Geothermal Alliance of Illinois

Snapshots of 4 Modules

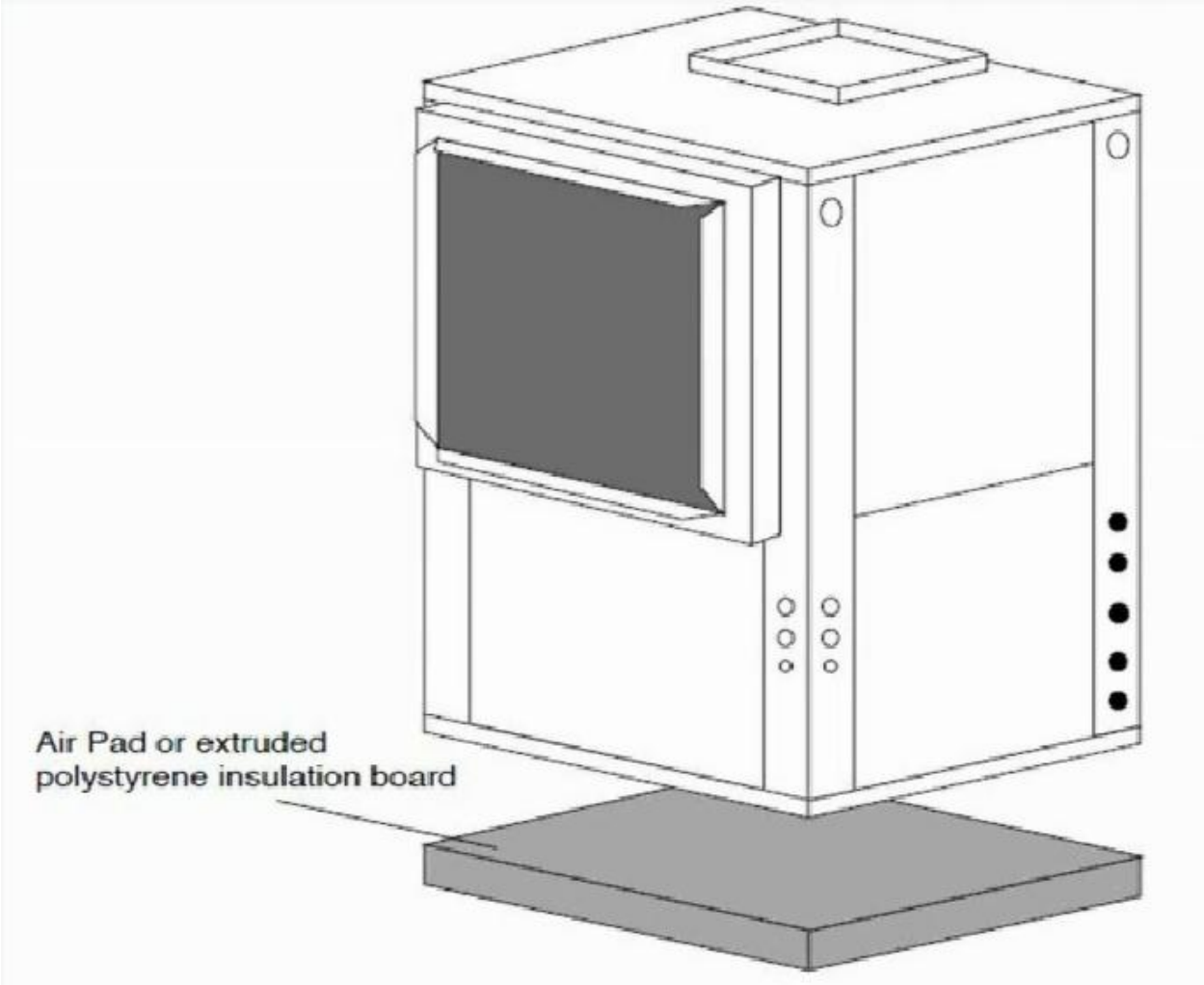
1. Installer Technician Module p. 2
2. Design Module p. 9
3. Loop Module p. 22
4. Service Module p. 31



Online Training Series

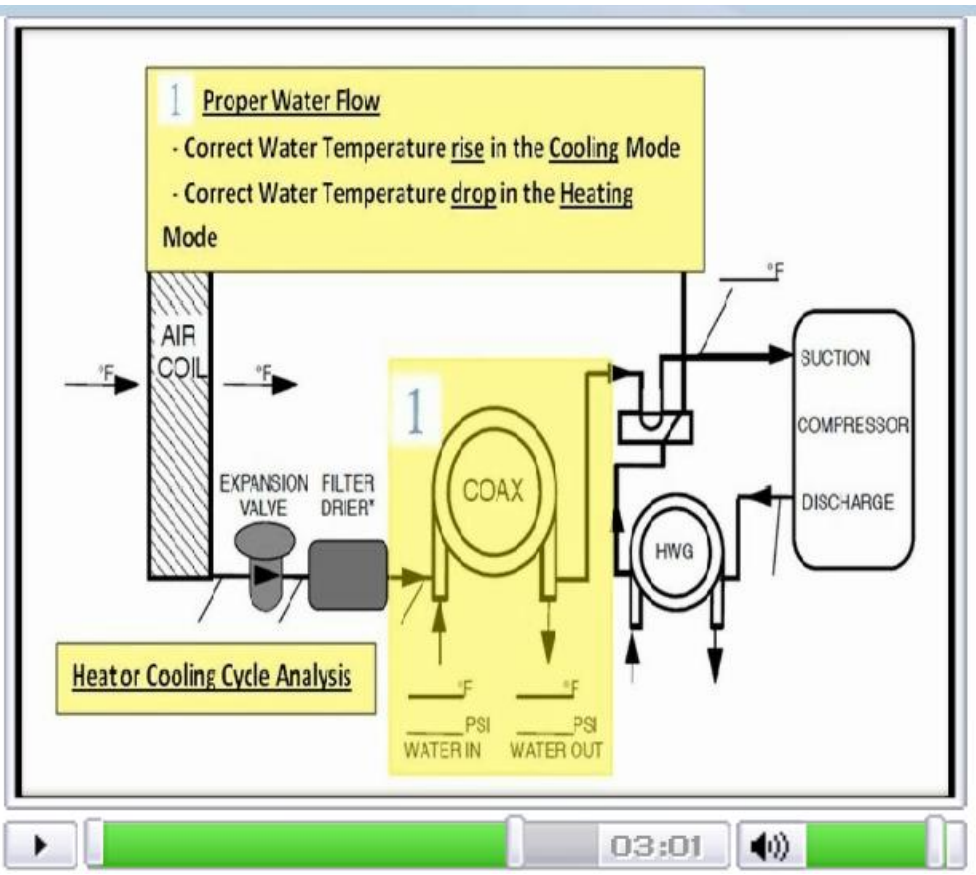
Installer Technician Module

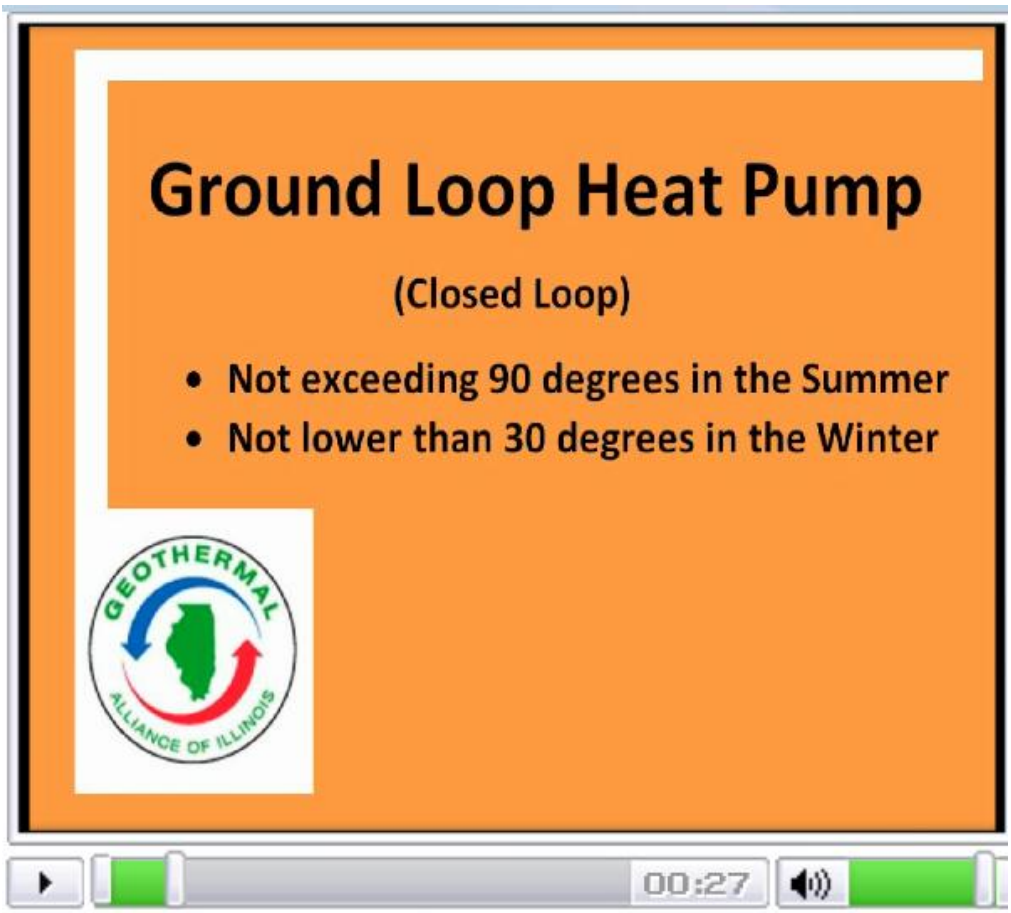
The #1 Resource for Geothermal Heating and Cooling in Illinois

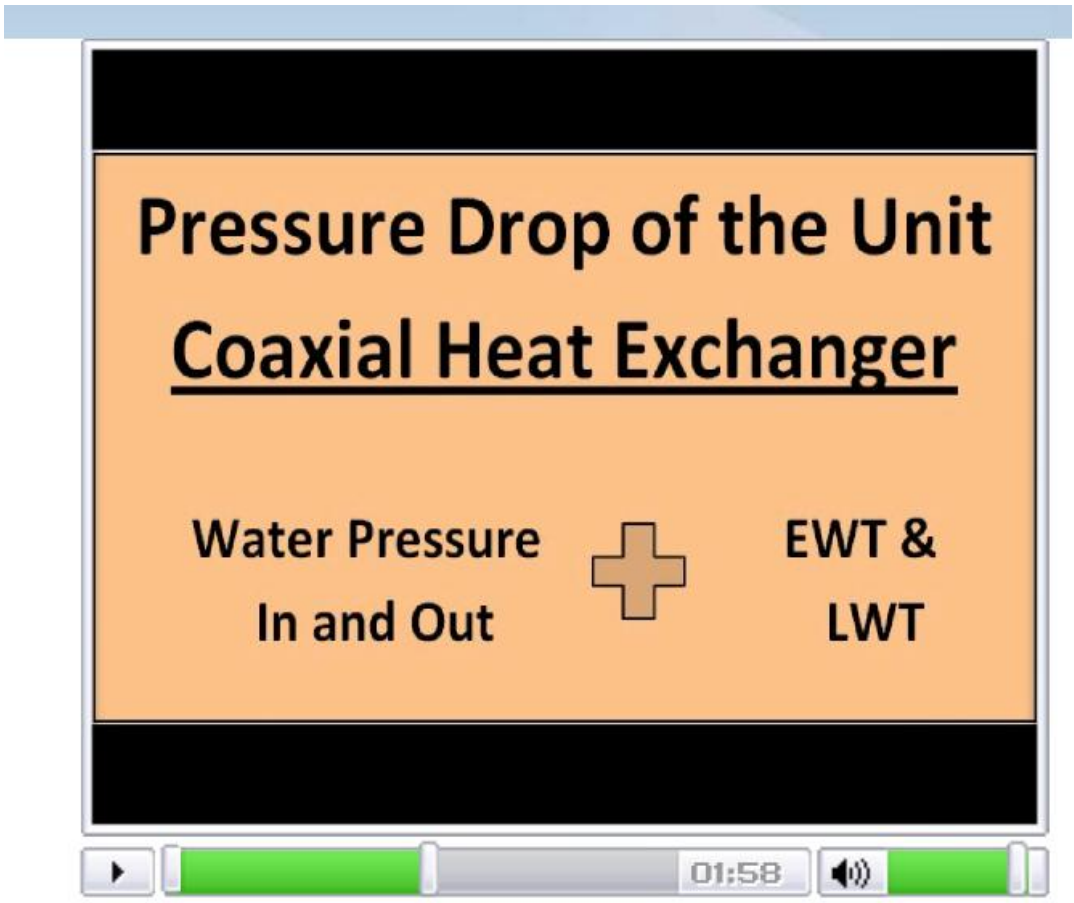

Air Pad or extruded
polystyrene insulation board

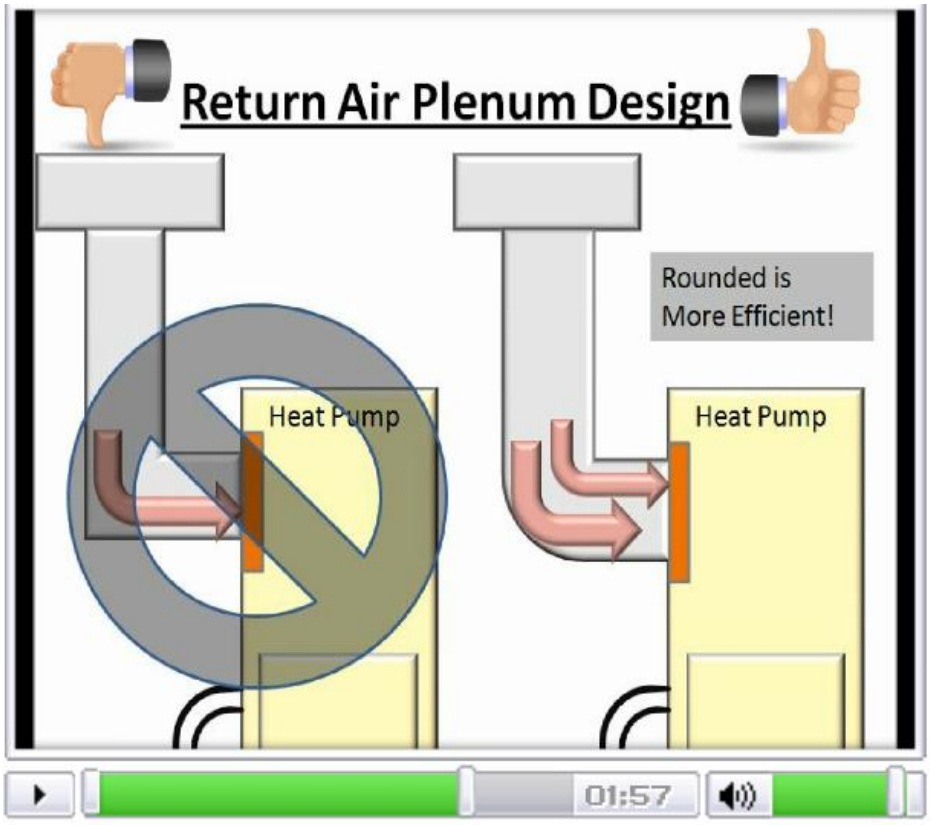
1st Principle:

Earth Loop Water Flow


1 Proper Water Flow
- Correct Water Temperature rise in the Cooling Mode
- Correct Water Temperature drop in the Heating Mode
AIR COIL
°F
°F
EXPANSION VALVE
FILTER DRIER*
1
COAX
°F
°F
PSI
PSI
WATER IN
WATER OUT
HWG
°F
SUCTION
COMPRESSOR
DISCHARGE
Heat or Cooling Cycle Analysis
03:01


Ground Loop Heat Pump
(Closed Loop)
• Not exceeding 90 degrees in the Summer
• Not lower than 30 degrees in the Winter
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ALLIANCE OF ILLINOIS
00:27


Pressure Drop of the Unit
Coaxial Heat Exchanger
Water Pressure
In and Out
EWT &
LWT
01:58


Return Air Plenum Design
Rounded is More Efficient!
Heat Pump
Heat Pump
01:57


Proper Duct Installation
Conditioned spaces require:
An insulated plenum, plus
First 5 to 10 feet of your supply trunk line.
For all spaces, The Return Drop must be:
Properly sized
Insulated
Always check with Manufacturer.....
00:27



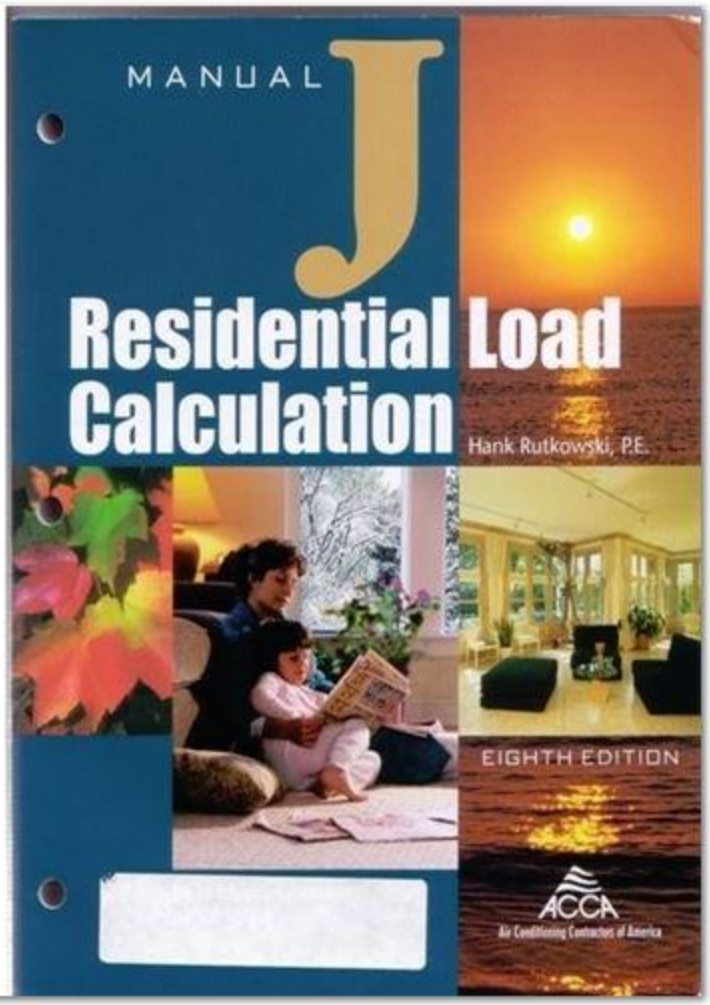
Online Training Series
Design Module for Residential
and Light Commercial

Steps for Design

- Perform an accurate load calculation
- Use the heat pump manufacturer's software
  - Select and size the proper heat pump
  - Size the loop
  - Size the pump
  - Model the energy and economic performance
- Size the ductwork

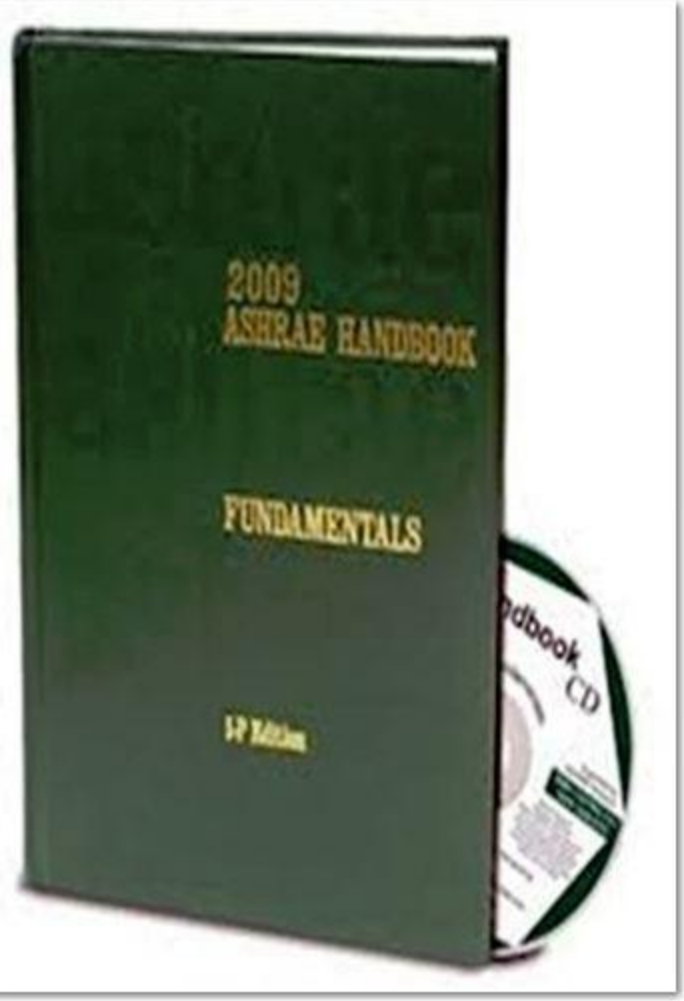
Load Calculation

- Residential
  - ACCA Manual J



Load Calculation

- Commercial
  - ASHRAE Fundamentals Handbook



Right-J® Worksheet

<< | < | prev zone

ACCA Manual J Eighth Edition

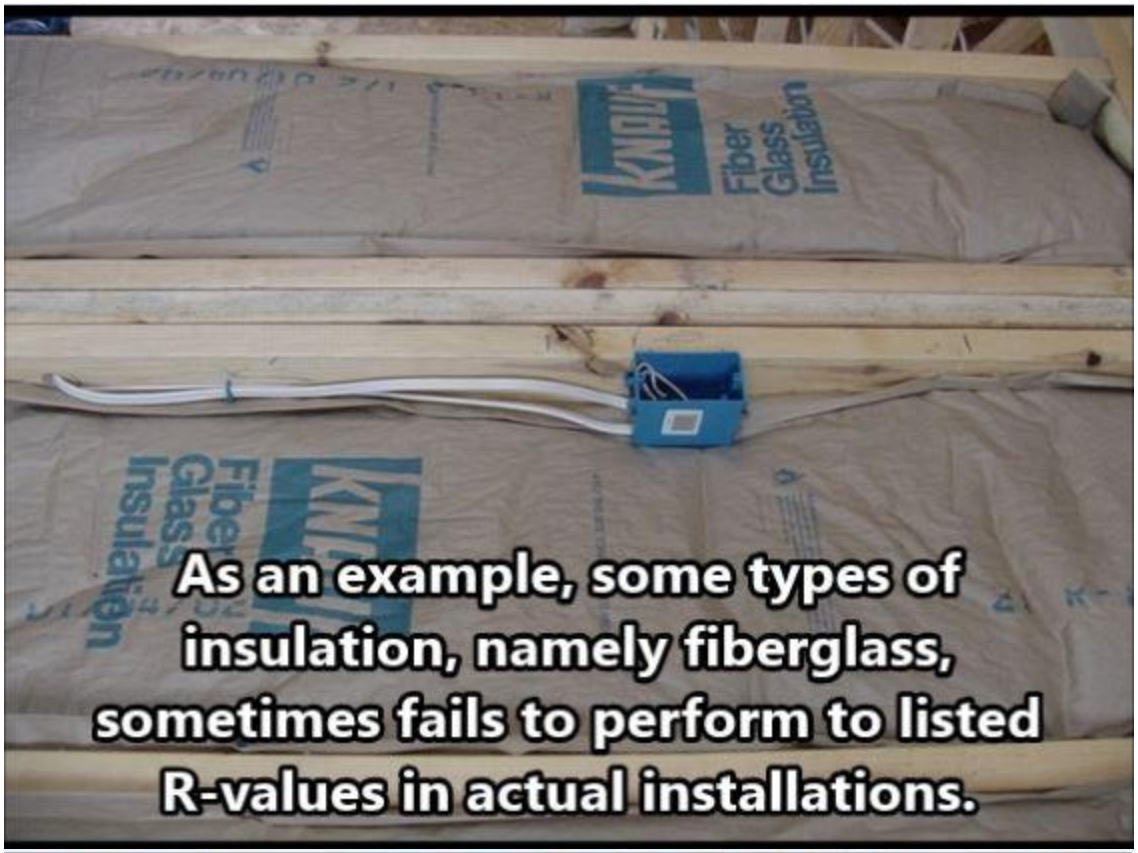
Room name	Atrium	•••
Exposed wall	24.0 ft	
Ceiling height	8.0	heat/cool
Room dimensions	19.0 x 12.0 ft	
Room area	228.0 ft²	

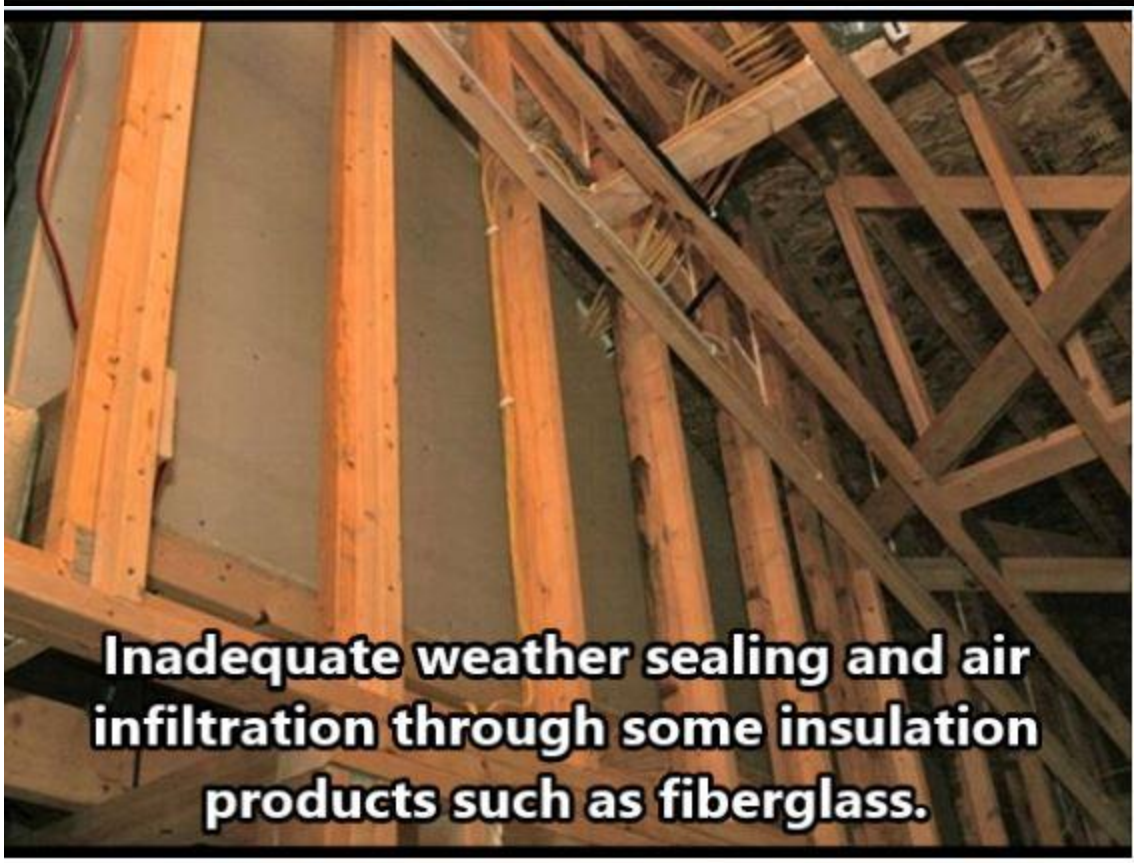
	Ty	Construction number (Select any cell then click here •••)	U-value	Or •••	HTM (Btuh/ft²) Heat	HTM (Btuh/ft²) Cool	Area (ft²) or perimeter (ft) Gross	Area (ft²) or perimeter (ft) N/P/S	Load (Btuh) Heat	Load (Btuh) Cool
6	W	12B-0bw	0.097	n	0	0	0	0	0	0
•	├G	1D-c2oc	0.570	n	0	0	0	0	0	0
•	└D	11K0	0.360	n	0	0	0	0	0	0
•	W	12B-0bw	0.097	e	4.850	1.591	96	78	378	124
11	├G	1D-c2oc	0.570	e	0	0	0	0	0	0
	└G	1D-c2oc	0.570	e	28.50	50.08	18	0	513	902
	W	12B-0bw	0.097	s	0	0	0	0	0	0
	└G	1D-c2oc	0.570	s	0	0	0	0	0	0
	W	12B-0bw	0.097	w	4.850	1.591	96	78	378	124
	├G	1D-c2oc	0.570	w	0	0	0	0	0	0
	└G	1D-c2oc	0.570	w	28.50	50.08	18	0	513	902
	P	12C-0sw	0.091	-	4.550	1.392	152	131	596	182
	└D	11K0	0.360	n	18.00	10.87	21	21	378	228
	C	16B-19ad	0.049	-	2.450	2.631	228	228	559	600
	F	22A-cpl	0.989	-	0	0	0	0	0	0
	F	22A-tpl	0.989	-	49.45	0	228	24	1187	0

Total room load	6363	4406
Air required (cfm)	0	239

Components of Load

- Building Envelope
  - Wall, Ceilings/Roof, Doors (area and r-value)
  - Window (area, r-value, and shading value)
  - Floor (area and r-value or length and floor loss coefficient)
  - Infiltration
- Ventilation
- Internal heat gains
  - Occupant number and activity level
  - Lighting
  - Equipment/Appliances


Fiber Glass Insulation
As an example, some types of insulation, namely fiberglass, sometimes fails to perform to listed R-values in actual installations.


Inadequate weather sealing and air infiltration through some insulation products such as fiberglass.

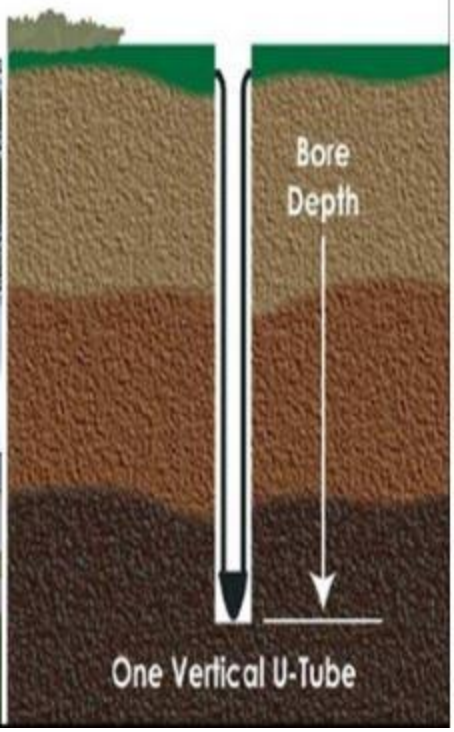
Loop Sizing

- Use geothermal heat pump manufacture's software to size the loop.
- The available land area (for instance, residential lot), availability of ground water, or an existing pond/lake what loop type will be used.

Vertical Loop



Figure 3-1: Vertical Single Pair per Bore



Factors That Affect Overall Loop Length

- Borehole Spacing
- Soil Type
- General Conductivity
- Presence of Water
- Type of Grout
- Heat Pump Run Time

Horizontal Loops

Figure 3-4: Two-Pipe Loop (Trencher or Backhoe)

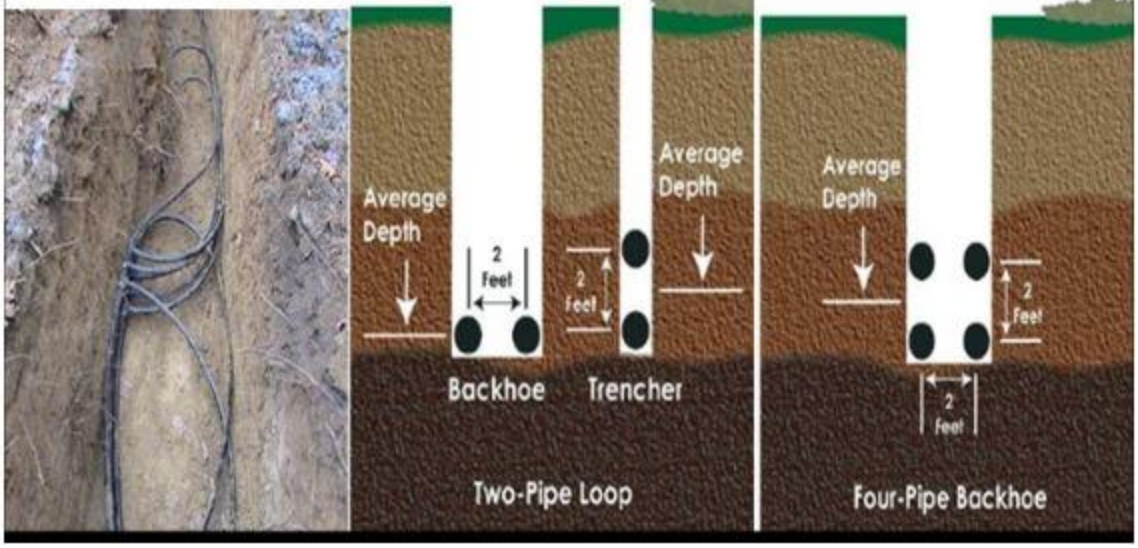
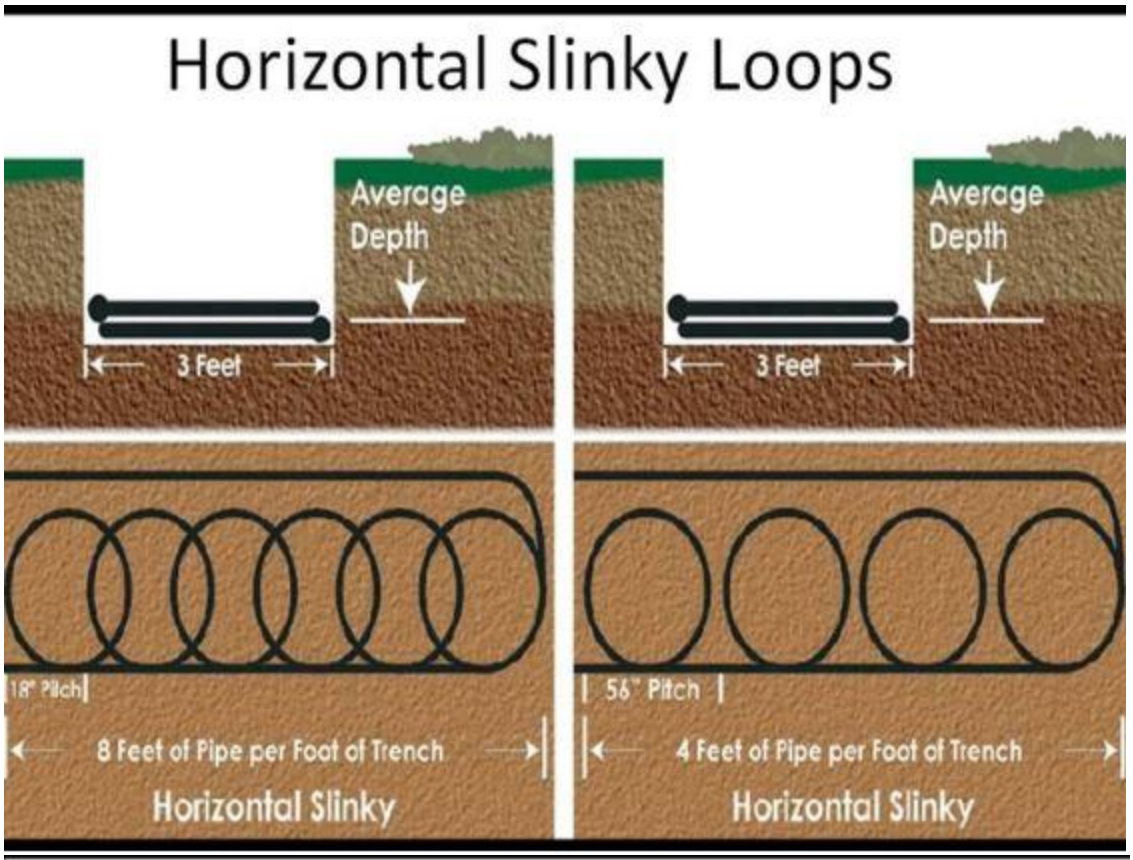


Figure 3-5: Four-Pipe Backhoe Loop



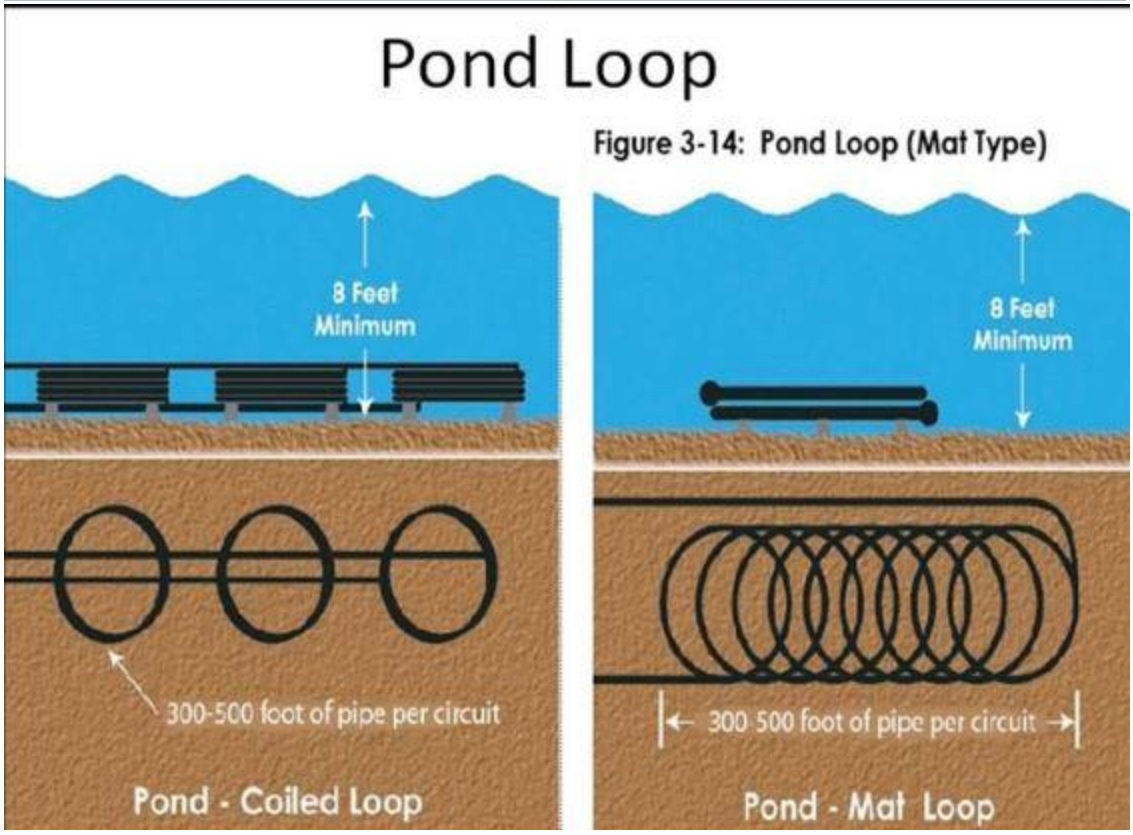


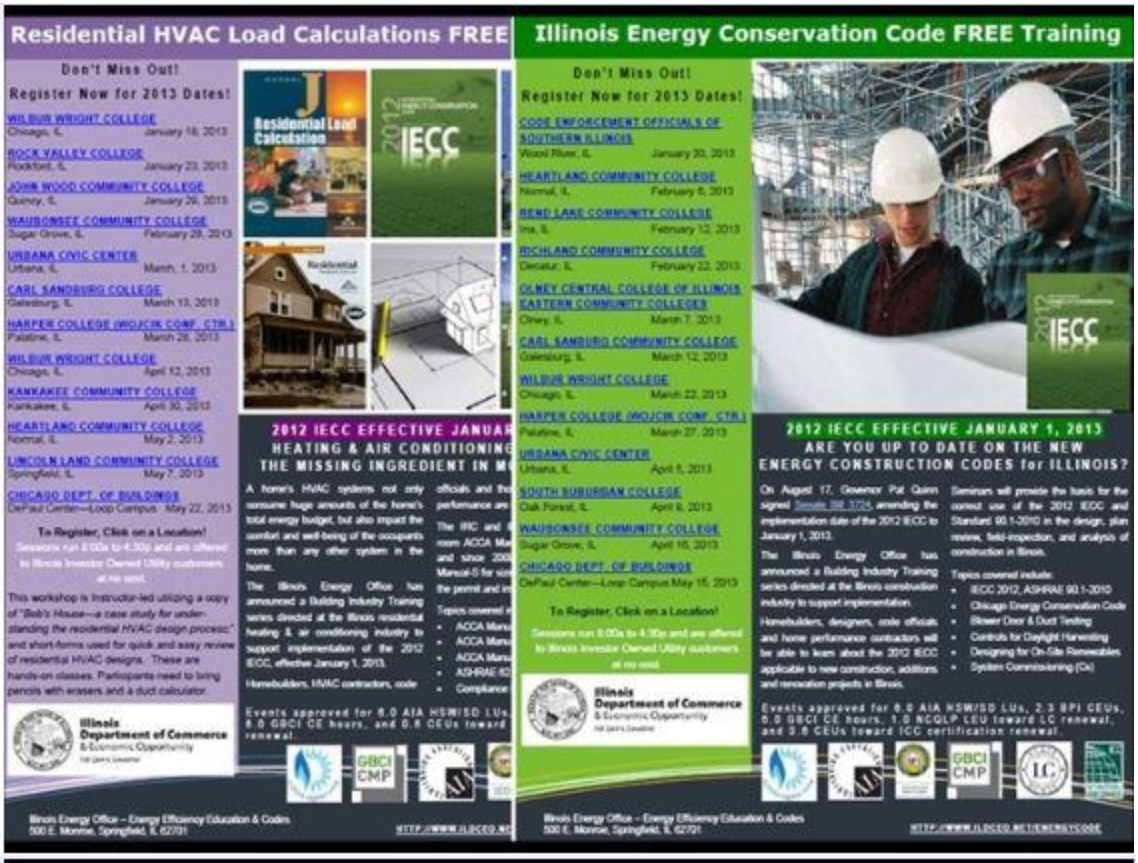
Figure 3-14: Pond Loop (Mat Type)

Pump Sizing

- Piping size and header design is critical to proper pump performance.
- Pumps and piping should designed to provide flow rates of approximately 3 gpm/ton

Duct Work

- 10’ of duct lining for acoustics
- Insulated Duct in unconditioned areas
- Duct sealing is recommended in unconditioned space
  – must meet energy code requirements.



Other Geothermal Applications

- Water Heating… use of a desuperheater
- Zoning and Multiple Units
- Radiant Floor

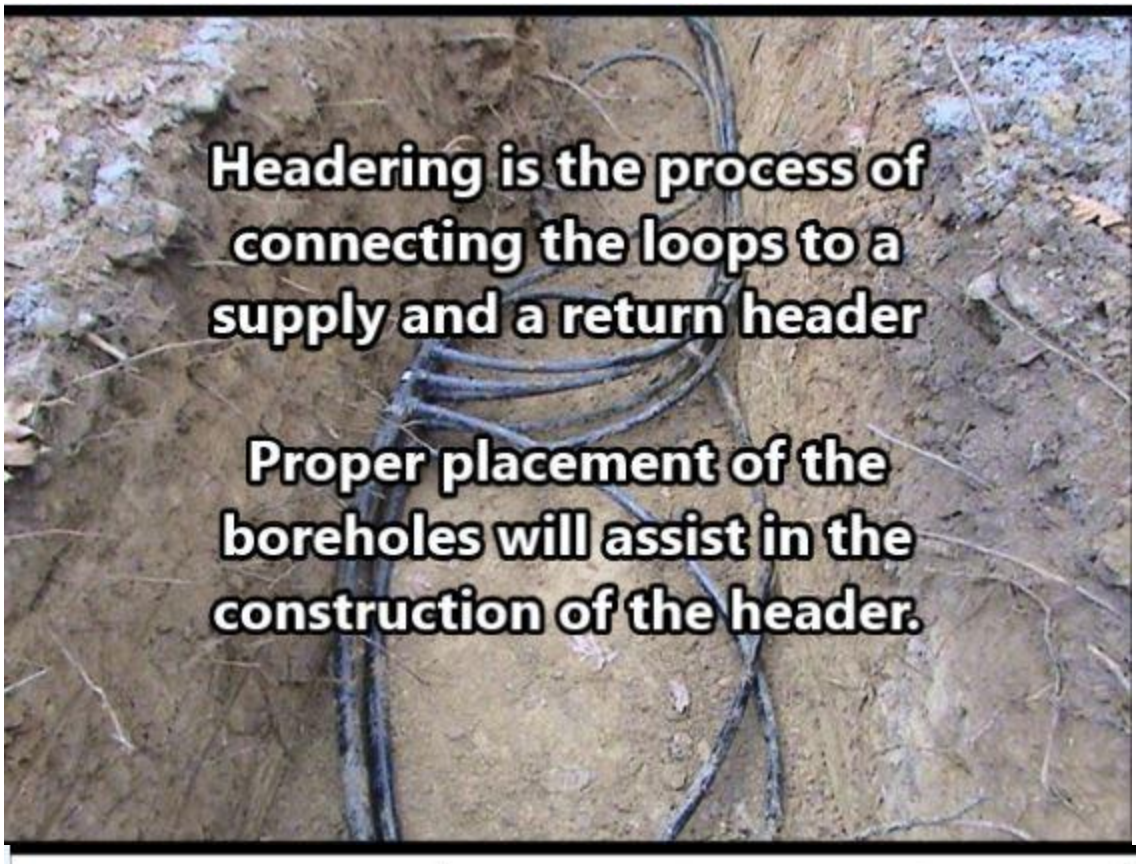
Zoning and Multiple Units

- Provides better comfort and efficiency
- Allows for larger building to be easy zoned
- Check valves for multiple pumps on a single loop field.

SUMMARY

- Importance of accurate load
- Use manufacturers software for heat pump selection, loop sizing, pump sizing.
- Ensure ductwork is adequate.


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OnlineTraining Series
Loop Module for Residential and Light
Commercial



Taking conductivity into consideration when determining pipe/loop needed to meet load.

Thermal conductivity is a comparison measurement of how much heat can be transferred with a type of soil.

Thermal conductivity is measured in Btu/foot hour, Degrees F, or in the metric system, Watts/Meter Degrees K.

This measurement helps to determine how much pipe would be needed in various soil types to meet the geothermal system's load.

Thermal Texture Class	Thermal Conductivity		Thermal Diffusivity	
	W/m °K	Btu/ft hr °F	cm²/sec	ft²/day
Sand or Gravel	0.77	0.44	0.0045	0.42
Silt	1.67	0.96	____	____
Clay	1.11	0.64	0.0054	0.50
Loam	0.91	0.52	0.0049	0.46
Saturated Sand	2.50	1.44	0.0093	0.86
Saturated Silt or Clay	1.67	0.96	0.0066	0.61

From IGHSPA Closed Loop Ground Source Heat Pump System Installation Guide

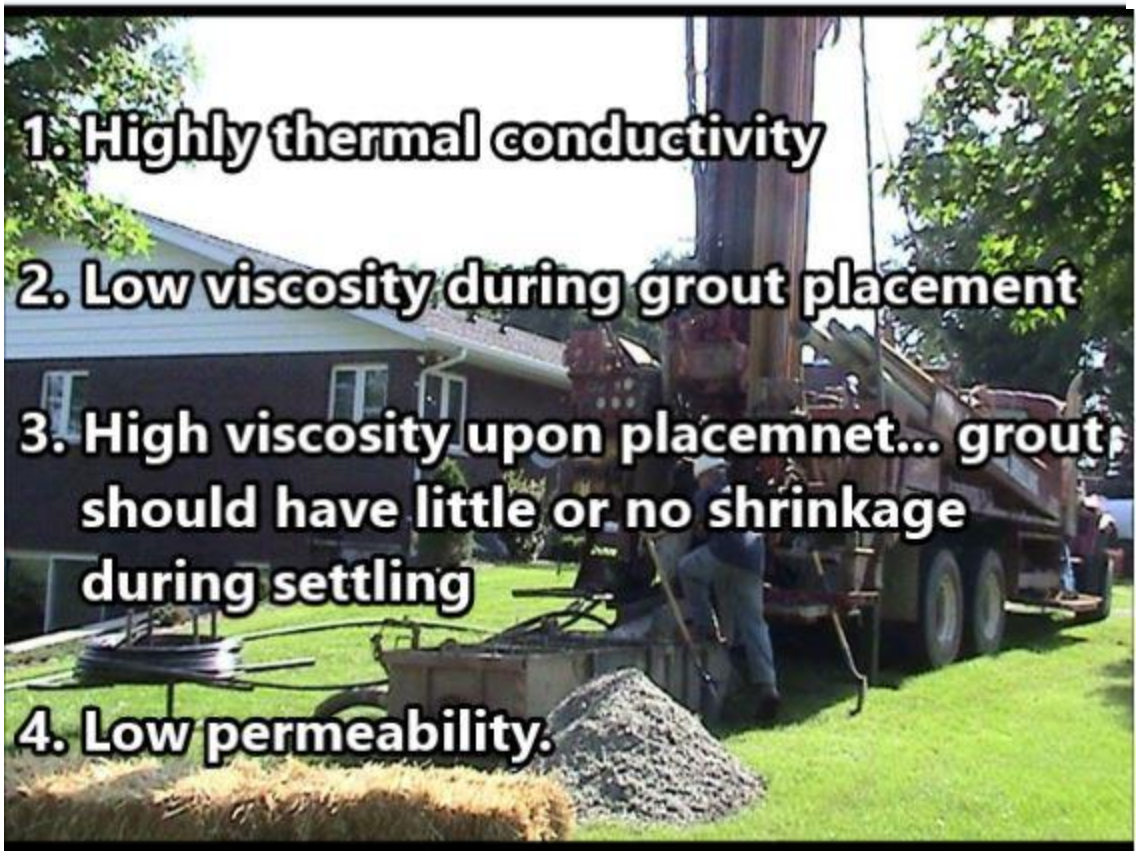
Poorly Grouted Borehole Consequences

1. Poor loop performance

2. Possibility of ground water contamination

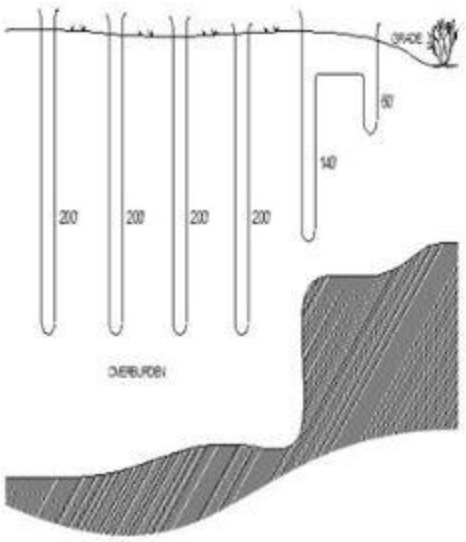
3. Sink holes can develop

4. Possible suspension or revocation of license from state or local government



Vertical loop fields

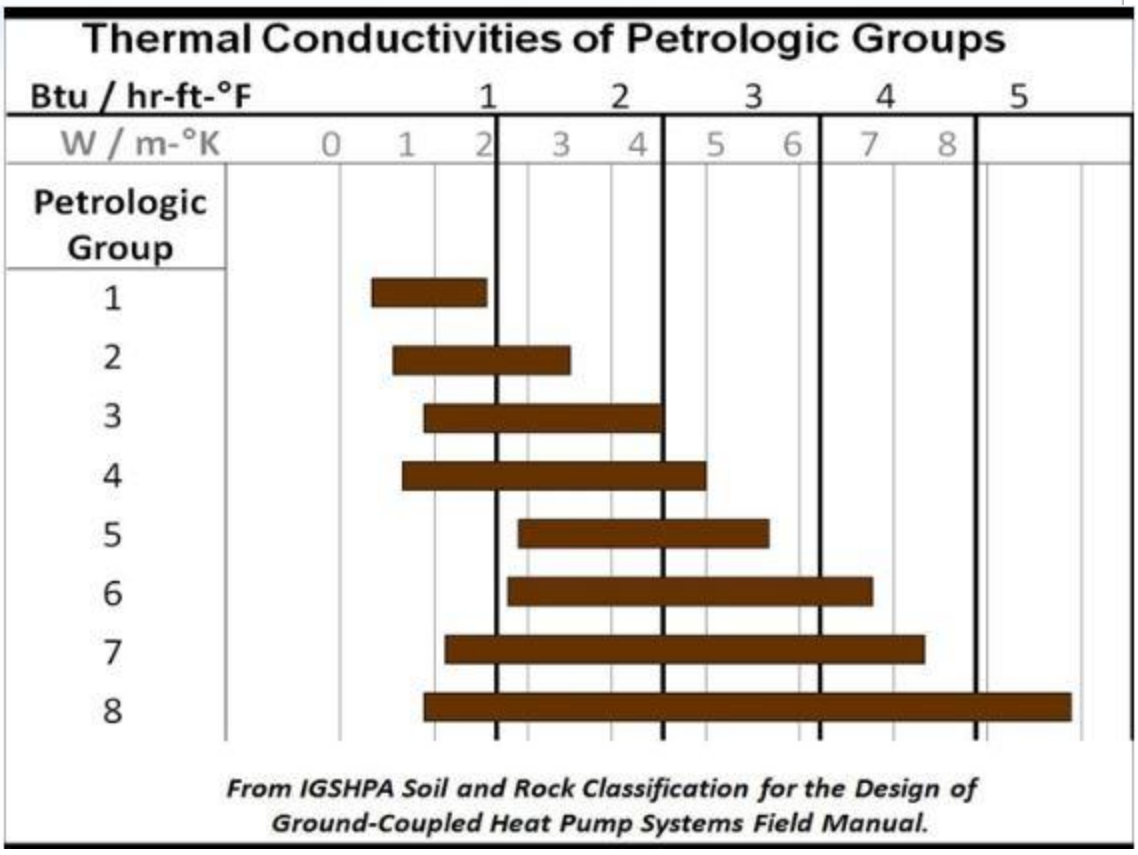
- Basic design
  - Loops must be grouted to seal bore holes and provide maximum loop field conductivity.
  - Minimum 10 foot spacing on loops
  - Reverse parallel flow in circuits
  - All circuits must be the same length
  - One circuit and 3 gpm flow per ton of geo capacity.
  - Typical Bore hole depths are:
    - -150-200 feet per ton in northern IL
    - -230-250 feet per ton in southern IL



The GAOI and IGSHPA recommend a minimum of 50 foot depths for all vertical heat exchangers.

Drilling Depths

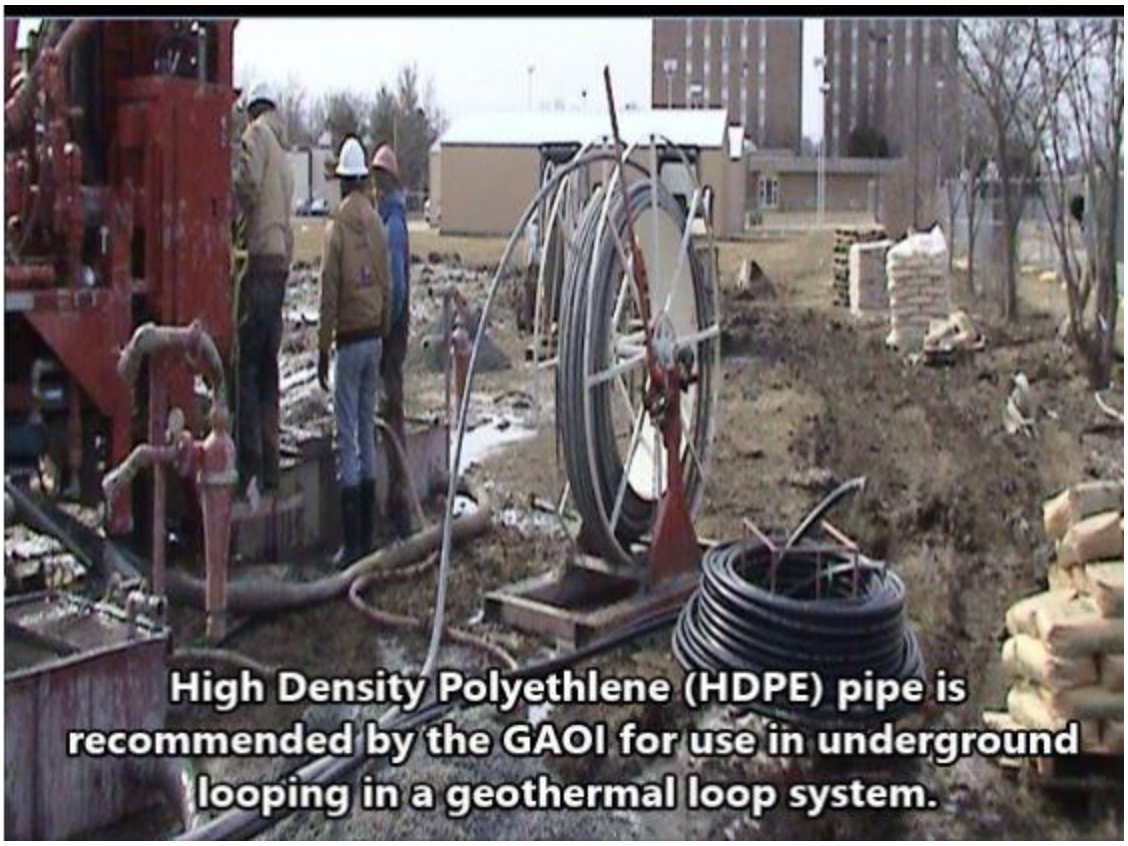
In drilling and installing a vertical loop field, the objective is to install a specified length of heat exchanger, or loop, in a vertical configuration; it is not important to reach a given depth. Soil and rock conditions, will determine drill rates and the most efficient and economical borehole depth.



Rotary Drilling

- Mud or Air transport drill cuttings to the surface.
  - -Sent down inside of drill pipe to lubricate and cool the drill bit and carry cuttings back to the surface.
  - -Best for clay, silt, sand, gravel and soft shale formations.




High Density Polyethlene (HDPE) pipe is
recommended by the GAOI for use in underground
looping in a geothermal loop system.

The loop is the heart of the geothermal heat pump system

Good design is vital and success starts with good planning.

Summary

Most geothermal systems in Illinois utilize a closed loop system with either vertical drilled or horizontal open trench systems.


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Online Training Series
Service Module for Residential and Light Commercial

This module will focus on two general areas

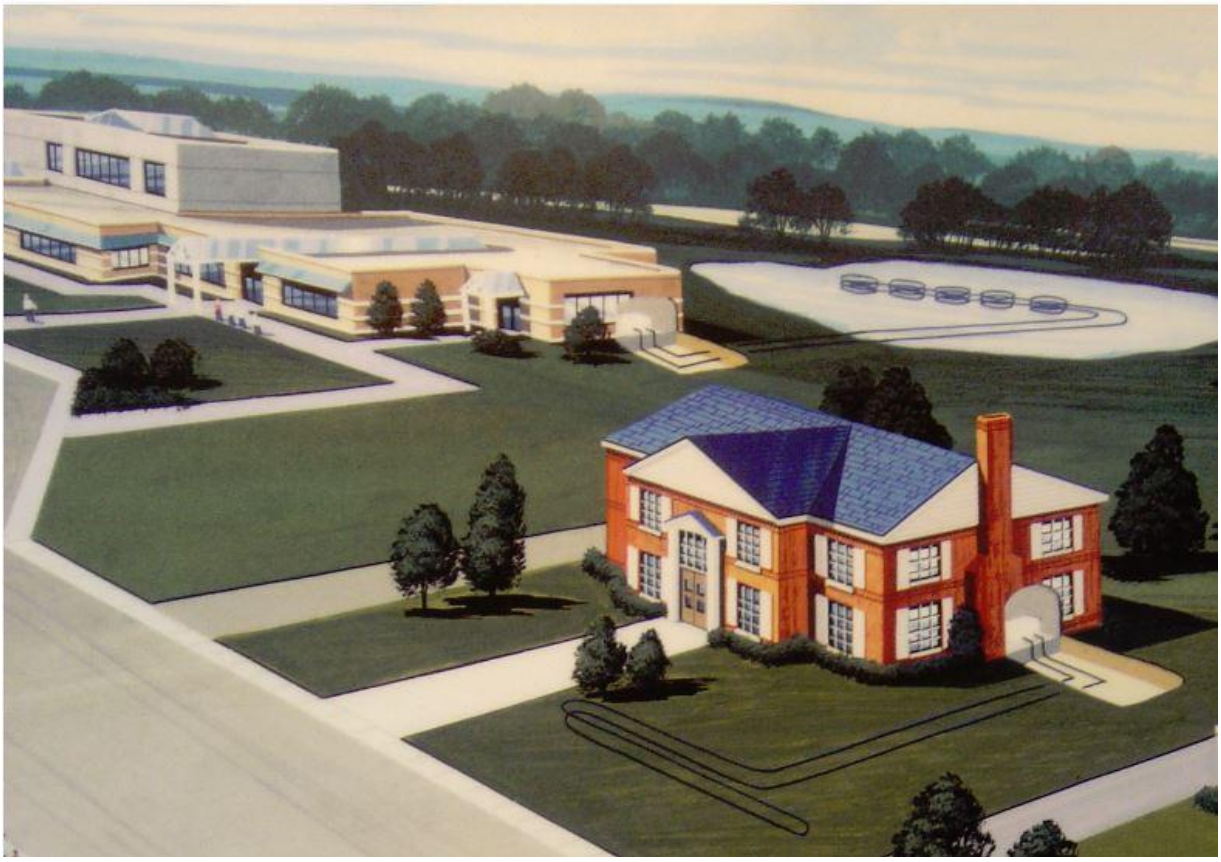
1. Refrigeration principles
2. Troubleshooting

GAOI Service Technician module





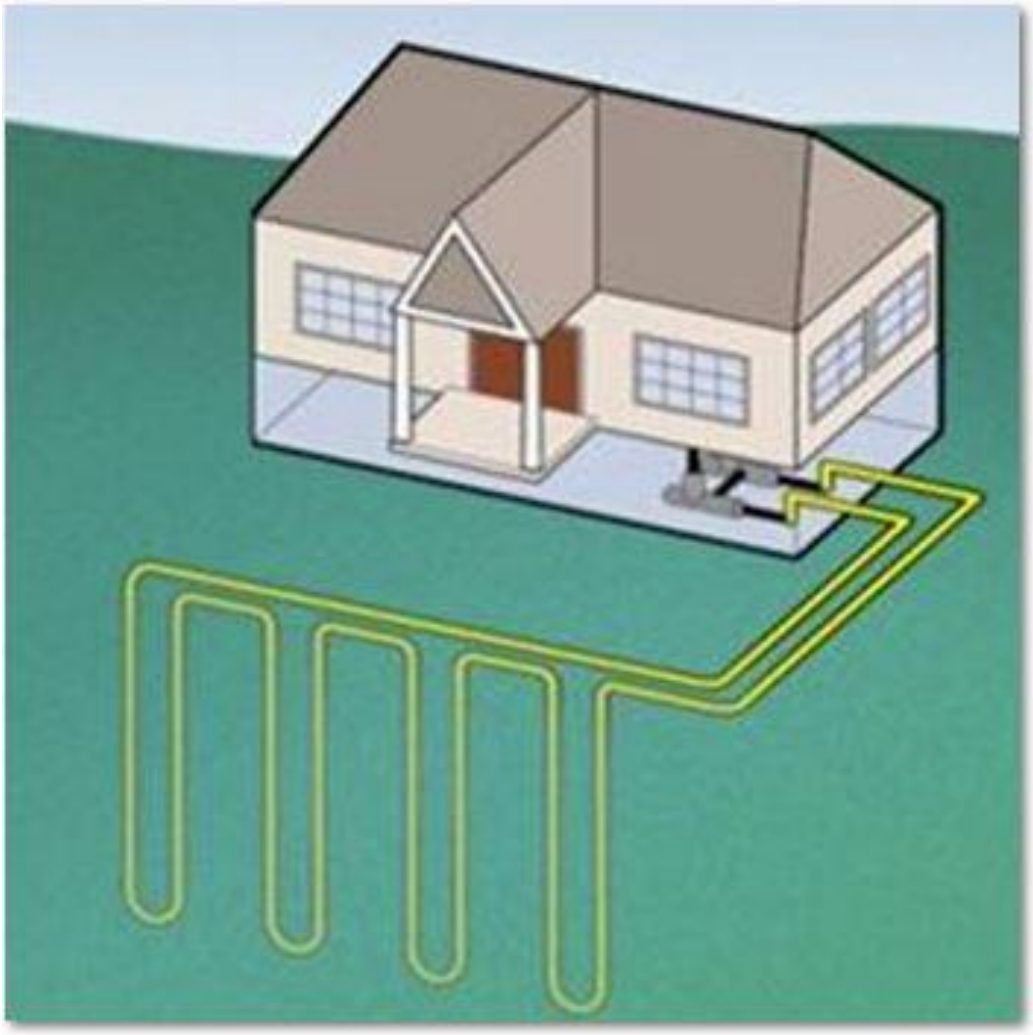





Honeywell
73°
ROOM
SET

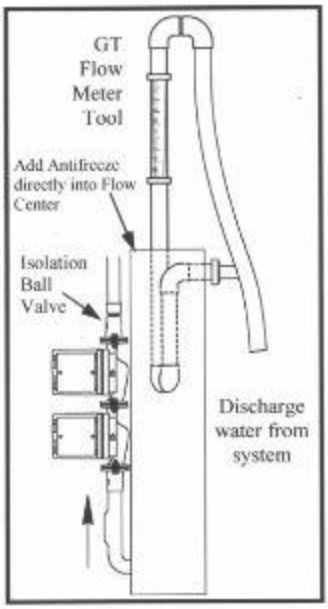

ECONAR
GeoSource 2000

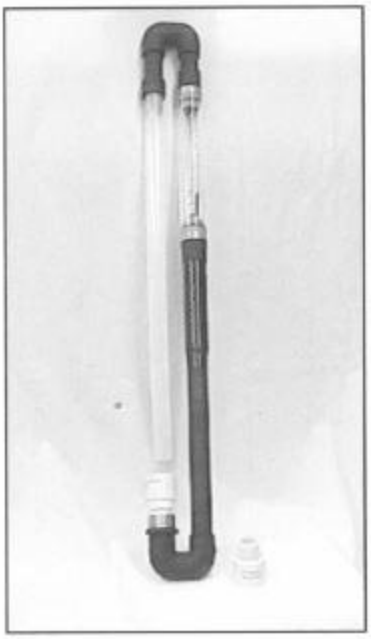




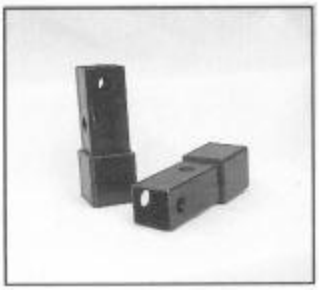
FLOWMETER TOOL

MEASURING FLOW





WRENCH



CATALOG NO.	ITEM
1-WFT17-A	FLOWMETER TOOL
1-WFTC40	COMMERCIAL FLOWMETER TOOL
2-WFTC100	COMMERCIAL FLOWMETER TOOL
1-FCW	WRENCH FOR FLOW CENTER TOP







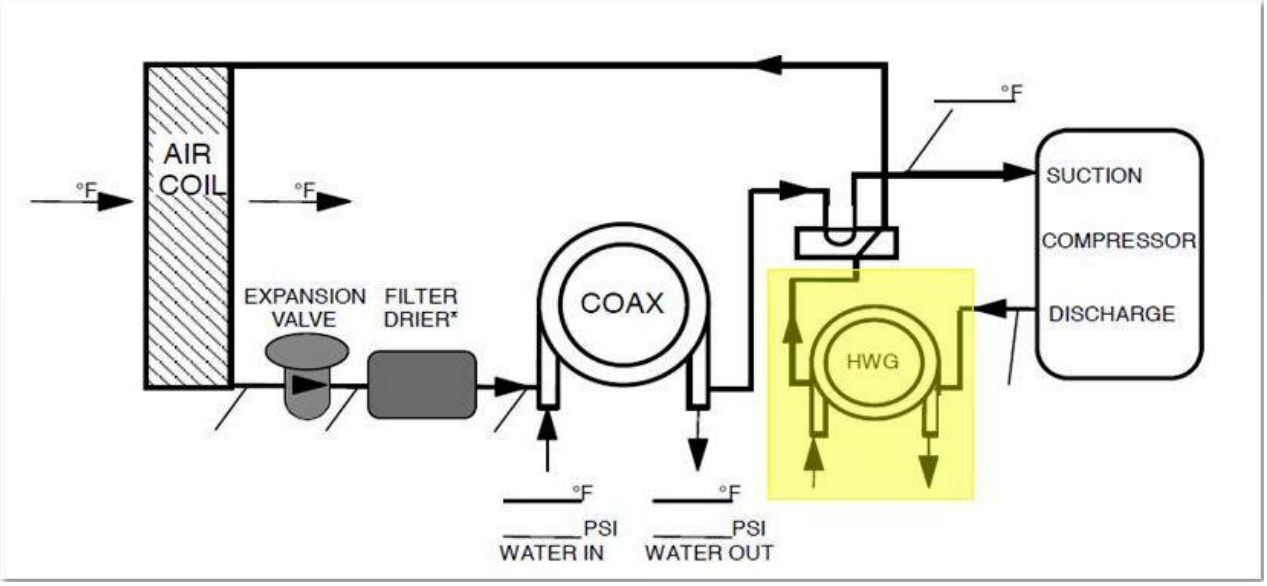











°F
AIR
COIL
°F
°F
SUCTION
COMPRESSOR
DISCHARGE
EXPANSION
VALVE
FILTER
DRIER*
COAX
HWG
°F
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WATER IN
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WATER OUT