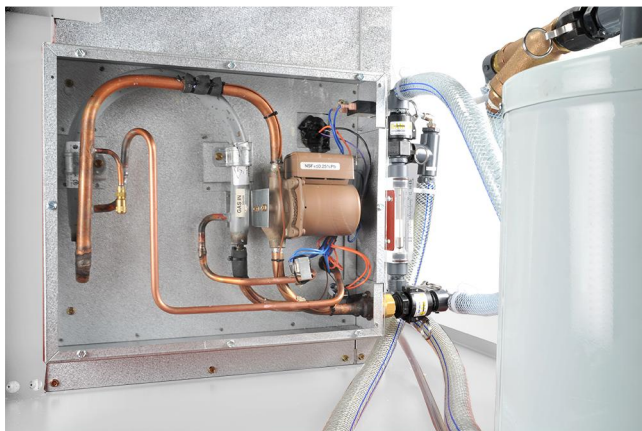
Ground loop header

various ground-loop conditions on the HVAC system performance.

The ground-loop heat exchanger mainly consists of two short loops and one long loop (copper coils) immersed in a water tank. Each loop includes a flow meter, flow control valves, and temperature test points at each end. Temperature values can be read via thermocouple terminal blocks. The inlet and outlet headers include transparent sections to observe fluid flow. A pressure meter with a three-way valve is also provided to measure the pressure at the inlet and outlet of the ground-loop header.

The ability to change the configuration of the ground loop and to control the flow of water in each loop enables students to observe the impact of

Domestic Hot Water System



Partial view of the domestic hot water system.

The domestic hot water system consists of a hot water tank, a desuperheater heat exchanger and a pump. The domestic hot water system is provided with a flowmeter and thermocouples to measure the parameters required to calculate the amount of energy that is being transferred to the domestic hot water tank. Parts of the desuperheater heat exchanger and pump section are made from clear plastic panels, enabling users to safely observe the processes.

Control Panel

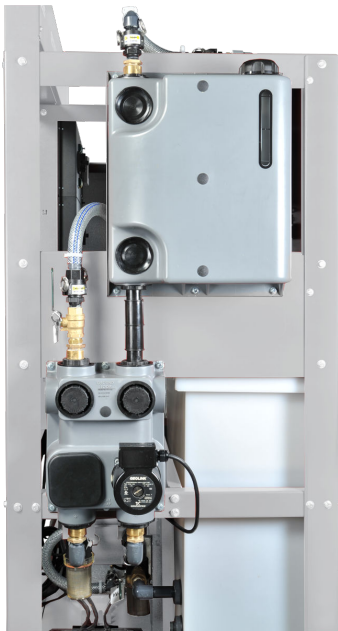


Geothermal Heat Pump control panel (both models) and Simulated Ground Heat Pump control panel (46126-A only)
Model 46120-A).

The operation of the geothermal heat pump and circulation pump is controlled via the geothermal heat pump control panel. This control panel features a main power switch, thermostat, indicator lights, and fault switches. Electrical faults can be inserted for troubleshooting purposes using switches hidden behind a cover.

The above photo shows the geothermal heat pump control panel (available in models 46126-0 and -A), as well as the simulated-ground heat pump control panel (available only in

Pumping Station



Priming tank and circulation pump

The pumping station mainly consists of a priming tank and a circulation pump. The priming tank supplies the circulation pump with water during startup, and prevents cavitation. The priming tank also allows variations in water level to compensate for pressure changes in the loop and can be bypassed to create a pressurized-loop configuration. This configuration also features an expansion tank typical for such a loop. The pumping station contains the connections to fill and flush the loops. A strainer is inserted in the network to remove impurities.

Troubleshooting



Connections to the control board are provided for troubleshooting purposes.

The Geothermal Training System contains six instructor-insertable fault switches to enable users to develop troubleshooting skills. Connections to the control board are provided to allow users to diagnose the faults. The instructor may also insert many mechanical faults that modify the operation of the system, such as choking a flow control valve, obstructing an air opening, etc.

Courseware

The training system includes a full courseware that consists of a student manual and an instructor guide. The student manual contains a series of job sheets. Each job sheet includes an information sheet that presents the theory and a manipulation section that lists a series of tasks for students to perform. The student manual is fully illustrated and color printed. Refer to the Table of Contents of the Manual(s) section of this datasheet to see the list of covered topics.

The instructor guide provides results and measurements obtained under typical operating conditions, as well as the answers to all questions.

No prerequisite are needed to attain the learning objectives of the courseware, since all the theory required is included in the information sheets. However, while not essential, it is recommended to have a basic knowledge in refrigeration, this is not essential.

Topic Coverage

- Explain the concept of geothermal energy, geothermal heat pumps, ground loops, and the refrigeration cycle
- Plot the refrigeration cycle on a pressure-enthalpy diagram using pressures and temperatures measured on the learning system
- Determine COP and energy efficiency ratio (EER) using measured temperature, humidity, voltage, and current values
- Learn how to characterize a geothermal heat pump system
- Analyze and compare two geothermal heat pump system projects using reports produced by software design tools

Features & Benefits

- Compact and safe workstation that faithfully replicates a geothermal residential installation
- Simulates the effects of various ground-loop lengths and configurations as well as changing environmental conditions
- Temperature measurement points, flow meters and pressure gauges to demonstrate the theoretical concepts involved
- Standard commercial components students will use in the field
- Six instructor-insertable electrical faults to develop troubleshooting skills

List of Manuals

Description	Manual number
Geothermal Heat Pump Systems (Job Sheets - Student) _____	580630 (88271-20)
Geothermal Heat Pump Systems (Job Sheets - Instructor) _____	580631 (88271-30)

Table of Contents of the Manual(s)

Geothermal Heat Pump Systems (Job Sheets - Student) (580630 (88271-20))

- 1 Geothermal Energy
- 2 The Ground Loop
- 3 Heat Pump Connections and Interior Piping
- 4 The Refrigeration Cycle
- 5 Psychrometrics
- 6 Geothermal Heat Pumps
- 7 Heat Exchangers
- 8 Heat Pump Control and Safety Devices
- 9 System Characterization
- 10 Maintenance and Troubleshooting
- 11 Geothermal Software Design Tools

Optional Equipment

Qty	Description	Model number
1	Geothermal Training System (Manuals on CD-ROM) _____	580632 (88271-A0)

Specifications

Parameter	Value
Geothermal Heat Pump	
Capacity - Cooling	4.3 kW (14 600 BTU/h)
Capacity - Heating	3.1 kW (10 600 BTU/h)
Refrigerant	R-410A, nominal charge of 0.54 kg (19 oz)
Water-to-Refrigerant Heat Exchanger Type	Tube-in-tube coil (coaxial)
Ground-Loop Heat Exchanger	
Loops	2 short loops, 1 long loop
Water Tank Capacity	140 L (37 gal)
Expansion Tank	2.8 L (0.75 gal)
Water Additives	Rust-inhibitor solution and antibacterial solution
Pumping Station	
Priming Tank	Insulated with level sight glass and two three-way valves
Pump Type	Centrifugal
Domestic Hot Water System	
Tank Capacity	7.5 L (2 gal)
Circulation Pump Type	Centrifugal
Desuperheater Heat Exchanger Type	Tube-in-tube coil (coaxial)
Control Panel	
Heat Pump Thermostat	Cooling/heating, non-programmable
Indicator Lights	Loop pump, reversing valve, compressor, desuperheater, heat pump fault, circulation pump
Fault Insertion	Six faults that can be inserted using switches
Other Component	Main power switch
Safety Devices	High-pressure control, frost sensor, relief valve, fuse, breaker, pullout disconnect switch, tag and padlock
Instrumentation	
High-Pressure Gauge	0 kPa to 5500 kPa (0 psi to 800 psi), refrigerant monitoring
Low-Pressure Gauge	200 kPa to 0 kPa / 0 kPa to 3450 kPa (-30 psi to 0 psi / 0 psi to 500 psi), refrigerant monitoring
Flowmeters	20 L/min (5 gal/min), quantity 3; 7 L/min (2 gal/min), quantity: 1

Parameter	Value
Thermocouples	Type K, quantity: 18, located at important points and accessible through terminal blocks
Pressure Gauge	0 kPa to 690 kPa (0 psi to 100 psi), heat exchanger monitoring, quantity: 2
Anemometer	Waterproof pocket size with air velocity, temperature, relative humidity, dew point, and wind chill
AC/DC Clamp-on Meter	Dual type K thermocouple inputs, true rms measurements for ac voltage and current measurements, built-in non-contact voltage detector, resistance, capacitance, and frequency measurements.
Physical Characteristics	
Intended Location	On the floor (stands on casters)
Dimensions (H x W x D)	1905 x 2273 x 740 mm (75.0 x 89.5 x 29.1 in)
Net Weight	279 kg (615 lb) (empty tanks)

Module Options Description

Geothermal Training System (Manuals on CD-ROM) 580632 (88271-A0)

List of Manuals

Description	Manual number
Geothermal Heat Pump Systems (Job Sheets - Student) _____	592132 (88271-20)
Geothermal Heat Pump Systems (Job Sheets - Instructor) _____	592133 (88271-30)
Geothermal Heat Pump Systems (Job Sheets - Student) _____	592214 (89952-20)
Geothermal Heat Pump Systems (Job Sheets - Instructor) _____	592215 (89952-30)

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