



NEW ONLINE DESIGN TOOLS FOR GEOHERMAL HEAT PUMP SYSTEMS

Jeff Hammond

Director of Marketing/Business Development

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Topics

- Overview of online design tools for loop layout/pump sizing
- Pump selection: Pump type, flow, and Watts
- Real world application of design tools

Online Design Tools

- Heat Pump Manufacturers
- Flow Center/Pump Manufacturers
- Free Reference Websites (advertising funded)

Why Online?

- Advantages
 - Platform independent
 - Windows, Mac, Linux
 - Mobile devices (tablets like iPad)
 - Free or low cost
 - Accessible from anywhere on all of your devices
 - No updates to download/install
- Disadvantages
 - Requires Internet access
 - Flash (more later)

Heat Pump Manufacturers – Example Ground Loop Sizing

System 1 - Geo System

Loop Information

One Vertical U-Tube ▾

Bore Depth

Pump ▾

Pipe Type = Polyethylene SDR-11 3/4"

Soil Type = Average Rock

Entering Water Temperature

Desired

Maximum (Summer)

Minimum (Winter)

Geo Unit

Series

▾

Unit

▾

Backup Heating

▾

ECM Blower is assume for all Geo Units

Hot Water

▾

DesuperHeater

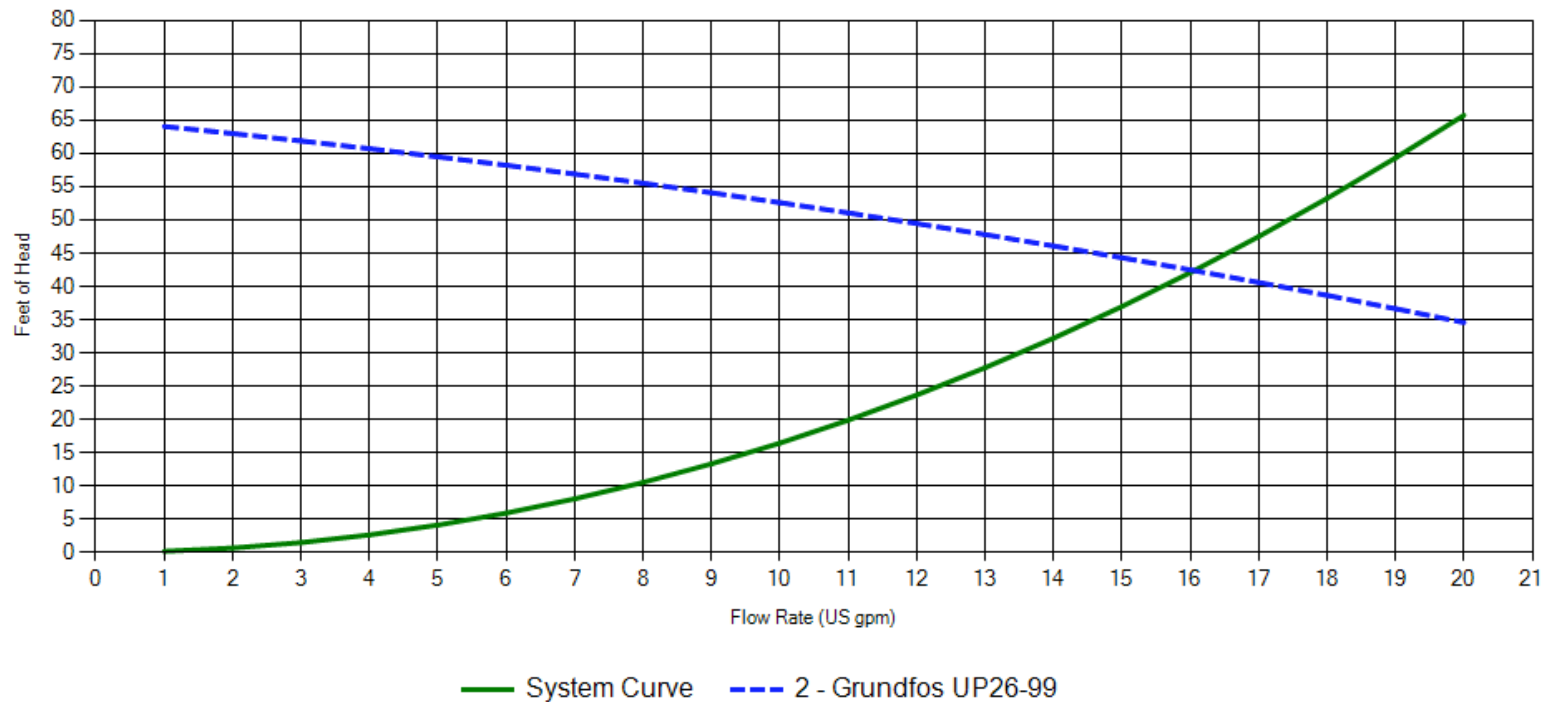
Loop

Auto Size Loop

Heat Pump Manufacturers – Example Pressure Drop Calc

Home Project System Information Units Piping **Pressure Drop Chart**

System Curve / Pump Curves



Nominal Flow Rate: 12.0 gpm
Actual Flow Rate: 16 gpm

Total Pressure Drop: 42.1 ft of head
Reynolds Number: 2755

Total Fluid in Loop: 70 gallons
Flushing Requirements: 22 gpm @ 78 Feet Head
Total Antifreeze Required: 15 gallons

[Print Report](#)

Heat Pump Manufacturers Software

- Most provide ground loop sizing and operating cost analysis
- Heat pump data is already loaded
- Print-outs lend credibility during sales process
- Allow “what if” scenarios
 - Larger/smaller unit or larger/smaller loop?
 - Warmer/cooler design temps?
 - Which loop layout?

Pump Manufacturers – Example Pump Selection

GRUNDFOS WEBCAPS



Home | Catalogue | Literature | Service | **Sizing** | Replacement | CAD Drawings | Help

Login

Settings

Heating

Your requirements

Installation Type

Replacement

Flow (Q) US GPM

Head (H) ft

More

Pumped liquid

Concentration %

Min. liquid temperature °F

Liquid temperature during operation °F

Max. liquid temperature °F

Ambient temperature °F

Min. inlet pressure psi

Allowed flow undersize %

Max. operation pressure All 87 145 232 290 psi

Control mode

Control mode

Select type of hydraulic

Preferred number of poles

Edit load profile

Heating season days

Energy price \$

Increase of energy price %

Interest rate %

Calculation period years

Hit list settings

Evaluation criterion

Limit search to ..

Include particular pump in hit list

Max. hits per product group

Max. hits total

Operational conditions

Frequency 50 60 Hz

Phase 1 or 3 1 3

Voltage V

Pump design

Pump material

Inline

Canned

Rotor

Inline Multistage

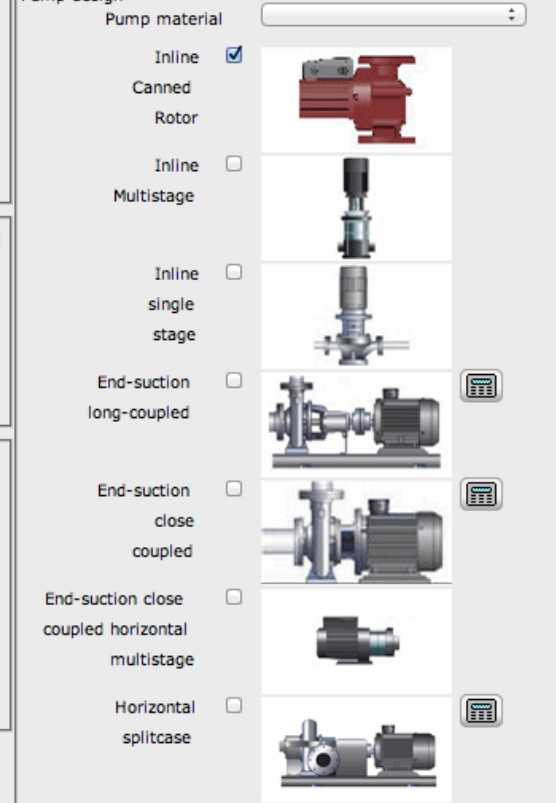
Inline single stage

End-suction long-coupled

End-suction close coupled

End-suction close coupled horizontal multistage

Horizontal splitcase



Pump Manufacturers Software

- Advantages
 - Lots of options
 - The latest models
- Disadvantages
 - Calculators tend to be very specific, which could result in pump selections that are not common in the geo industry
 - Additional information that's not always needed

Flow Center Manufacturers – Example Pump Selection

[Home](#)
[Pressure Drop Calculator](#)
[Flush Cart Calculator](#)
[Pump Sizing Calculator](#)

Pump Sizing Calculator

Version 1.0

Instructions: Enter the flow rate and system pressure drop for the entire system (ground loop, heat pump heat exchanger, inside piping, etc.), including antifreeze correction. Select pump(s), and output.

System Input	Design system flow rate -- U.S. GPM	12.0	GPM
	Total system pressure drop (loop, inside piping, heat pump heat exchanger)*	38.0	ft. of hd.
Pump Selection	Select pump(s)		
	Number of pumps (not applicable for UPS60-150)		
	NOTES:		
	1. Selecting two 32-140 pumps actually selects one 32-140 and one 26-99.		
	2. Max. number of pumps are as follows:		
	GEO32-140, UPS32-160, UPS40-160, UPS40-240: Max = 2**		
	UPS60-150: "2" is the only choice for this pump, regardless of input.**		
	UP26-99, UPS26-99		
	**Pumps are in series		
Operating Cost	Cost per kWh -- for comparing pump Watts		
	Heat pump type		
	Annual run time assumed for this calculation is 3,066 hours per year for single speed, 4,145 hours per year for two-stage, and 5,468 hours per year for variable speed.		

- ✓ Magna GEO32-140 (var. spd.)
- UPS26-99 - Low speed
- UPS26-99 - Med speed
- UPS26-99 - High speed
- UP26-99
- UP26-116
- UPS32-160 - Low speed
- UPS32-160 - Med speed
- UPS32-160 - High speed
- UPS40-160 - Low speed
- UPS40-160 - Med speed
- UPS40-160 - High speed
- UPS40-240 - Low speed
- UPS40-240 - Med speed
- UPS40-240 - High speed
- 2 - UPS60-150 - Low speed
- 2 - UPS60-150 - Med speed
- 2 - UPS60-150 - High speed

*Determined from pressure drop calculator.

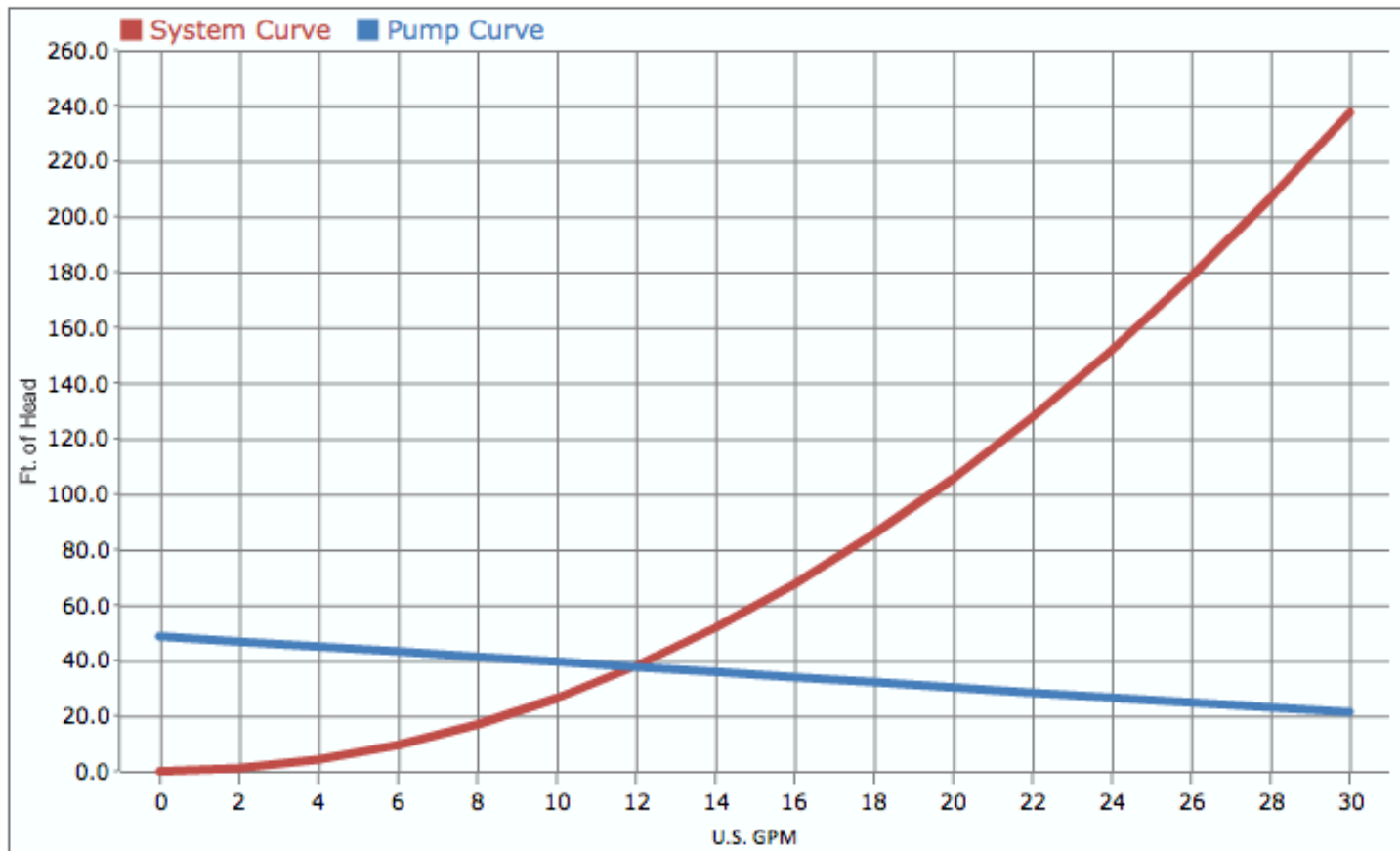
Design System Flow Rate	12 U.S. GPM
Total System Pressure Drop	38.0 Ft. of Head

Pump Selection = 32-140 + 26-99

Flow Center Manufacturers – Example Pump Selection

Design System Flow Rate 12 U.S. GPM
 Total System Pressure Drop 38.0 Ft. of Head
 Pump Selection = 1 - Magna GEO32-140 (var. spd.)

Actual System Flow Rate 12 GPM @ 37.4 Ft. of Hd.
Average Power Consumption 105 Watts
Pump Operating Costs \$32 per year



Flow Center Manufacturers Software

- **Advantages**
 - Pre-selected pump choices
 - Minimal amount of data needed (GPM, pressure drop, pump selection)
 - “Packaged” approach when using a flow center
- **Disadvantages**
 - Normally don’t include heat pump or ground loop sizing as part of the software package (use heat pump manufacturers software)

Free Reference Websites

- Conversion Calculators
- Lookup Tables
- Drawings/Drawing Tools
- Definitions/Explanations of Applications

Free Reference Websites – Example Drawing Software

Copy of HVAC Diagram Template ☆

File Edit View Insert Format Arrange Tools Help Last edit was made seconds ago by jffhmmnd

The Engineering ToolBox
 www.EngineeringToolBox.com

FREE online HVAC diagram template!
 Enabled for use with the amazing FREE Google Docs!
 Runs in Your browser - no installation required!
 Collaborate with others. Publish your drawings!

Sign in to your FREE Google account - select from the menu "File > Make a Copy" to make your own diagrams!
 Remove this text and the default drawing.

No	Date	Class	Rev	Description	DWN	VER	CHKID	SUB	APP
Project XX									
System XX HVAC Diagram								Drawn:	
								Design:	
								Checked:	
								Date:	
Submitted:					Approved for release:				
The Engineering ToolBox www.EngineeringToolBox.com								Sheet: S-0001	
Classification:								Reviewer:	
Project ID: 12355								Drawing no: V36-001	
								Date:	
								Rev: 0	
Made with the FREE online engineeringtoolbox.com HVAC template and Google Docs									

Free Reference Websites – Example Lookup Table

Freezing Point of Propylene Glycol based Water Solutions

Freezing point of [propylene glycol](#) based water solutions at different temperatures:

Freezing Point								
Propylene Glycol Solution (%)	<i>by mass</i>	0	10	20	30	40	50	60
	<i>by volume</i>	0	10	19	29	40	50	60
Temperature	^o F	32	26	18	7	-8	-29	-55
	^o C	0	-3	-8	-14	-22	-34	-48

Due to slush creation propylene glycol and water solutions should not be used close to the freezing points.

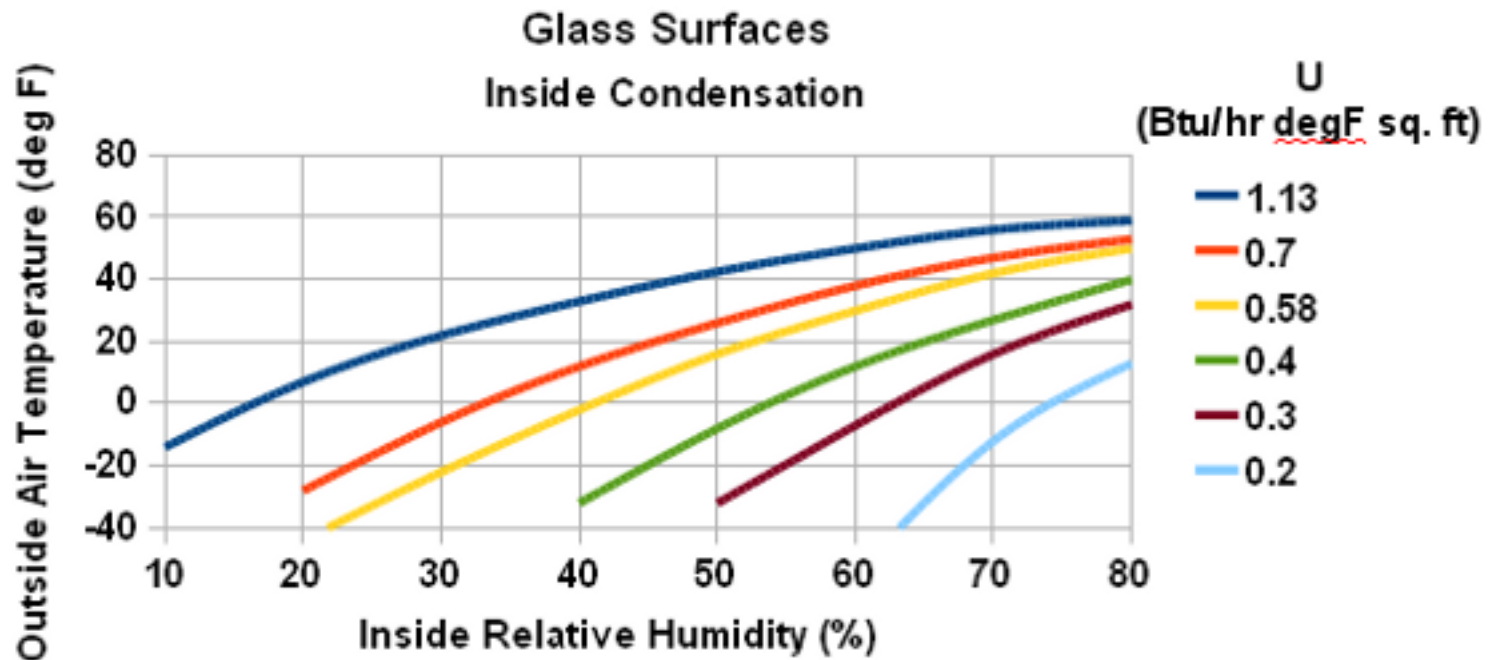
Specific Gravity of Propylene Glycol Solutions

[Specific gravity](#) of propylene glycol is in the range

Specific Gravity - SG -								
Propylene Glycol Solution (%)	<i>by mass</i>	0	10	20	30	40	50	60
	<i>by volume</i>	0	10	20	29	40	50	60
Specific Gravity - SG - 1)		1.000	1.008	1.017	1.026	1.034	1.041	1.046

1) Specific gravity based on propylene glycol solutions with temperature 60°F.

Free Reference Websites – Example Reference Chart



Free Reference Websites – Source of Funding

Typically funded by advertising links



Resources, Tools and Basic Information for Engineering and Design of Technical Applications!

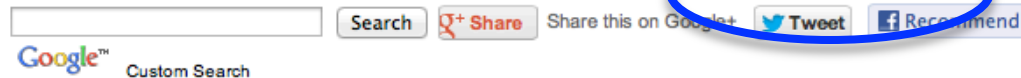
Ads by Google

[Pipe Pressure Drop](#)

[Geothermal Pipe](#)

[PVC Pipe Fittings](#)

[Geothermal Systems](#)



Home

- Acoustics
- Air Psychrometrics
- Basics
- Combustion
- Drawing Tools
- Dynamics
- Economics
- Electrical
- Environment
- Fluid Mechanics
- Gas and Compressed Air
- HVAC Systems
- Hydraulics and Pneumatics
- Insulation
- Material Properties
- Mathematics
- Mechanics
- Miscellaneous

Equivalent Pipe Length Method - Calculating Pressure Loss in I Calculating pressure loss in piping systems with the Equivalent Pipe Length

Pipe Marking Color Codes

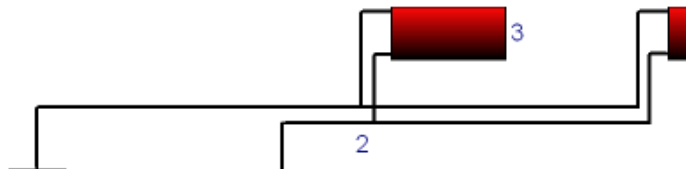
www.DuraLabel.com

Free guide to pipe color coding standards set by ANSI and ASME

An efficient and simple way to calculate the pressure loss in a piping system is the "Equivalence

1. Make a Diagram of the Piping System

Make a diagram where the system is structured with nodes as shown below.



Online Summary

- More options than ever
- Many are free or low cost
- Most are mobile friendly
 - New browsers are available for iOS and Android that can even handle Flash graphics

Puffin Web Browser

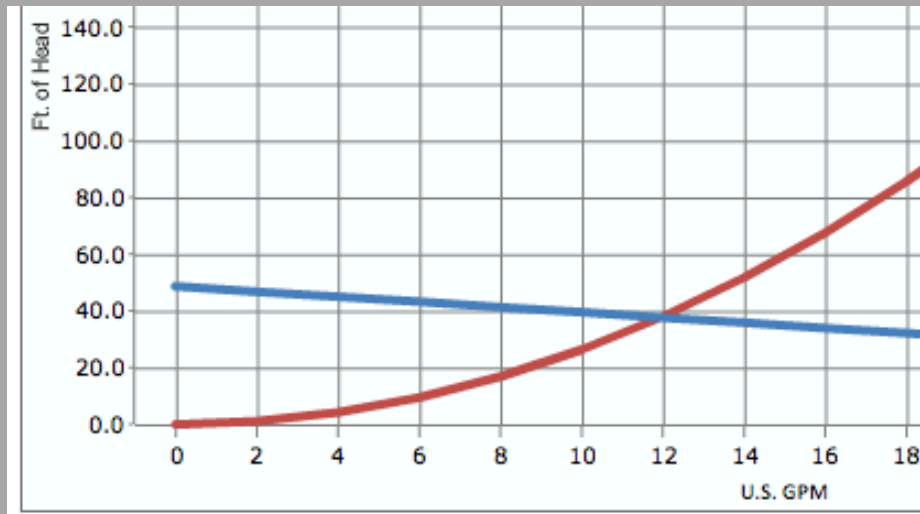
By CloudMosa, Inc.

Open iTunes to buy and download apps.



Design Calculators – Pump Selection Topics

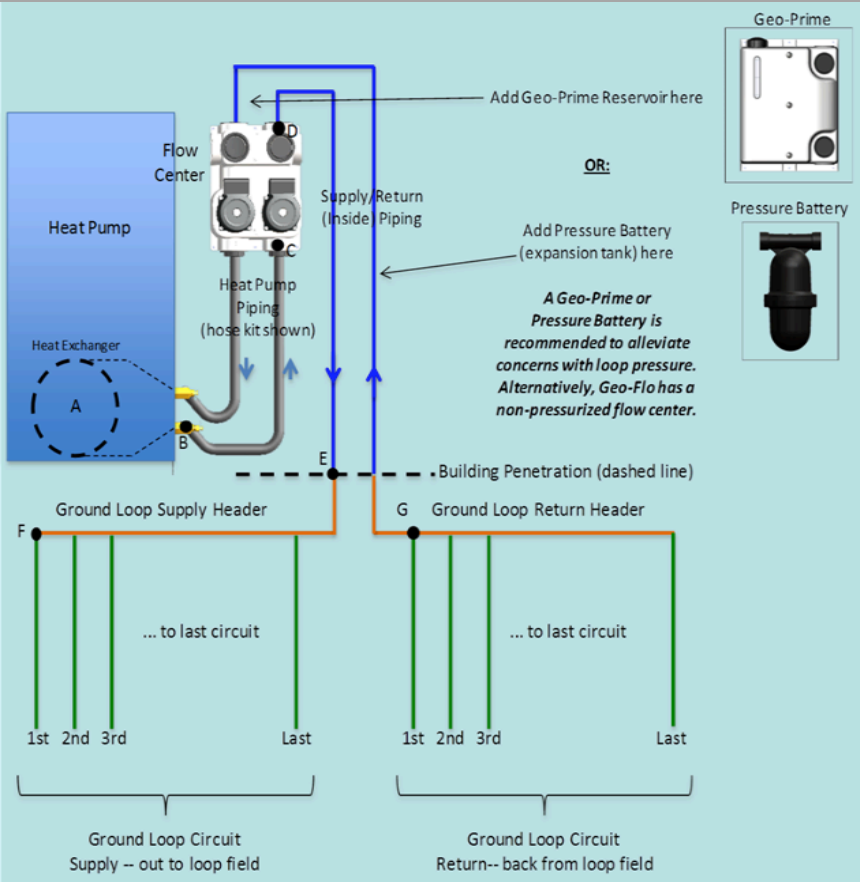
- Pump Curve/System Curve (how to read)
- Flow rates
 - Nominal vs. minimum
- Pump Options
 - Constant speed (single and multi speed)
 - Variable speed
- Pump Watts for single speed and two-stage or variable speed heat pumps



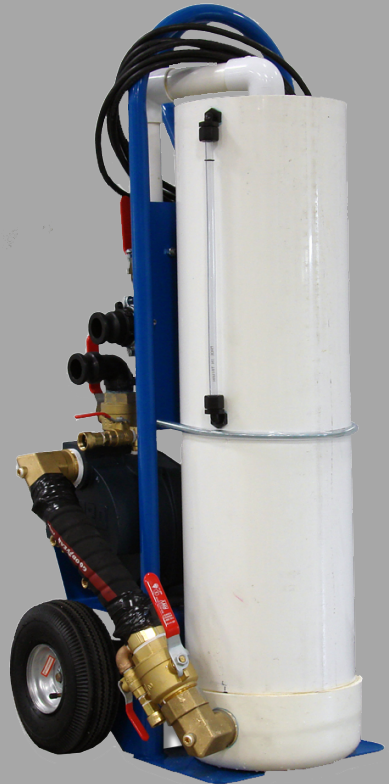
ONLINE CALCULATOR DEMONSTRATION

Design Calculators – Pressure Drop Topics

- Antifreeze
 - How much is needed?
 - How does antifreeze affect pressure drop?
 - What about Reynolds Number?
- PE types (e.g. 3408 vs. 4710)
- Ball valves
- Flushing the system
- IGSHPA 2009 Installation Guide



RE



ONLINE CALCULATOR DEMONSTRATION

Where to get these calculators

- Heat pump manufacturers websites (free or low cost)
 - Ground loop/heat pump sizing
 - Operating cost analysis
- www.engineeringtoolbox.com (free)
 - Conversion charts
 - Lookup tables
 - Drawing tools
- www.calculators.geo-flo.com (free)
 - Pressure drop calculation
 - Pump sizing
 - Cv calculator
 - Flush cart calculator
 - Reynolds Number calculator
 - Antifreeze calculator
 - Flow rate calculator (from pressure drop)
 - Heat of Extraction/Heat of Rejection calculator

QUESTIONS?

Thank You!

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The logo for GEO-FLO, featuring the text "GEO-FLO" in white, bold, sans-serif font, set against a blue rectangular background.