Hydronics 101 Basics

Class Outline & Workbook

- ***Heat Loss***
- ***Heating type***
- ***Heat Source***
- ***Space***
- ***Piping method***
- ***Pump/Pipe size***
- ***Separation***
- ***Zoning***
- ***Venting***
- ***Expansion tank***
- ***Water or Glycol***
- ***Controls***
- ***Gas Piping***

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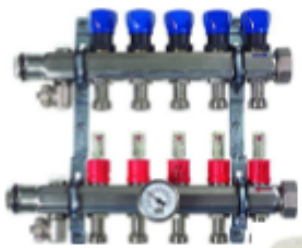
Components of a hydronic system!!

















"A poorly designed distribution system can ruin the performance of any hydronic system!"

THERE IS NO "ONE-SIZE-FITS-ALL" SOLUTION

What to know or consider before and during your project!!

Heat Loss

Heating Type

(HIGH MASS OR LOW MASS)

- *In Concrete or Gypcrete*
- *Staple up*
- *Above floor panel*
- *Baseboard*
- *Fan Coils*
- *Radiators*
- *Ceiling Panels*
- *Wall Panels*

Heat Source

- *Condensing/Non-Condensing*
- *Electric*
- *Heat Pump*
- *Steam*
- *Heat Exchanger*
- *Wood*
- *Oil*

Space

- *Location of equipment*
- *Size of equipment*
- *Clearances*

Piping method

- *Straight in straight out "Primary"*
- *Primary/Secondary*
- *Mixing/Injection*
- *Heat Exchanger*
- *Buffer Tank*

Pump/Pipe size

- *GPM*
- *Head loss*
- *BTU load*

Separation

- *Air*
- *Dirt*
- *Magnetic*

Zoning

- *Zone Valves/Actuators*
- *Zone circulator(s)*
- *Fixed Speed*
- *Variable Speed (ECM)*

Venting

- *Location*
- *Size*
- *Type*

Expansion tank

- *Size*
- *Location*
- *pressure*

Water or Glycol

- *Percentage*
- *Treatment for fluid*

Controls

Gas Piping

Hydronic systems require A LOT of considerations

(IT IS RECOMMENDED TO INSTALL A MAGNETIC DIRT SEPARATOR IN ANY SYSTEM USING AN ECM-TYPE CIRCULATOR)

❖ *Heat Loss*

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Heat Loss Summary

ASHRAE Load Calculation
Project #:001
February 18, 2019

Project Information

Project #: 001
Name: Frailey
Location: Stockton, Utah

Notes:

Load Calculation Summary

Design Location:	SALT LAKE CITY INTL, Utah	Component Losses:	49,617 Btu/hr
Load Calculation Method:	ASHRAE	Infiltration/Ventilation:	19,109 Btu/hr
Outdoor Temperature:	14.4 °F	Radiant Back Losses:	7,081 Btu/hr
Floorplans / Levels:		Total Heating Load:	75,808 Btu/hr
Basement	1,893 ft²		
Main Floor	3,751 ft²	Radiant Heating:	68,726 Btu/hr
Total Area:	5,645 ft²	Radiant Back Losses:	7,081 Btu/hr
		Total Heating Load:	75,808 Btu/hr

Load Calculation Results

Total Project

Room	Area	Heating Type	Room Temp	Walls	Windows	Doors	Skylights	Floor	Ceiling	Infiltration	Additional	Recovered Panel Loss	Design Load	Unit Loss
Total For Project	5,645	RH	70.0	10,283	8,915	16,761	0	9,566	13,410	19,109	0	-2,237	75,808	14.1

How many BTU's do we have in the given heat loss example? _____

What was our total area in this example?_____

What is the GPM and Head loss from the given example? _____GPM _____ Head Loss

Radiant Heating Details

Manifold Summary

Manifold Name	Zones	Circuits	Flowrate	Head Loss[1]	Required Temp.	Supplied Temp.	Temp Drop	Manifold Type	Control Type	Actuators	S/R Length[2]	S/R Pipe
Manifold 1	1	8	0.85	2.5	91	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Manifold	0	30	ViegaPEX Barrier 3/4" (Coil)
Manifold 2	3	5	0.54	2.0	94	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Circuit	5	50	ViegaPEX Barrier 3/4" (Coil)
Manifold 3	3	3	0.34	1.9	96	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Circuit	3	50	ViegaPEX Barrier 3/4" (Coil)
Manifold 4	1	9	3.19	15.6	109	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Manifold	0	60	ViegaPEX Barrier 3/4" (Coil)
Manifold 5	1	9	2.16	10.2	100	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Manifold	0	80	ViegaPEX Barrier 3/4" (Coil)
Manifold 6	2	4	0.72	2.7	110	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Circuit	4	70	ViegaPEX Barrier 3/4" (Coil)
Manifold 7	2	5	0.58	2.3	97	110	20	Stainless Steel - Shut Off/Balancing/Flow Meters, 1-1/4"	Circuit	5	80	ViegaPEX Barrier 3/4" (Coil)
Total	13	43	8.37	15.6	110	-	-	-	-	17	-	-

(1) Total Head loss includes manifold, circuits and supply/return piping if specified., (2) S/R Length = one way

- **Calculate the net heated area.**
- **Use charts to make an initial materials list for the net area to be heated.**

Concrete System Tubing Estimator

Viega Barrier PEX Tubing	Net Heated Area	Multiplier	Estimated Amount
6" Spacing		2.2	
9" Spacing		1.5	
12" Spacing		1.1	
Viega Barrier PEX Tubing ½", ⅝", ¾"			

Based on our total area in our example, how much ½” tubing do we need to order if we are installing at

6” on center: _____

9” on center: _____

12” on center: _____

What is the standard max floor temperature for wood floors?_____

What is the standard practice for residential radiant tubing size? _____

Standard on center spacing for living areas in a home? _____

Most snowmelt tubing applications use what size tubing? _____

Can you use ½” tubing for snow melt? _____

Typical design length for ¾” tubing in a snow melt application is?_____

❖ *Heating Types*

What are your 4 basic heating types?

1. _____
2. _____
3. _____
4. _____

Do all heating types use the same boiler water temperature?_____

What is the optimal boiler water temperature design for condensing boilers doing radiant floor heat?

_____

❖ *Heat Source*

Do condensing boilers condens above 140°? _____

Can different types of heating equipment be installed on the same system?_____

What are your options and why use them?

Condensing vs Non-condensing

_____

Electric or heat pump

_____

Wood burning or oil burning

_____

Steam

_____

Heat exchanger

_____

❖ *Piping Methods*

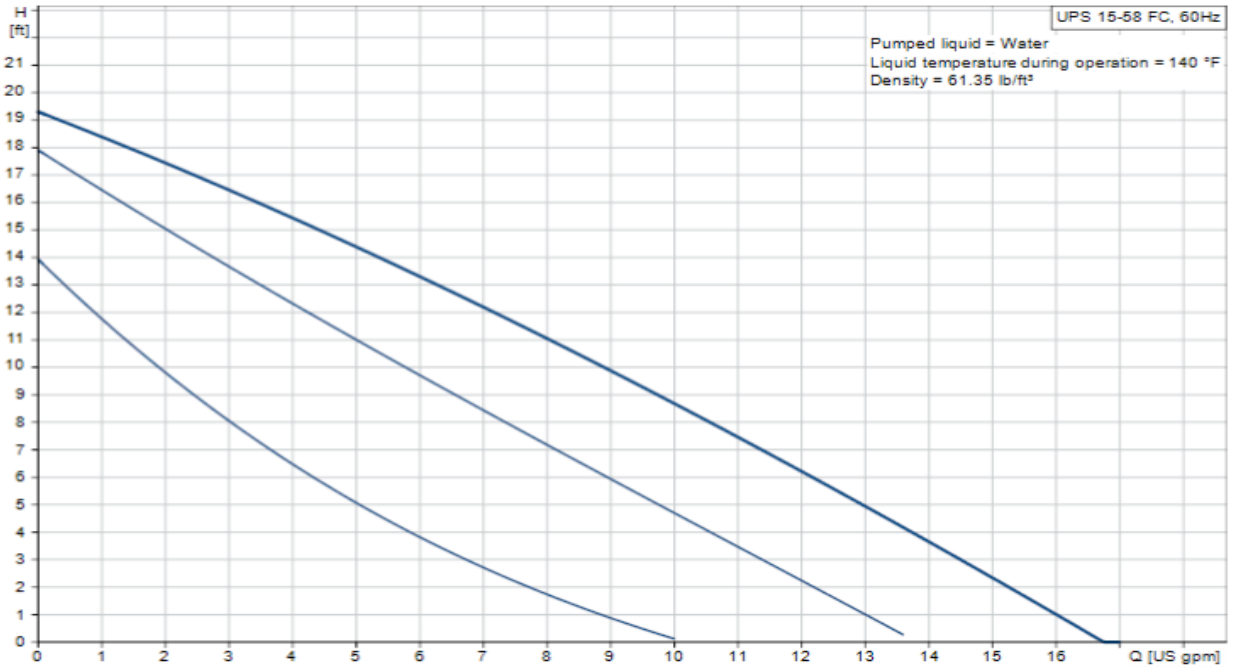
- What type of piping method is commonly used today? _____
- What is our main goal for doing primary/secondary piping?

  _____
- _____ into a tee must equal _____ out of a tee!
- Instead of closely spaced tee's, we can use? _____

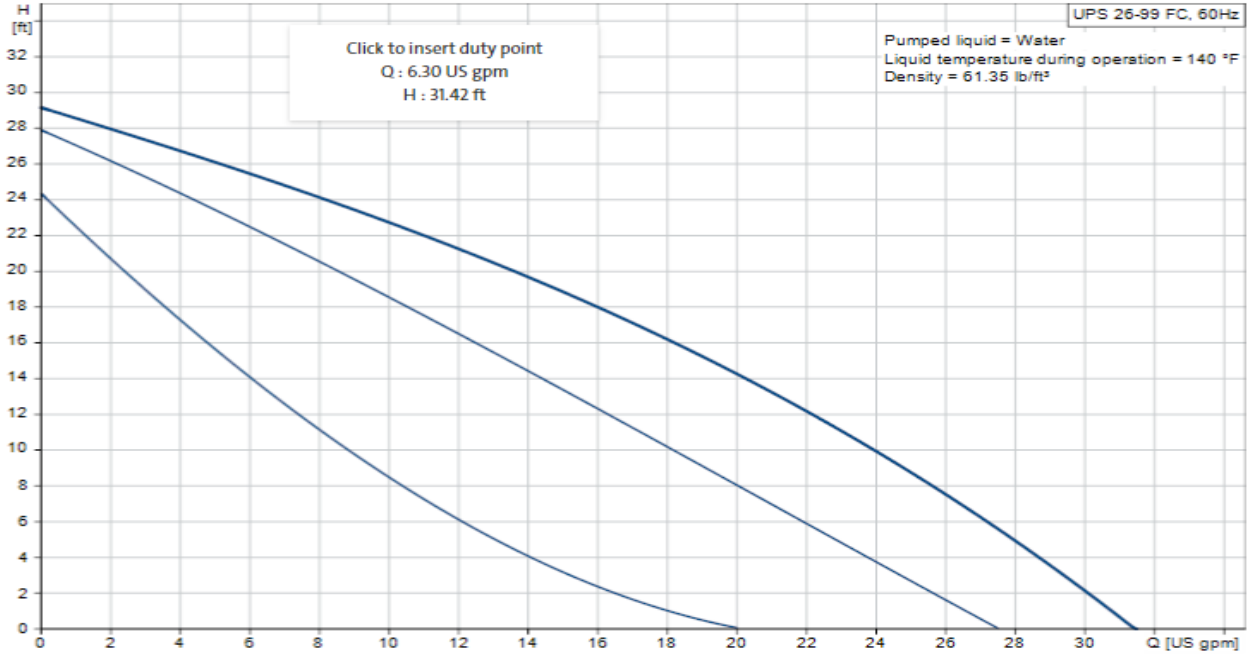
  Also called? _____(Hint: LLH)
- When is mixing/injection used on a system? _____
- What is the main benefit of using a heat exchanger? _____
- When is a good time to consider using a buffer tank? _____
- The supply in and out, (hottest water) are always piped to the _____ of the tank.

❖ *Pump/Pipe Sizing*

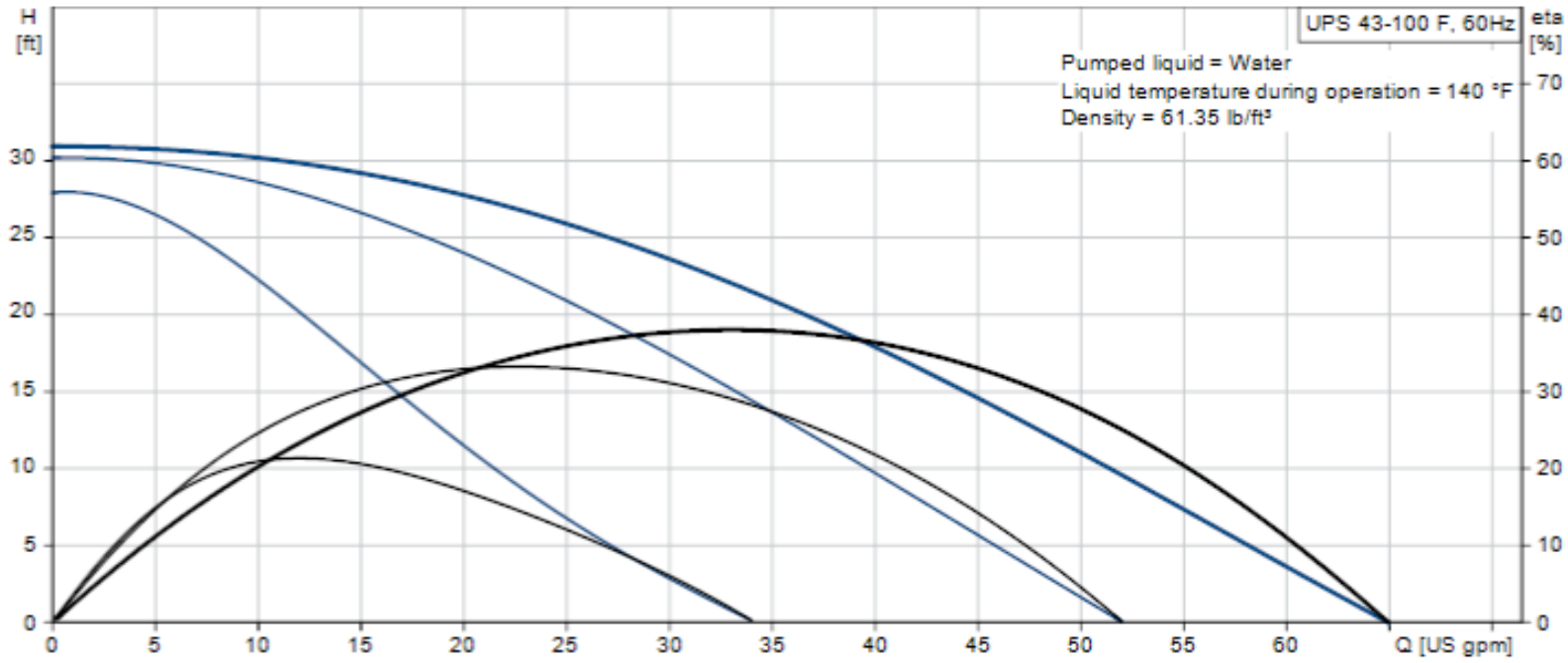
Pump #1



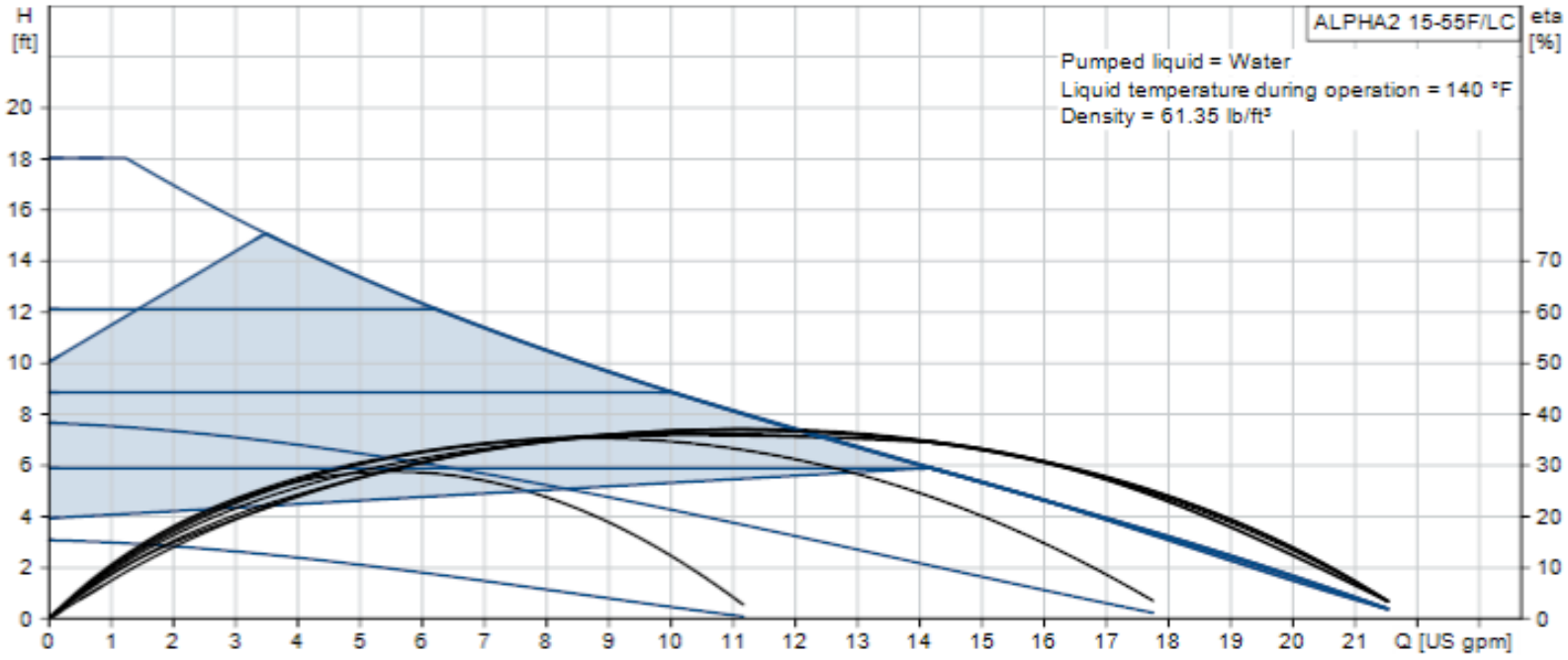
Pump #2



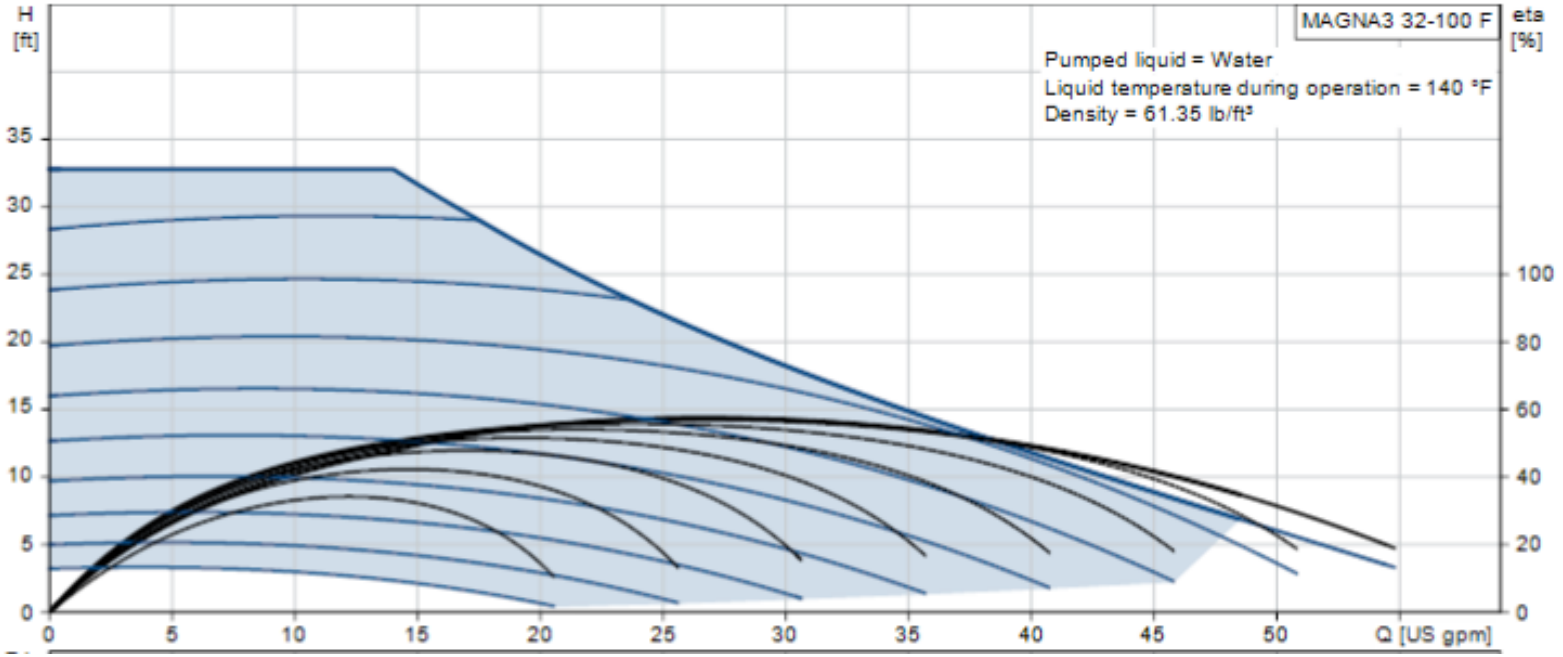
Pump #3


H
[ft]
UPS 43-100 F, 60Hz
eta
[%]
Pumped liquid = Water
Liquid temperature during operation = 140 °F
Density = 61.35 lb/ft³
0
5
10
15
20
25
30
35
40
45
50
55
60
Q [US gpm]
0
10
20
30
40
50
60
70

Pump #4


H
[ft]
ALPHA2 15-55F/LC
eta
[%]
Pumped liquid = Water
Liquid temperature during operation = 140 °F
Density = 61.35 lb/ft³
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Q [US gpm]
0
2
4
6
8
10
12
14
16
18
20
10
20
30
40
50
60
70

Pump #5


H
[ft]
MAGNA3 32-100 F
eta
[%]
Pumped liquid = Water
Liquid temperature during operation = 140 °F
Density = 61.35 lb/ft³
35
30
25
20
15
10
5
0
100
80
60
40
20
0
0
5
10
15
20
25
30
35
40
45
50
Q [US gpm]

What are the two pieces of information that we need for sizing a pump?

_____ & _____

What information do we need to size a pipe? _____

Does the length of pipe affect your head loss? _____

What copper pipe size do we need for a boiler loop that requires 12 GPM? _____

What PEX pipe size do we need for a boiler loop that requires 12 GPM? _____

What is head loss? _____

Can we transfer 530,000 btu's through 1-½" pipe using 40% Glycol? _____

(See the heat carrying capacity chart)

What is the smallest pipe size for 30% glycol, 1,000,000 BTU's? _____

If we have a 2 story house with a pipe going 20' vertically, do we have to account for the 20' of vertical pipe? _____

Example #1:

We have a room that is 1000 sqft. Total load is _____ BTU's to heat. We will have _____ runs of ½" tubing @ 250' each, 9" on center. Our pex pressure loss chart says that ½" tubing has a loss of _____ per foot. So based on the information given,

We need a min of ____GPM for 30,000btu's. One run of ½" tubing @ 250'= ____psi/ft.

.75 * 2.31= _____ft/hd.

The head loss is the same for all 6 runs so our tubing head loss is _____

"Most stainless manifolds and brass manifolds add another 1 ft of head to your total head loss."

To size a pump we need one that will handle _____GPM and _____ ft head.

- What pump would best fit this application with the given GPM and Head Loss from above?_____
- Does more than one pump fit this application?_____

Example #2:

Our first manifold has 6 loops of ½" tubing @ 250' each loop with the needed GPM and Head, 2 GPM and 2.73 ft head.

If we have a second room that is 1800 sqft. At a 30 ΔT, we need _____ BTU's.
How many loops do we do at 9" on center and how long is each loop?
_____ loop manifold of ½" tubing @ _____ each loop.
What is our minimum GPM?
Each loop gets _____ gpm and _____ft head. Add the gpm up for ___ gpm and take the max head loss with the manifold: _____.

This manifold gets _____ gpm @ _____ft head.

For one pump to handle both manifolds then we combine the gpm, 2 + 3.6 = _____ GPM
Take the highest head loss, ____ and now we need a pump that can do
_____ gpm and _____ ft/hd.

- What pump would best fit this application with the given GPM and Head Loss from above?_____

Example #3:

We have a single boiler, 210,000 btu's. We are trying to heat a small driveway of 1400 sqft, @ 12" on center. How many loops do we need? _____ loops of ¾" tubing @ _____' each loop. The GPM is _____ gpm total, our total head loss is _____ ft/hd.

- What pump do we need? _____
- Do we have more than one option? _____
- What size main lines do we run in PEX? Distance is 10' away? _____

- ***Separation***
  - ***Air***
  - ***Dirt***
  - ***Debris***
  - ***Metals***

Why do we need to have an air separator on our system?

_____

When do we want to use a magnetic separation device?

_____

An air separator will usually be installed at the _____ and the _____ point of the system,

and always before the _____.

Do we have to install air vents at all high points in the system? _____

- ❖ ***Zoning***
  - ➢ ***Pumps***
- ➢ ***Zone Valves***

Why should we even consider doing multiple zones?

_____

_____

What is the best way, Pumps or Zone Valves? _____

Are thermal actuators the same as a zone valve? _____

Thermal actuators are usually mounted where? _____

Do zone valves get mounted on the supply side or the return side? _____

Why would we use zone valves or actuators instead of just using pumps?

_____

❖ *Expansion*

Try to avoid mounting the tank in what two positions? _____

The expansion tank is always mounted _____ the system circulator.

A residential boiler that is 250,000 btu's doing radiant heat needs what size expansion tank? _____

A small commercial boiler doing snow melt, 500,000 btu's needs what size tank? _____

What if that same 500,000 btu's is for a residential house doing snow melt? _____

A residential house using 250,000 btu's doing baseboard heating needs a _____ gallon tank.

Most, if not all commercial applications require _____ rated tanks.

When in doubt, always size the tank _____ then you may think.

❖ *Water or Glycol*

What's the difference between an open and close system?

_____

_____

Why use glycol? _____

Are all glycols made the same? _____

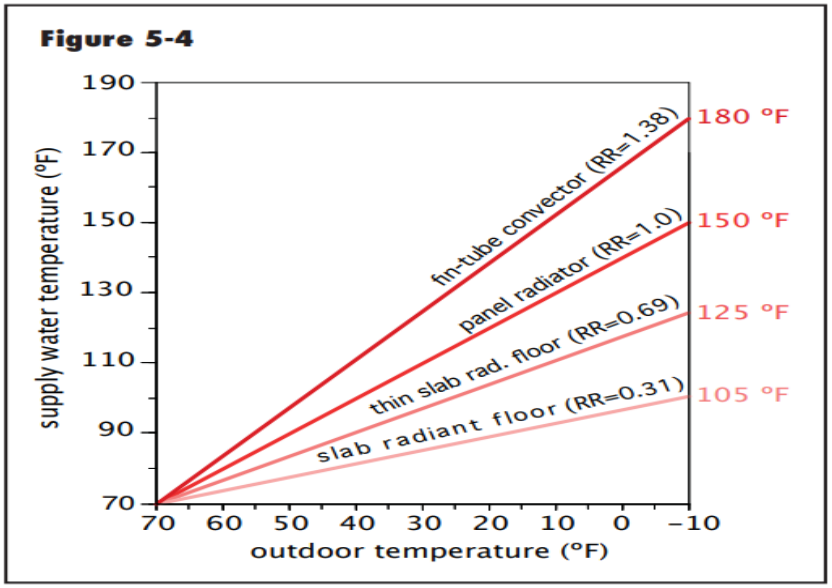
40% glycol will not freeze above? _____

1) If I have a system that needs 125 gallons and I want to make the glycol solution 30%, how much glycol do I need and how much water do I need? _____

Ga = V * G% ÷ 100

2) My current system is a snow melt system that has been leaking for a year. The maintenance crew has been adding water to keep the pressure up and now the current glycol solution is down to 20% glycol. I need the solution to be 40%. My total volume from the original installer's notes says he put in 220 gallons to fill the system. How many gallons needs to be removed and replaced with 100% glycol to bring the system back to 40%? _____

Vg=TSV(PSd-PSt)÷(100-PSt)



❖ ***Controls***

What is outdoor rest? _____

_____

Just about all thermostats for radiant controls are _____ V's.

What if our circulator produces more amps then our relay control or boiler can handle?

_____

Can you mix zone pump controls and zone valve controls? _____

If you have an application where only 2 wires were ran for the thermostats, do you have to install thermostats that are battery powered only? _____

What sensors need to be installed for a snow melt controller to work? _____

_____

Always make sure the snow melt sensor housing has adequate _____.

❖ *Gas Pipe*

If an in line gas regulator is used, it must be a minimum of _____ feet from the boiler.

If the regulator is to be vented outside, for every _____ you need to increase the vent pipe size.

The regulator body size should not be more than _____ size smaller than the outlet pipe size.

When sizing your gas lines make sure you convert your _____ to _____.

Example:

We have a residential snow melt boiler of 500,000 btu's in Salt Lake City. The boiler is 40' from the gas regulator that is in the same room, and the boiler has a gas connection size of 1-¼". System supply pressure to the mechanical room is 2lb. Our gas regulator is stepping down from the 2lb to the 4oz for the boiler.

What size supply line do we need from the regulator to the boiler? _____

What pipe connection size on the regulator can we get away with? _____

Do we need to vent the regulator to the outside? _____

Where should the gas line shutoff valve be located? _____

Can we run CSST gas pipe from the gas regulator to the boiler? _____