Common Issues with Geo Thermal Heat Pumps

Sean Hogan

Technical Trainer

System Sizing

- Size heat pump, loop field by rule of thumb
- Size pump(s) by rule of thumb
- Use prescriptive approach (square foot/ton)

Heat Load

- The amount of heat either gained or lost by a building due to outside ambient conditions and internal gains

A Typical House in Texas

1231 sq. ft. / 500 = 2.5 ton

A Crucial Error

The 500 square foot per ton approach is a short cut method that takes the two dimensional amount of flat floor space and presumes to predict the appropriate size of the air conditioning system.

What's missing in this approach?

What's missing?

The third dimension of the house!

What makes each house distinctly different?

Many characteristics including:

Design Considerations

Local codes
Windows
Skylights
Doors
Walls
Floor
Roof/ Attic
Infiltration

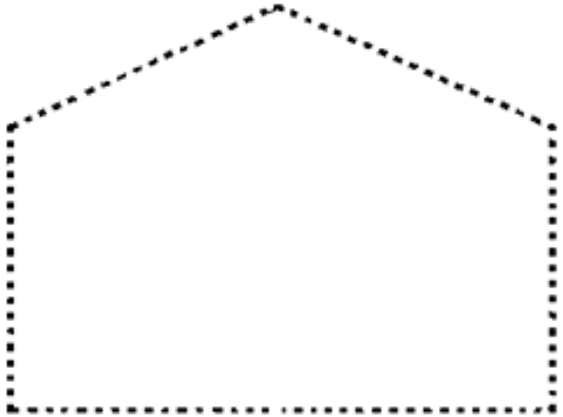
Internal gains
Ducts
Orientation/Exposure
Zoning
Fresh air requirements
Existing duct system
Return system
Grilles and Registers

Manual J 500

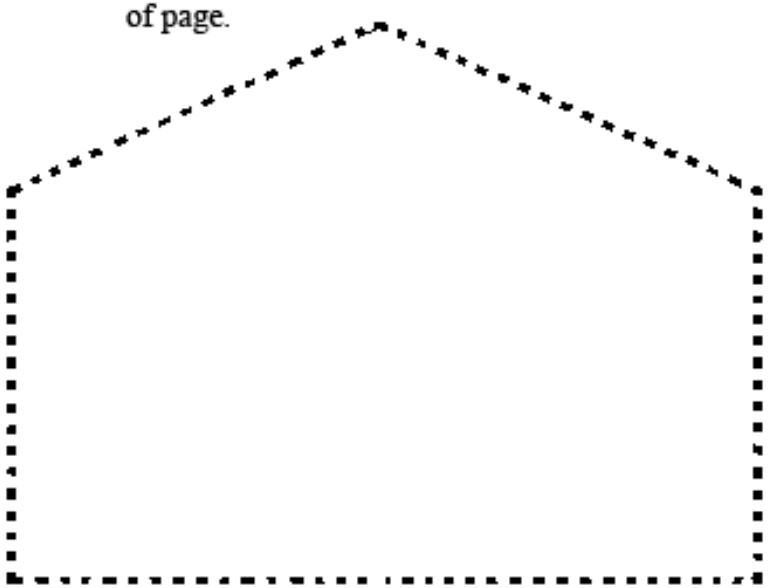
"We do a modified Manual J"

Air Conditioner or Heat Pump
Sizing Chart

1 1/2 to 2 ton



2 1/2 to 3 1/2 ton



4 to 5 ton

Preparing your sizing chart:

1. Print out this page.
2. Leaving the page intact, carefully cut out the holes on the dotted lines.
3. For operating instructions, see bottom of page.

Operating Instructions

1. Stand on the curb.*
2. Hold the sizing chart approximately one foot from your face.
3. Look at the house through each hole.
4. If the house fits in a hole; that's the size unit to use.

This quick reference tool is known as a Curb-u-lator©

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4 to 5 ton

The Curb-u-lator© shows this house as 2 ½ to 3 ½ tons

System 1 Room Load Summary

No	Room Name	Area SF	Htg Sens Btuh	Htg Nom CFM	Run Duct Size	Run Duct Vel	Clg Sens Btuh	Clg Lat Btuh	Clg Nom CFM	Air Sys CFM
---Zone 1---										
1	Laundry	45	1,835	24	1-5	409	971	271	56	56
2	Spare Bedroom	110	2,358	31	1-7	407	1,892	54	109	109
3	Dining	105	3,445	46	1-9	411	3,160	101	181	181
4	Kitchen	64	1,402	19	1-4	461	700	39	40	40
5	Front Hall	28	672	9	0-0	0	325	17	19	19
6	Hall	116	250	3	0-0	0	335	0	19	19
7	Bedroom 1	120	2,735	36	1-7	414	1,927	69	111	111
8	Bedroom 2	120	3,676	49	1-7	455	2,115	108	121	121
9	Master Closet	16	472	6	0-0	0	94	20	5	5
10	Living Room	266	4,617	61	2-7	440	4,094	93	235	235
11	Hall Bath	40	86	1	1-4	76	116	0	7	7
12	Master Bath	30	654	9	1-4	134	204	25	12	12
13	Master Bedroom	161	4,155	55	1-7	404	1,882	125	108	108
14	Hall Closet	10	22	0	0-0	0	29	0	2	2
	Duct Loads		6,731				4,319	484		
	System 1 total	1,231	33,110	349			22,163	1,406	1,025	1,025

System 1 Main Trunk Size: 12x20 in.
Velocity: 666 ft./min
Loss per 100 ft.: 0.057 in.wg

Cooling System Summary

	Cooling Tons	Sensible/Latent Split	Sensible Btuh	Latent Btuh	Total Btuh
Net Required:	1.96	94% / 6%	22,163	1,406	23,569
Recommended:	2.46	75% / 25%	22,163	7,388	29,551

Sensible load:
22,163 Btuh

Total load:
29,551 Btuh

2.4 ton load

Project Summary
Entire House
Tradesman Heating & A/C Services

Job: 001
Date: Apr 12, 2005
By:

Project Information

For:

Notes:

Design Information

Weather: Waco, TX, US

Winter Design Conditions

Outside db	26	°F
Inside db	70	°F
Design TD	44	°F

Summer Design Conditions

Outside db	99	°F
Inside db	75	°F
Design TD	24	°F
Daily range	M	
Relative humidity	50	%
Moisture difference	29	gr/lb

Heating Summary

Structure	24731	Btuh
Ducts	2920	cfm
Central vent (64 cfm)	3056	Btuh
Humidification	0	Btuh
Piping	0	Btuh
Equipment load	30707	Btuh

Sensible Cooling Equipment Load Sizing

Structure	15300	Btuh
Ducts	3005	Btuh
Central vent (64 cfm)	1646	Btuh
Blower	0	Btuh
Use manufacturer's data	y	
Rate/swing multiplier	1.00	
Equipment sensible load	19951	Btuh

Infiltration

Method	Simplified
Construction quality	Average
Fireplaces	0

	Heating	Cooling
Area (ft²)	1164	1164
Volume (ft³)	9312	9312
Air changes/hour	0.45	0.23
Equiv. AVF (cfm)	70	36

Latent Cooling Equipment Load Sizing

Structure	1700	Btuh
Ducts	216	Btuh
Central vent (64 cfm)	1262	Btuh
Equipment latent load	3178	Btuh
Equipment total load	23129	Btuh
Req. total capacity at 0.70 SHR	2.4	ton

Heating Equipment Summary

Make	Bryant
Trade	Reliant 697C
Model	697CN036-D

Efficiency	7.8	HSPF
Heating input		
Heating output	35400	Btuh @ 47°F
Temperature rise	29	°F
Actual air flow	1120	cfm
Air flow factor	0.041	cfm/Btuh
Static pressure	0.50	in H2O
Space thermostat		

Cooling Equipment Summary

Make	Bryant
Trade	Reliant 697C
Cond	697CN036-D
Coil	FK4CNF001

Efficiency	12.5	SEER
Sensible cooling	23520	Btuh
Latent cooling	10080	Btuh
Total cooling	33600	Btuh
Actual air flow	1120	cfm
Air flow factor	0.061	cfm/Btuh
Static pressure	0.50	in H2O
Load sensible heat ratio	0.86	

Printout certified by ACCA to meet all requirements of Manual J 8th Ed.

Sensible
19,951

Total
23,129

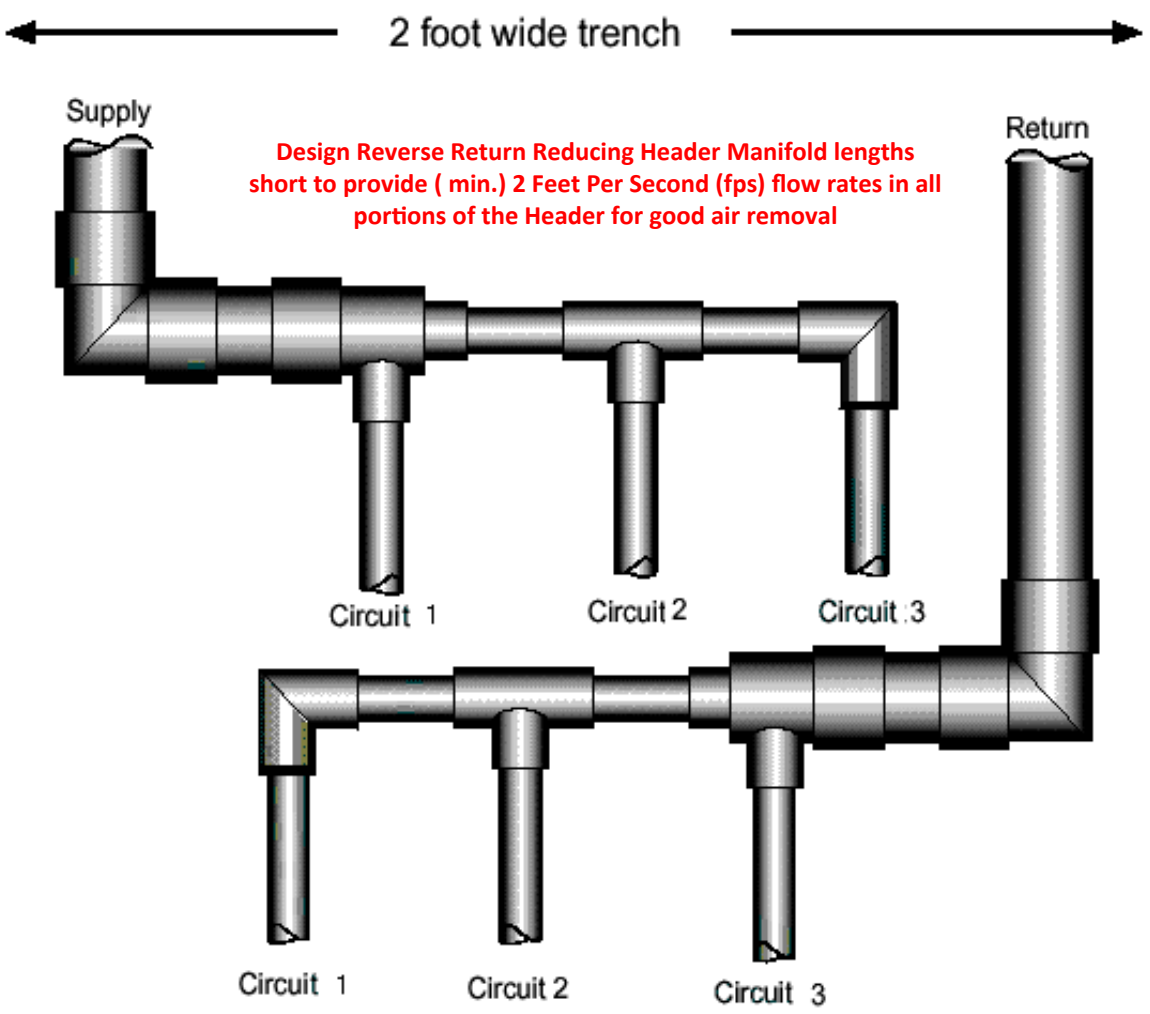
2.4 tons

- Determination of heating & cooling loads
- Selection of a properly sized heat pump system
- Size the loop to support the heat pump with accurate soil descriptions
- Selection & design of air distribution system

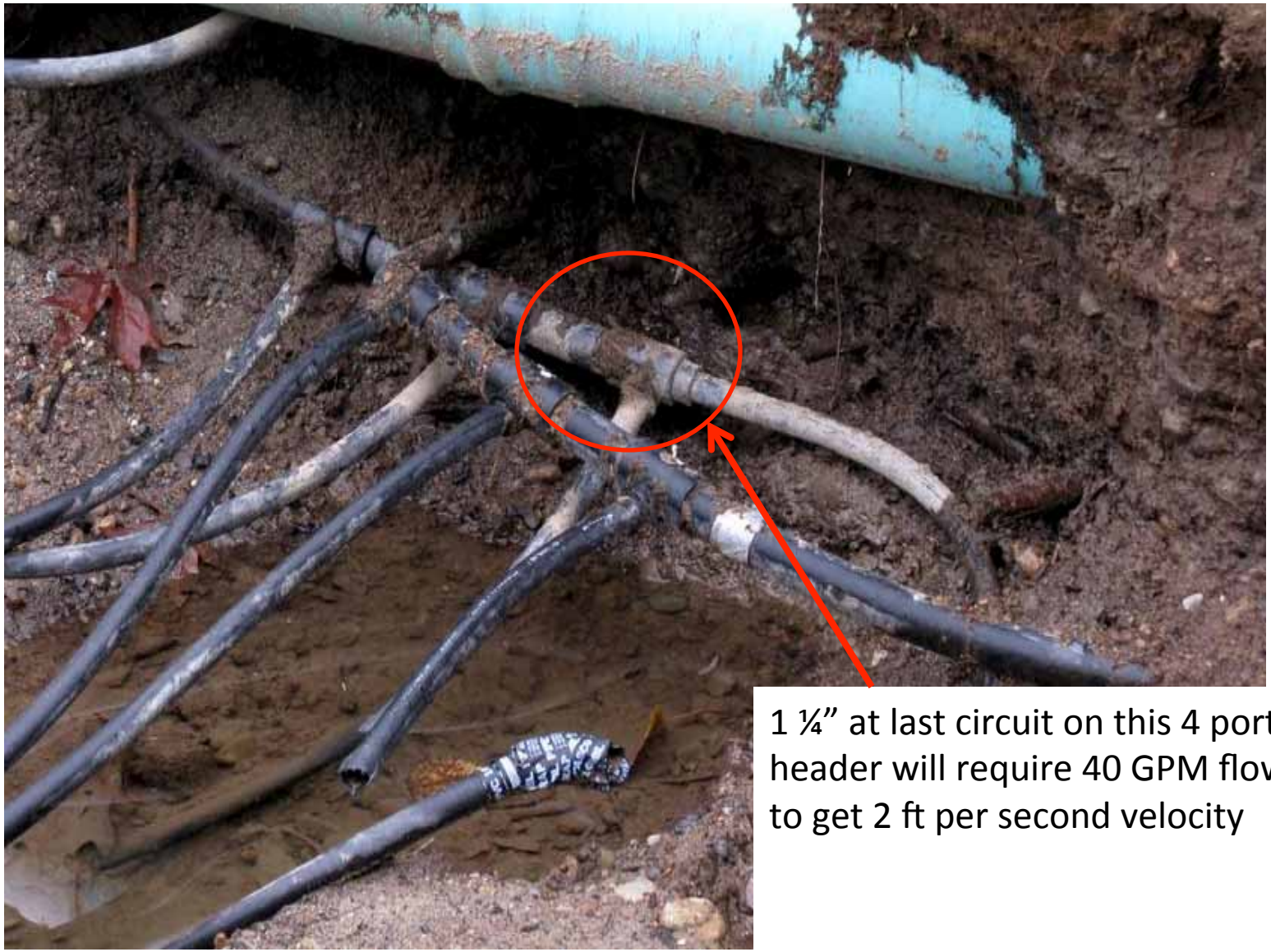
Improper or Inadequate Loop Flushing

- “I saw no more bubbles, I must be done”
- “I flushed for the entire 30 minutes”
- “The loop pumps can flush the system”
- “Why won’t my sump pump & garbage can work”

Air Removal part of every design
Reverse Return piping method



Improper Manifold Design



1 ¼” at last circuit on this 4 port header will require 40 GPM flow to get 2 ft per second velocity

Reverse Return Headering

System doesn’t work must be the heat pump

Flush Cart

Custom P-handle cart, powder coated

Bag filter (inside tank)

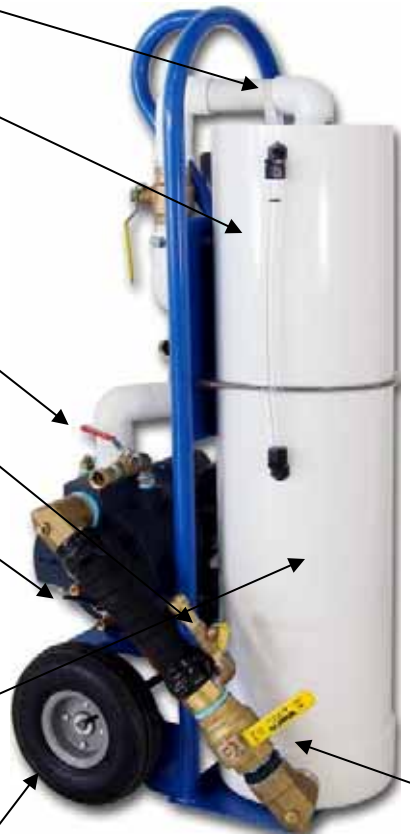
Fluid level indicator with o-ring

Power drain Fill valve

2” Flexible connection between tank and pump

13 Gallon tank

Pneumatic tires



GFCI and water resistant switch

20 ft cord

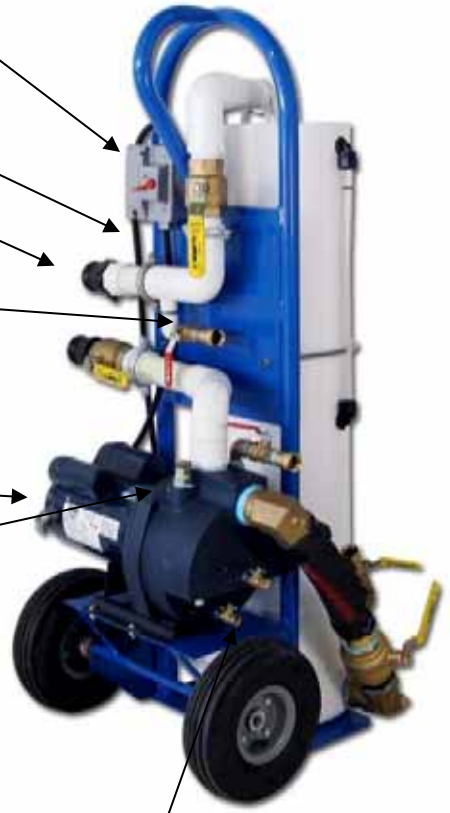
Quick connect hose fittings

Pump and dump valve

1.5 HP pump

PT port for pressure measurement

Power flushing capability

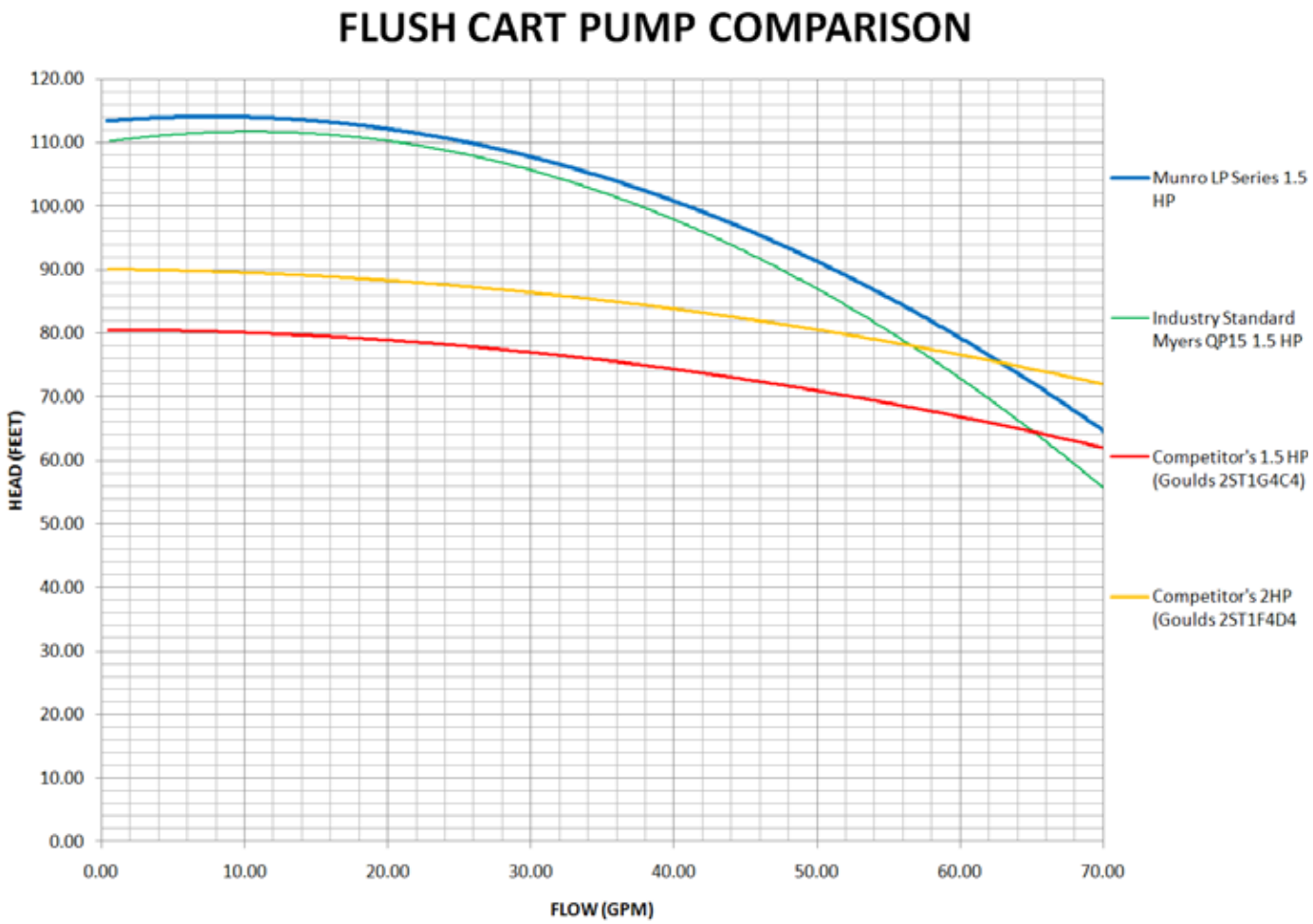


Drain valves

Includes two 10 ft hoses with quick connect fittings (not shown)

Flush Cart Pump

- Munro LP Series Pump
  - 1.5 HP, 115V, 13.7 FLA



Calculate Flushing requirement

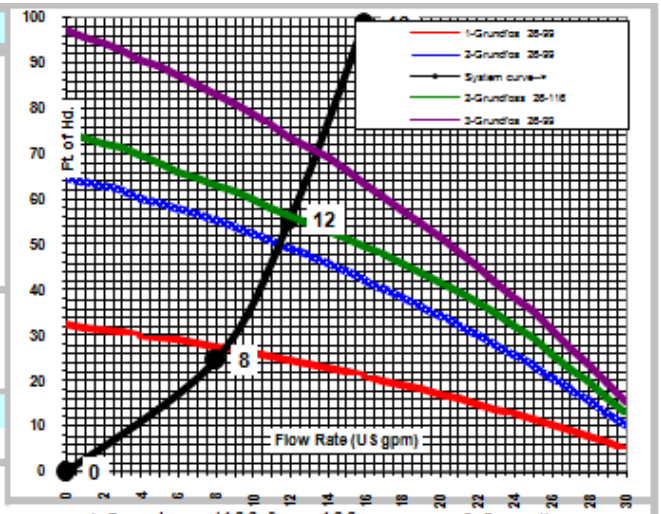
Minimum system flow rate should be 9 gpm.

8. Determine Pump Sizing Curve Coordinates:

Tot. gpm (3 gpm/ton) =	Q1	12.0	x	point A
Tot. pres. drop (Ft hd)=	h1	55.6	y	
Tot. gpm **x** 2/3 =	Q2	8.0	x	point B
PD=(Q2^2)(h1)/(Q1^2)	h2	24.7	y	
Tot. gpm **x** 4/3 =	Q3	16.0	x	point C
PD=(Q3^2)(h1)/(Q1^2)	h3	98.9	y	

9. Plot system curve & determine which Flow Controller will produce the desired flow rate.
Pump Sys C = 12 gpm (to the nearest gpm)

10. Verify circuit Reynolds number: 4655
(Should be 2,500 or greater)



11. Calculate the amount of antifreeze needed:

(Pipe size:	1.00)	4	tot. feet* **x**	4.5	volume/100 ft. ÷ 100 =	0.2	gallons
(Pipe size:	1.25)	170	tot. feet* **x**	8.3	volume/100 ft. ÷ 100 =	14.1	gallons
(Pipe size:	0.75)	2400	tot. feet* **x**	2.8	volume/100 ft. ÷ 100 =	67.2	gallons
(Pipe size:	)		tot. feet* **x**	-	volume/100 ft. ÷ 100 =	-	gallons
					Total fluid in loop:	92.5	gallons**
					% antifreeze **x**	21%	by vol.
					Total antifreeze req.:	19.4	gallons

Notes: 1) Use decimal number for pipe size (e.g. 3/4" = 0.75)
2) Volume/100 ft. is shown for PE pipe only.
3) Use 1" pipe for rubber hose.

12. Determine Flushing Requirements. Flushing requirements: 12 gpm @ 56 ft. hd.

*Enter ft. of pipe in both directions. **Includes coax & flush cart.

When your flush cart is not enough.

Air in closed loop systems can lead to the following problems:

- Noise in the piping and heat pump
- Inadequate circulator performance
- Inadequate heat output from the heat pump
- Accelerated corrosion due to oxygen in contact with ferrous metals
- Circulator noise or failure due to improper lubrication
- Complete loss of flow and heat output due to large air pockets

CLIMATEMASTER
Geothermal Heating & Cooling Systems

Insufficient Antifreeze

- Heating dominant climates could cause freeze damage to heat exchanger.
- Ice build up in Koax, slows flow rate which lowers fluid temp faster and faster
- Ice could damage loop pump(s)

Frozen Koax

Excessive Antifreeze

- Diminished temperature transfer, almost like an insulator
- Can be more difficult to pump and or have turbulent flow in loop field
- If inhibited antifreeze is used, can coat Koax

“My Unit Keeps Faulting”

- Didn’t pull fault code
- Didn’t cut the FP1 (now LT1) jumper on closed loop antifreeze system
- Can’t provide start up or troubleshooting form
- P/T ports not installed
- My flow rate is greater than catalog spec’s

Air Flow Issues:

- duct sizing (too large or small)
- Air throw from registers inadequate
- Closed registers
- Inadequate return or dirty filter
- Heat pump used during construction
  plugged coil