

# Common Issues with Geo Thermal Heat Pumps

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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



$$1231 \text{ sq. ft.} / 500 = 2.5 \text{ ton}$$



# 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

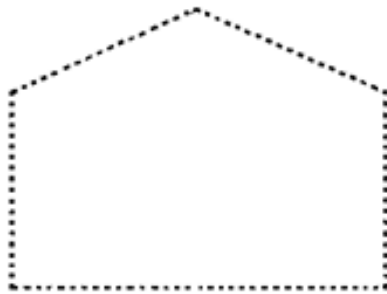
Grilles and Registers

# Manual J 500

“We do a modified Manual J”



# Air Conditioner or Heat Pump Sizing Chart



1 1/2 to 2 ton



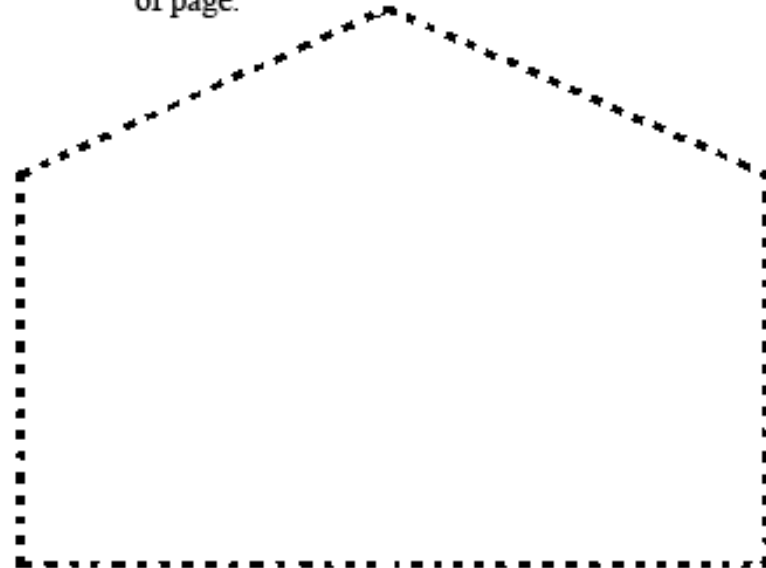
2 1/2 to 3 1/2 ton

## 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.

## Preparing your sizing chart:

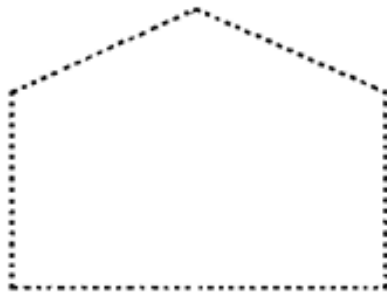
1. Print out this page.
2. Leaving the page intact, carefully cut out the holes on the dotted lines.
3. For operating instructions, see bottom of page.



4 to 5 ton

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

# Air Conditioner or Heat Pump Sizing Chart



1 1/2 to 2 ton

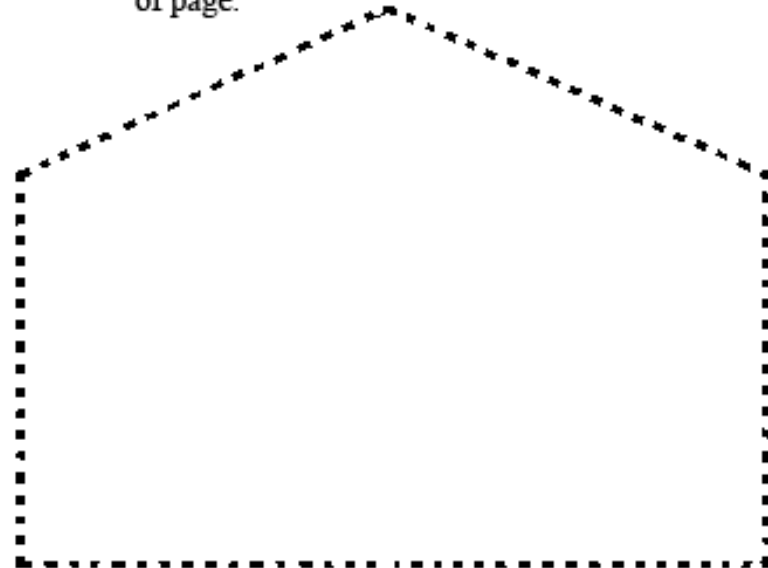


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4 to 5 ton

The Curb-u-lator<sup>☺</sup> shows this house as 2 ½ to 3 ½ tons



### System 1 Room Load Summary

Room 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

#### Infiltration

Method	Simplified	
Construction quality	Average	
Fireplaces	0	
Area (ft²)	Heating 1164	Cooling 1164
Volume (ft³)	9312	9312
Air changes/hour	0.45	0.23
Equiv. AVF (cfm)	70	36

#### Heating Equipment Summary

Make Bryant  
Trade Reliant 697C  
Model 697CN036-D

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

#### 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

#### 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

#### 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

Sensible  
19,951

Total  
23,129

2.4 tons

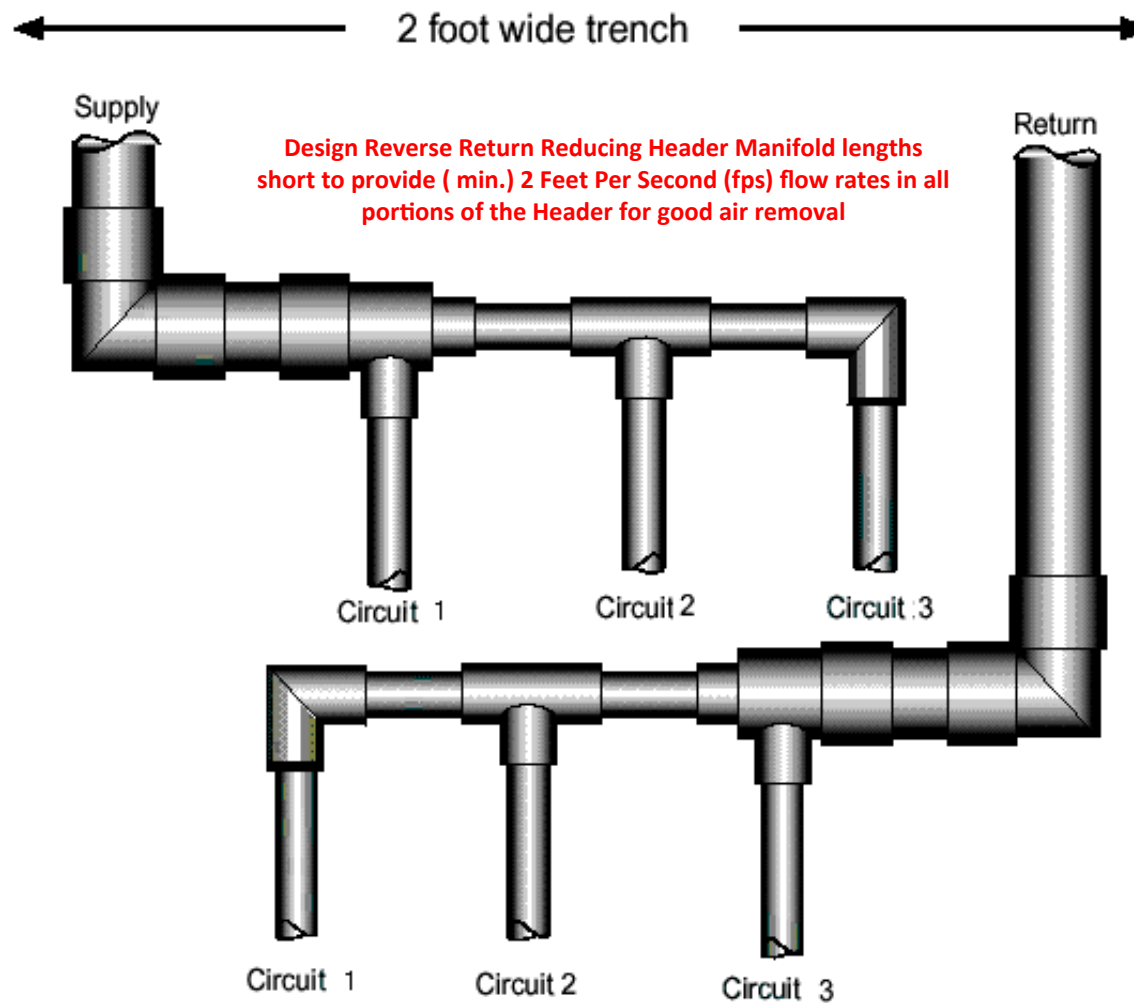
- ❑ Determination of heating & cooling loads
- ❑ Selection of a properly sized heat pump system
- ❑ Size the loop to support the heat pump with accurate soil descriptions
- ❑ Selection & design of air distribution system

# Improper or Inadequate Loop Flushing

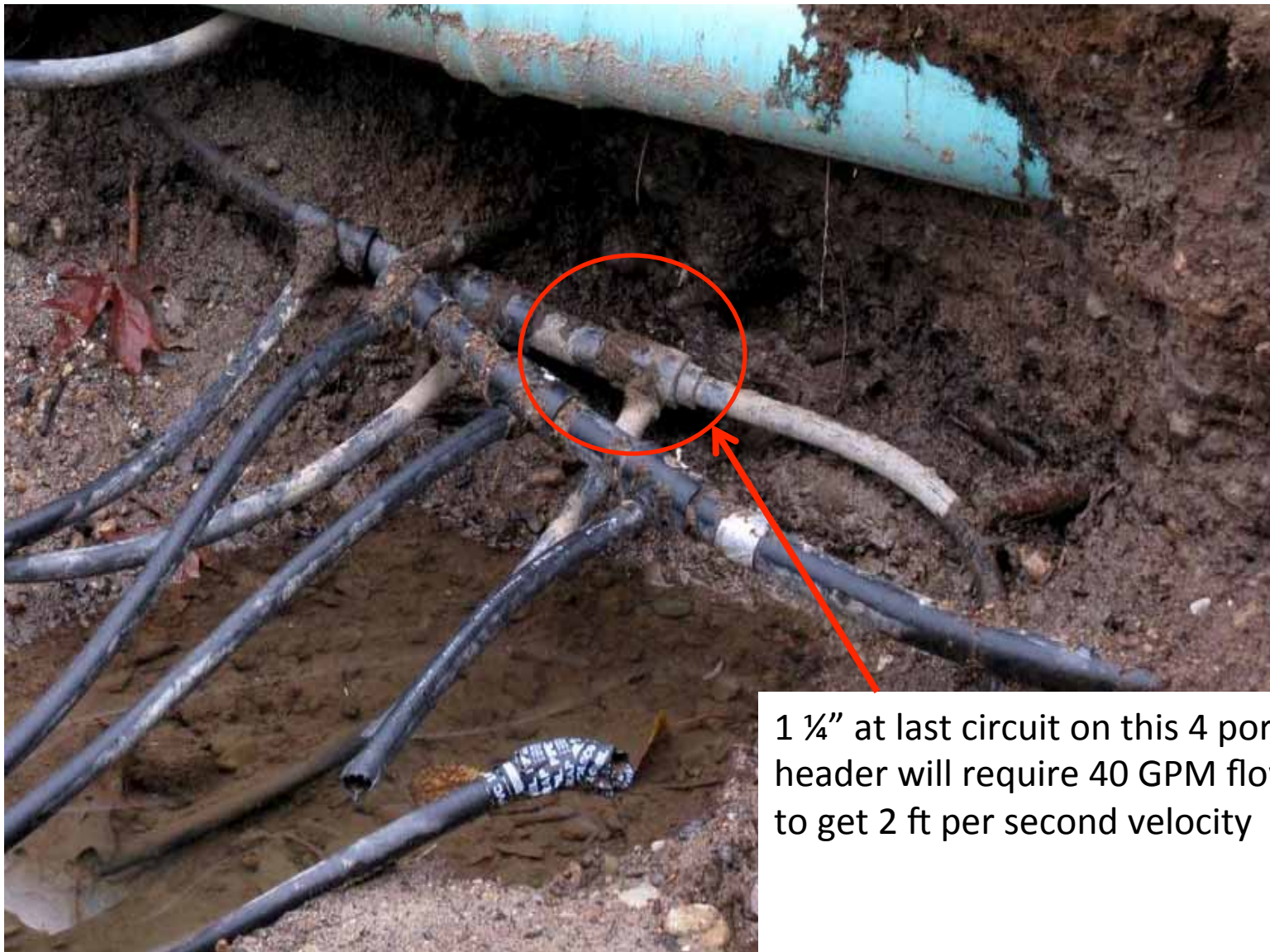
- “I saw no more bubbles, I must be done”
- “I flushed for the entire 30 minutes”
- “The loop pumps can flush the system”
- “Why won’t my sump pump & garbage can work”

# 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

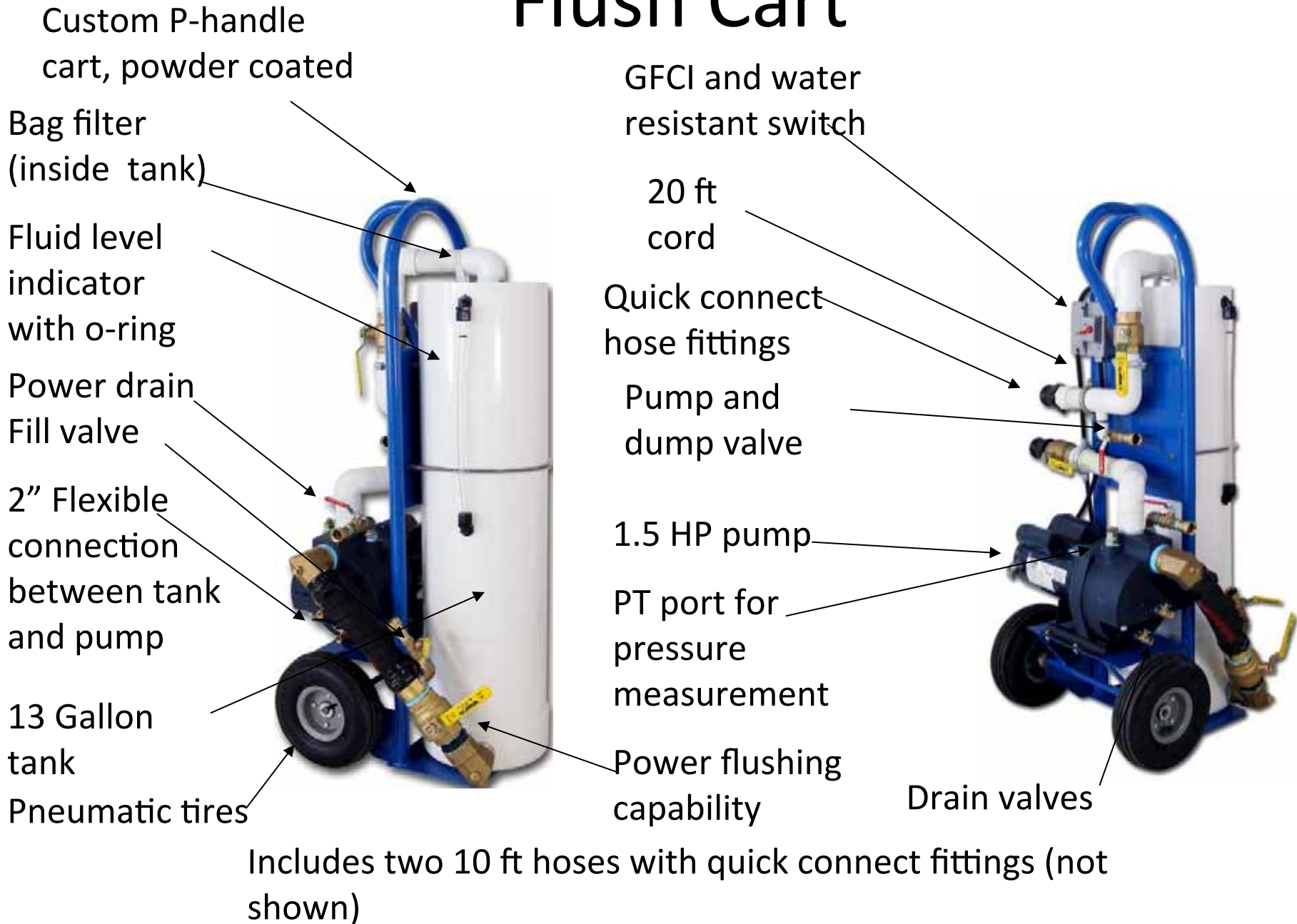
# Reverse Return Headering



System doesn't work  
must be the heat pump



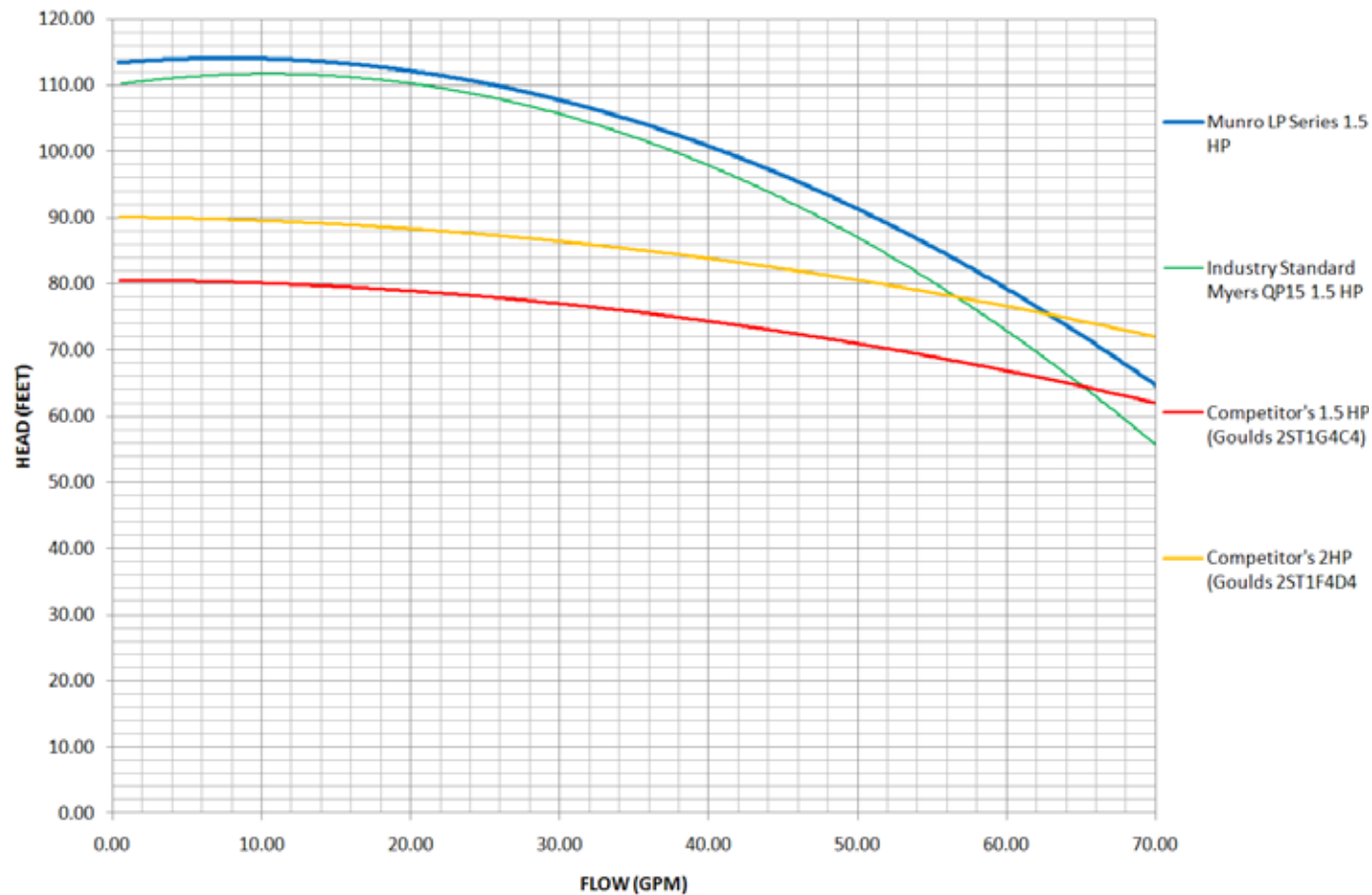
# Flush Cart



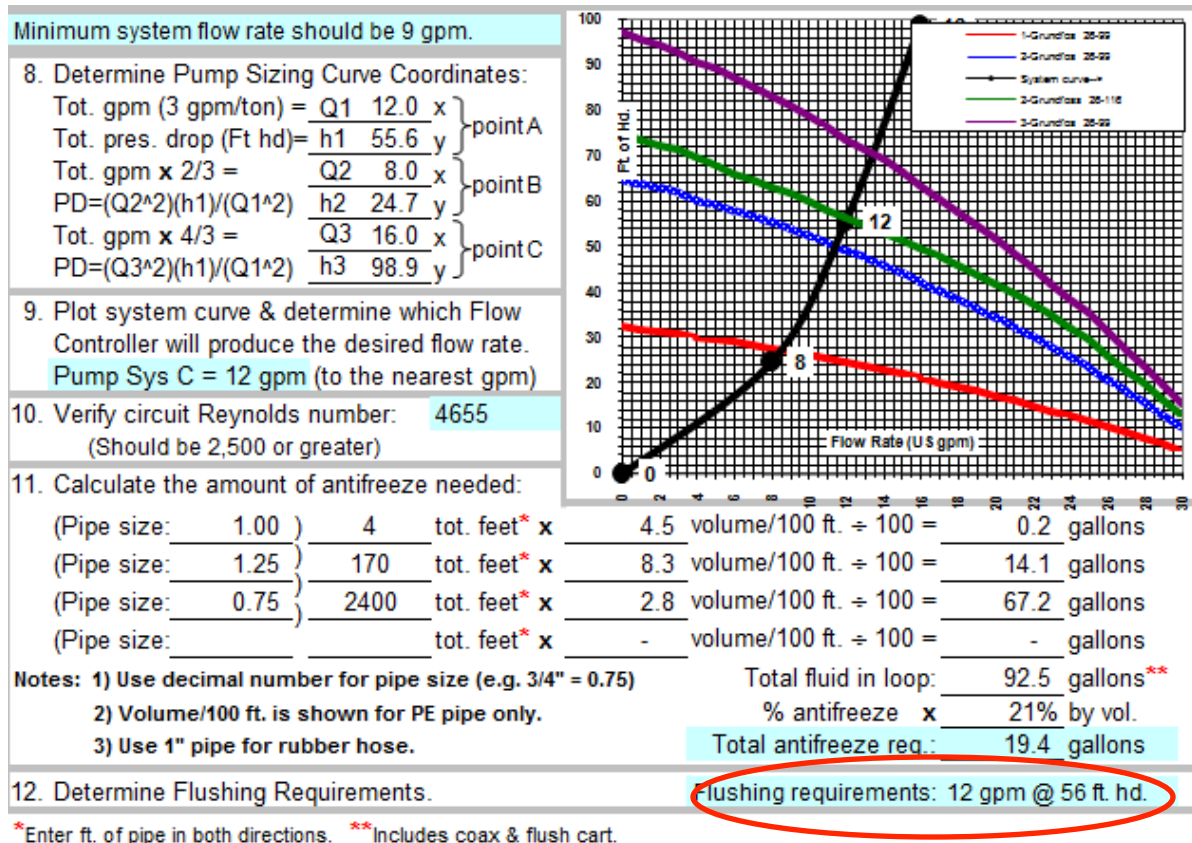
# Flush Cart Pump

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

**FLUSH CART PUMP COMPARISON**



# Calculate Flushing requirement



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



# 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

