Best Practices for DX Piping

Greg Drensky – Jacco & Associates

Who is Jacco

- Established 1968
  - Hudson, Ohio
  - Columbus, Ohio
  - Toledo, Ohio

- Focused on the Engineered Environment

- Systems Knowledgeable
  - HVAC Systems
  - Service & Maintenance
  - Parts

Purpose Statement

The purpose of our Company is to solve our customers problems, in the most economical way, at all times optimizing the owning experience.

Who is Jacco

- Operations
  - Brenda Homjak
  - Mike Spangler
  - Chad Russell
  - Mike Mueller
  - Hana Lee
- Contractor Owning Experience
  - Dan Duignan
  - Rick Baker
- Engineering Owning Experience
  - Greg Drensky
  - Jerry Cohen
- Owning Experience
  - Beth Plazak
  - Jeff Watson

Who is Jacco

- 30 Minute Pledge
  - Design
  - Questions
  - Problems
  - Answers

Who is Jacco

Upcoming Seminars & Events:

- Aaon Split System Trailer
- July 11th – Birthday Party at Alley Cat (5-7)
- August 15th – DBA Akron (5-7)
- September 12th: Applying Adiabatic and Steam Humidification Systems
- December 12th: Applying Low Dewpoint OA Systems Using DX and Desiccant Technology

Agenda

- **Why Line Sizing Matters?**
- Refrigerant Vapor, Liquid, Reheat Line Guidelines
- AAON Line Sizing Programs
  - Split System Line Sizing in ECat
  - AAON Engineering Toolkit EES 307 AAON Refrigerant Line Sizer
- Different Scenarios & Applications
  - Air Cooled w/ Hot Gas Reheat - CU below AHU (suction down)
  - Air Cooled w/ Hot Gas Reheat - CU above AHU (suction up)
  - Air Cooled w/ Tandem Compressors - CU above AHU (suction up)
  - Heat Pump w/ On/Off Compressors - CU below AHU (suction down & up)

Why Line Sizing Matters?

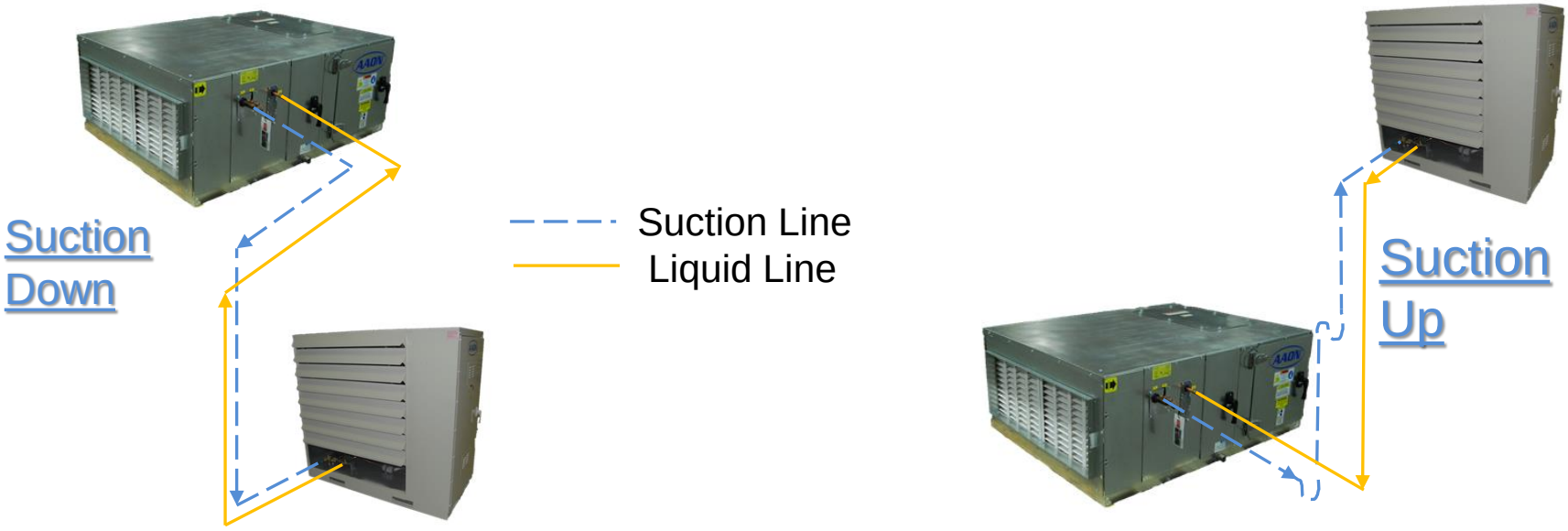
- SAVE THE COMPRESSORS!!
  - Design for Proper Liquid Refrigerant Control
  - Design for Proper Oil Management
    - Return oil to compressor
    - Ensure that only liquid refrigerant enters the expansion device.
  - Minimize system capacity loss

Why Line Sizing Matters?

- What is my Design Priority???
  - Design for Maximum Capacity (saves operating costs)
  - Design for Minimum Cost (saves installation costs)
  - Design for Minimum Power Consumption (low pressure drop)
  - Design for Minimum Refrigerant Charge (smaller liquid lines)

Line Sizing Considerations

- Equipment Location Affects Refrigerant Line Sizing
  - Total length of lines, number of elbows, & accessories
  - Vertical lift
  - Orientation of equipment
    - AHU above CU OR AHU below CU



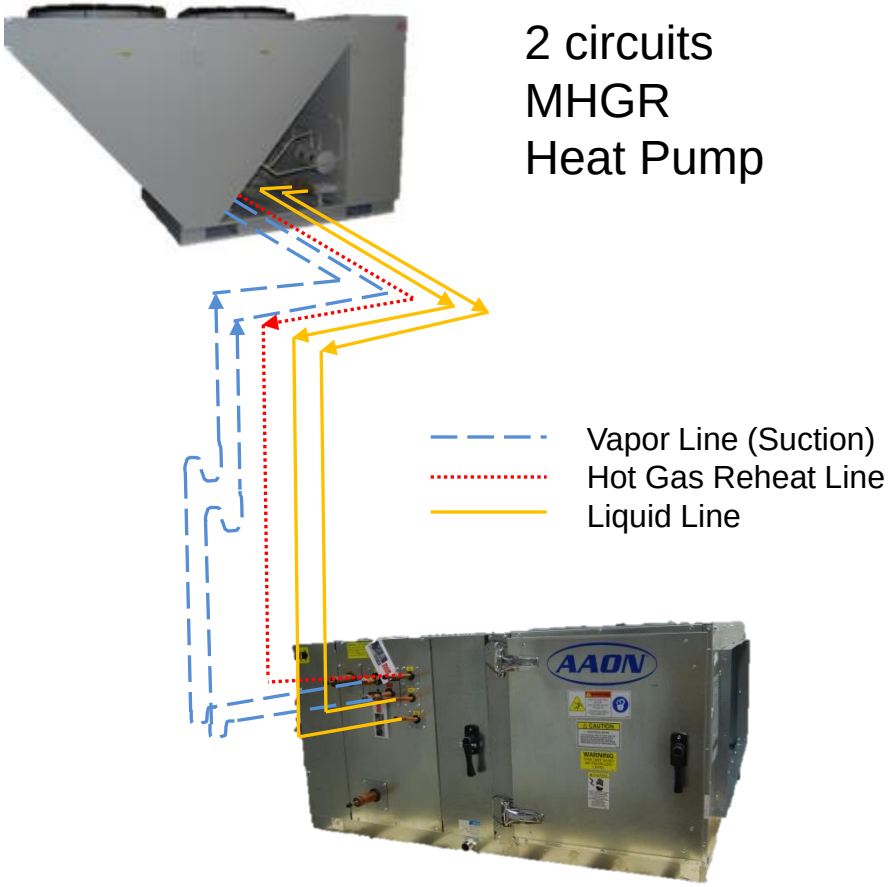
Line Sizing Considerations

- System Type is IMPORTANT!
  - Cooling Only?
  - Cooling with MHGR?
  - Single Circuit, Dual Circuit, or 4 Circuits?
  - On/Off, Digital, VFD, or Tandem Compressors?
  - Heat Pump?
  - Heat Pump with MHGR?

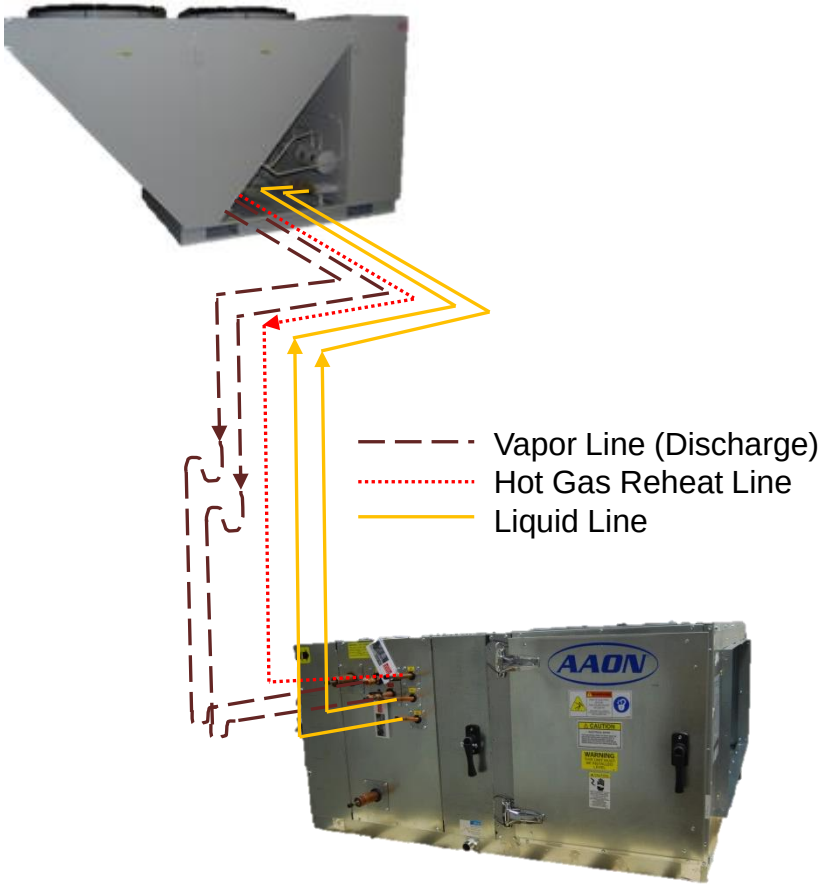
Tandem Compressors

Heat Pump Lines

AC Mode



Heat Pump Mode

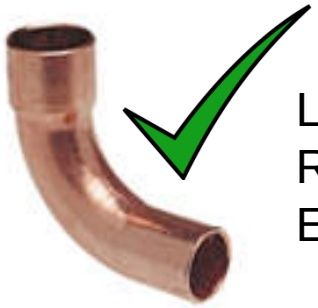


General Piping Requirements

- Use clean Type L copper tubing (ACR)
  - Copper-to-copper joints: BCuP-6 without flux
  - Copper-to-steel (or brass) joints: BAg-28, non-acid flux
- Properly support piping to account for expansion, vibration, and weight
- Avoid installing piping underground
  - Dirty installation and hard to leak test
  - If required: insulate separately, waterproof and protect with hard casing like PVC.
- Test entire refrigerant circuits for leaks

General Line Sizing Guidelines

- Equivalent Line Length (ELL)
  - ELL = vertical length + horizontal length + equivalent length of components (valves, elbows, etc.)
  - *Maximum allowable suction line temperature loss = 6°F
- Vertical Rise
  - *Maximum allowable = 70ft
- Use Air Conditioning and Refrigeration (ACR) Tubing and Long Radius Fittings



Long Radius Elbow

Short Radius Elbow

*Additional length and vertical rise may be allowed upon AAON review and approval.

Line Sizing Procedure

- 1) Determine total length of piping
- 2) Calculate refrigerant velocity at maximum & minimum capacities
- 3) Select largest pipe diameter that results in acceptable velocity at both maximum & minimum capacities
- 4) Calculate total equivalent length of straight pipe & fittings
- 5) Determine pressure drop due to pipe & fittings
- 6) Add pressure drop due to accessories

Suction Line Sizing

- Ensure adequate velocity to return oil to compressor at all steps of unloading.
- Avoid excessive noise
- Minimize system capacity and efficiency loss

Suction Line Guidelines Air-Cooled Only

- CU below AHU (Suction Down)
  - Fluid Velocity < 4000 fpm
    - Fluid Velocity > minimum velocity for oil return
  - Temperature Loss = up to 6°F
  - Insulation = Recommend 1” insulation

- CU above AHU (Suction Up)
  - Fluid Velocity < 4000 fpm
    - On/Off Compressor > minimum velocity for oil return
    - Digital Compressor > 1500 fpm
    - Tandem Compressor > minimum velocity for oil return with one compressor
    - Digital Tandem Compressor > 1500 fpm with one compressor or 3000 fpm for both
  - Temperature Loss = up to 6°F
  - Insulation = Recommend 1” insulation
  - Oil Return = Suction line traps for every 20ft of vertical rise

Suction Line Guidelines
Air-Cooled Only

- If compressor only cycles on & off – only maximum system capacity need to be considered.
- If variable speed unloading or manifolded compressors are used, minimum & maximum system capacities need to be considered.
- If more than 1 independent refrigeration circuit, each circuit requires its own set of refrigerant lines; capacity of each circuit must be considered separately.

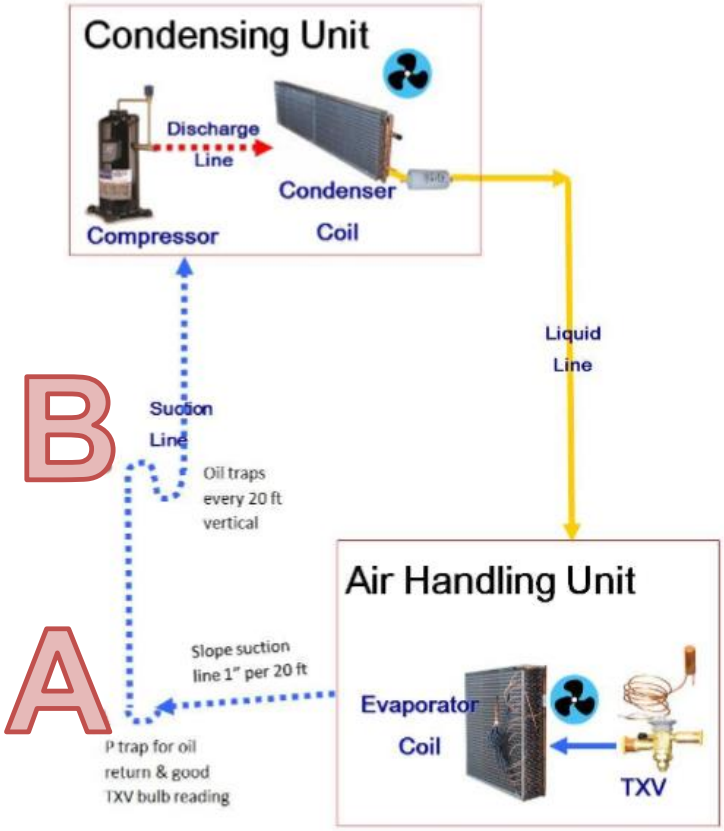
Minimum Velocity for Oil Return

Table 3 - Minimum Velocity & Tons for R-410A Oil Return
This table does not apply to digital scroll compressors.

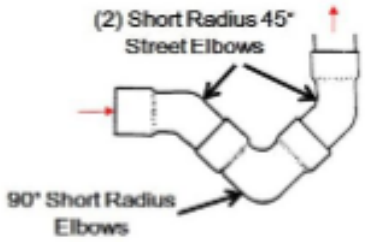
Line OD (in)	Minimum Velocity for Oil Return (fpm)		Minimum Tons for Oil Return (tons)	
	Suction Line*	Discharge Line**	Suction Line*	Discharge Line**
3/8	253	223	0.09	0.15
1/2	320	261	0.23	0.33
5/8	377	292	0.44	0.60
3/4	427	317	0.72	0.95
7/8	476	341	1.11	1.41
1-1/8	569	384	2.26	2.72
1-3/8	646	419	3.79	4.36
1-5/8	723	451	6.01	6.66
2-1/8	873	512	13.04	13.58
2-5/8	735	559	16.52	22.29
3-1/8	830	606	27.29	35.35
3-5/8	914	646	40.62	50.95
4-1/8	993	682	57.38	69.97
5-1/8	1142	748	102.80	119.6

These are absolute minimum velocities for oil return. Do not design lines at the minimum velocities due to the many possible operating conditions.

Suction Line Trap Guidelines



A. The P-trap is necessary on any vapor line where refrigerant is traveling up



B. This S-shaped trap is necessary Every 20 ft suction line up

Suction Line
Other Considerations

- Suction line traps are not required by ASHRAE
  - Oil droplets are moved inside a pipe by the force of mass flow, not by turbulence
  - AAON still requires traps if over 20’ in height
- Pitch horizontal sections to drain toward evaporator
- Insulate entire suction line
  - Prevents condensation
  - Minimizes loss of capacity due to heat gain
- Install suction-line filter close to compressor
  - Manual shutoff valves allow isolation for replacement
- Install access ports to measure suction pressure and superheat

Discharge Line Sizing

- Design of Discharge line is less critical than Suction line
  - Refrigerant vapor is at a higher temperature
  - Allows oil to be carried more easily

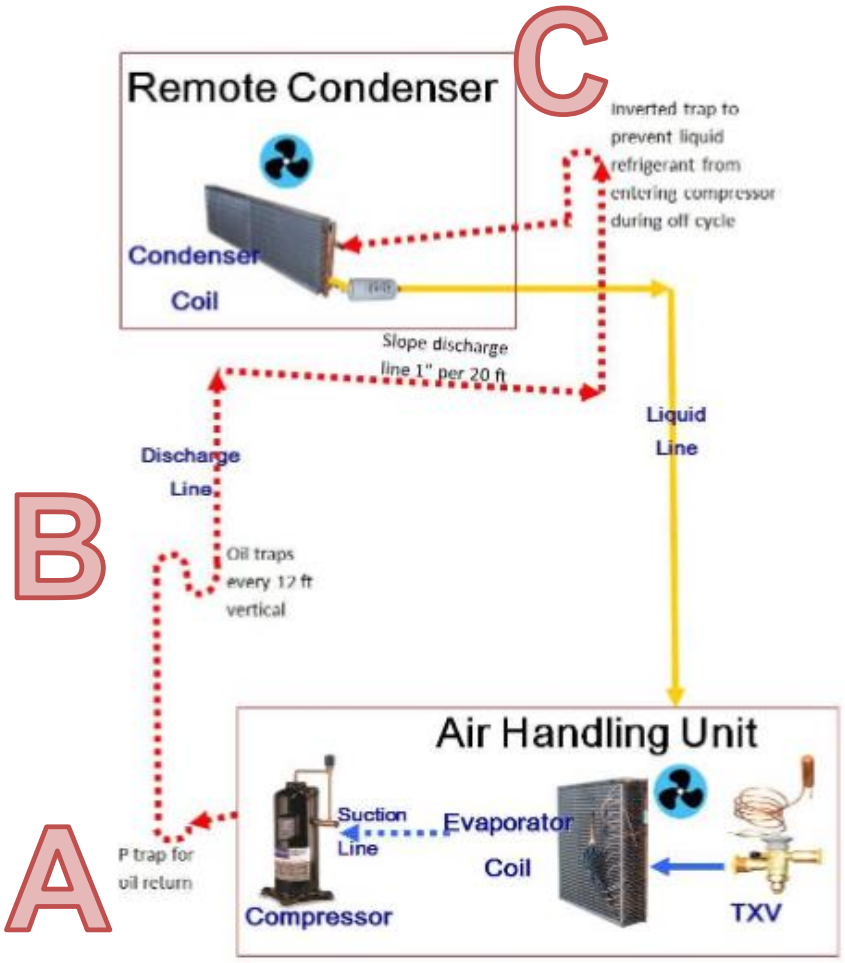
- Ensure adequate velocity to return oil to compressor at all steps of unloading.
- Avoid excessive noise
- Minimize efficiency loss

Discharge Line Guidelines
Heat Pumps & Remote Condenser

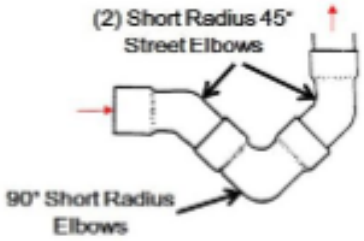
- CU above AHU (Discharge Down)
  - Fluid Velocity < 3500 fpm
    - Fluid Velocity > minimum velocity for oil return
  - Temperature Loss = up to 6°F
  - Insulation = Recommend 1” insulation

- CU below AHU (Discharge Up)
  - Fluid Velocity < 3500 fpm
    - On/Off Compressor > minimum velocity for oil return
    - Digital Compressor > 900 fpm
    - Tandem Compressor > minimum velocity for oil return with one compressor
    - Digital Tandem Compressor > 900 fpm with one comp. or 1800 fpm with both
  - Temperature Loss = up to 6°F
  - Insulation = Recommend 1” insulation
  - Oil Return = Suction line traps for every 12ft of vertical rise

Discharge Line Trap Guidelines



A. The P-trap is necessary on any vapor line where refrigerant is traveling up

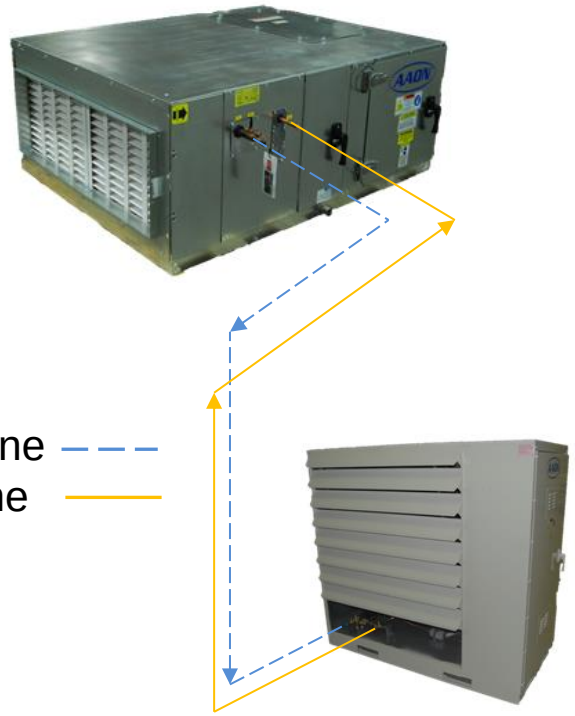


B. This S-shaped trap is necessary Every 12 ft discharge line up

C. This inverted trap is necessary to prevent liquid refrigerant from entering the compressor

Liquid Line Guidelines

- Liquid Line
  - Fluid Velocity < 300 fpm if a liquid line solenoid valve is field installed
  - Temp loss = 8°F (w/o additional sub-cooling)
  - Insulation = normally not required but recommended on heat pump units



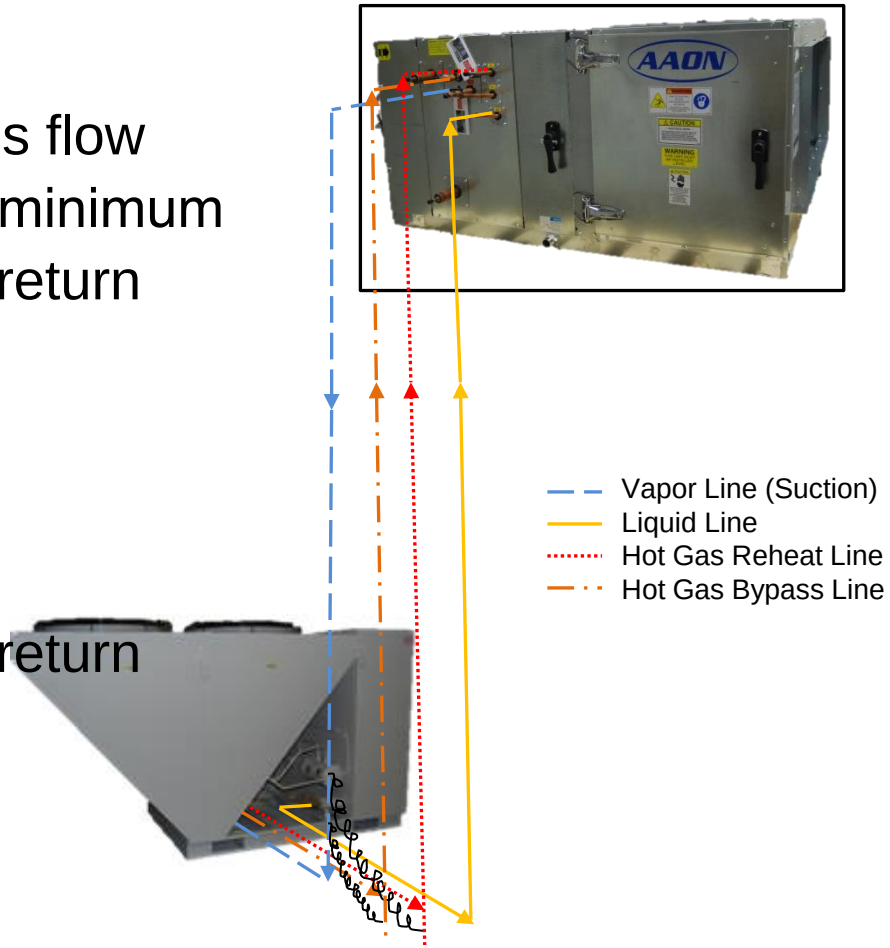
Liquid Line Guidelines

- Charge weight of R-410A in 100ft of liquid line @ 110F liquid temperature

Line Size (OD)	lbs of R-410A
3/8”	3.2
1/2”	6.2
5/8”	10.0
3/4”	14.5
7/8”	20.1
1 1/8”	34.3

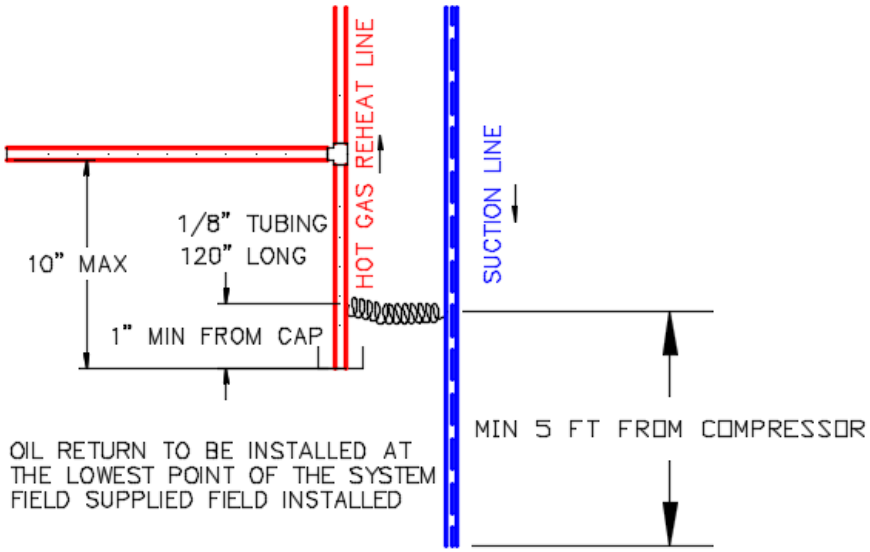
Reheat Line Guidelines

- Reheat Line
  - Must be sized for 100% mass flow
  - Insulation = Recommend 1” minimum
  - Purge circuit required for oil return
- Hot Gas Bypass
  - Size for a maximum of 67% mass flow
  - Purge circuit required for oil return



Reheat Line Guidelines

- Purge Circuit
  - Required on hot gas reheat or hot gas bypass lines
  - Consists of a drain leg & oil return line

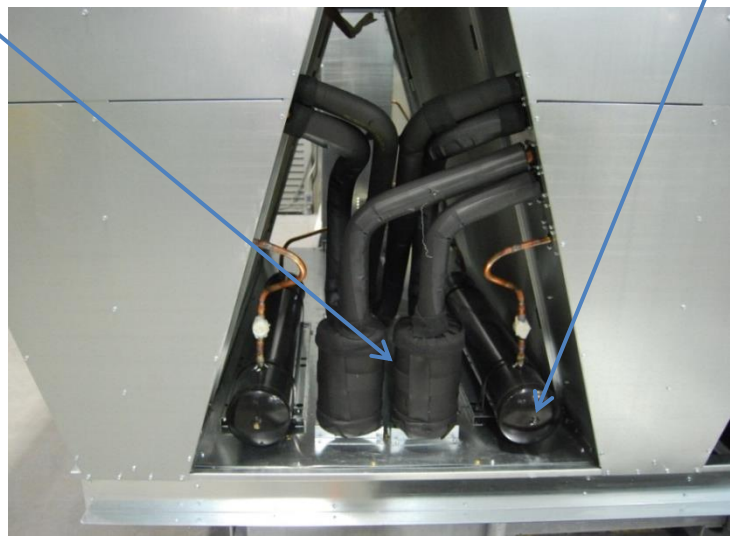


Purge Circuit is to be field furnished & installed at the **lowest** point of the line set.

With this installation, oil drains into the drain leg, where the pressure difference forces the oil through the oil return line into the suction line.

Additional Components

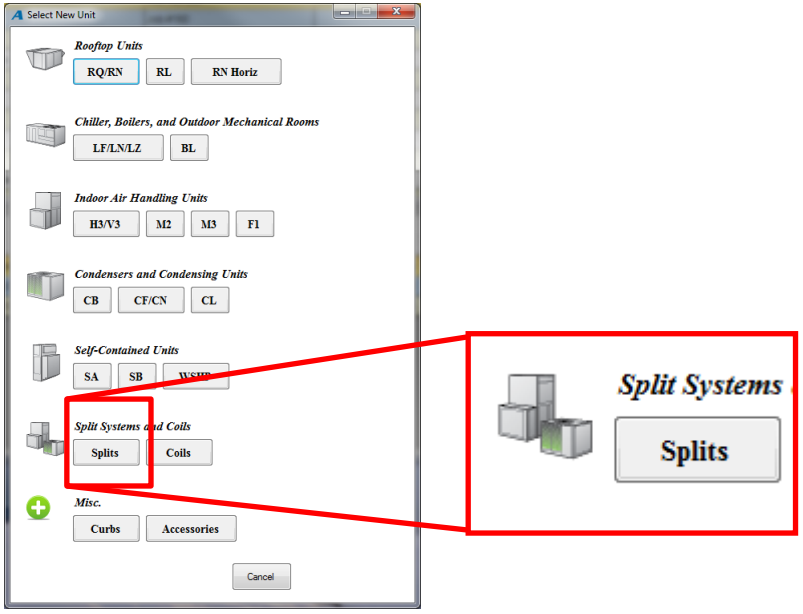
- Suction Line Accumulator
  - Prevent compressor damage from sudden surge of liquid refrigerant (compressor floodback)
  - AAON installs accumulators on all heat pump units



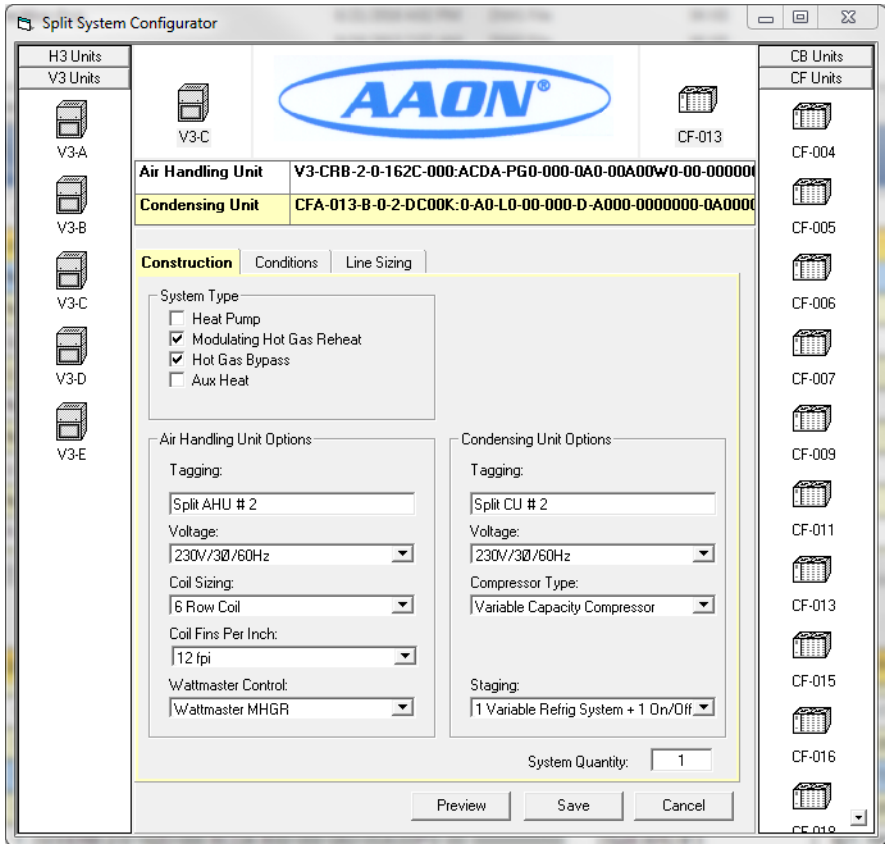
- Liquid Line Receiver
  - Stores liquid refrigerant after it leaves the condenser
  - AAON installs receivers on
    - Units with Reheat
    - Units with Heat Pump
    - Units with Floodback Condenser Low Ambient Control

ECat Split System Software

- AAON ECat Split System Selection Software
  - H3/V3 Series air handling units paired with CF/CB Series condensing units



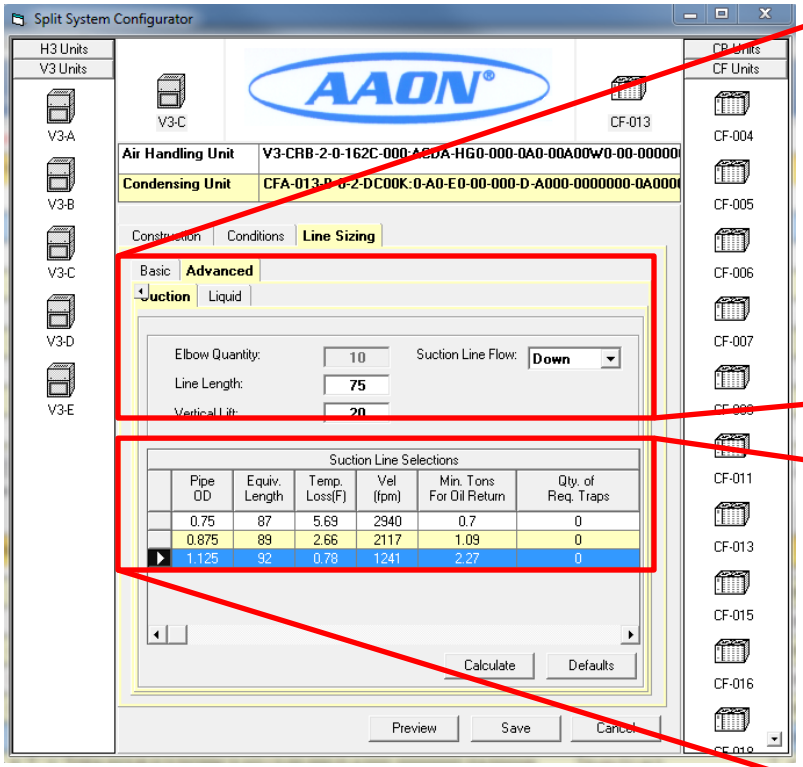
Add New Unit



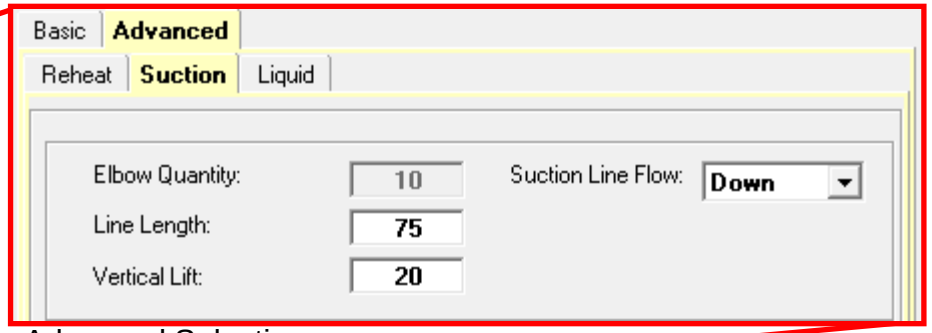
Split System Configurator Screen

ECat Split System Software

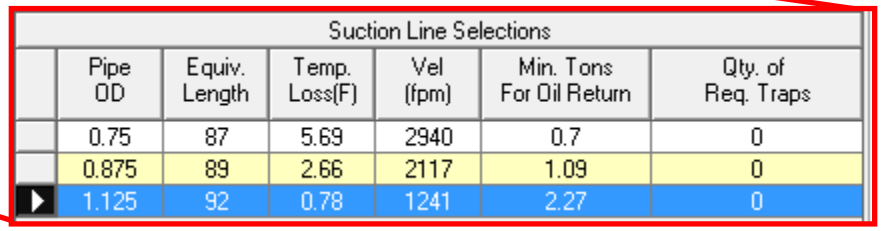
- AAON ECat Split System Selection Software
  - Advanced Selection for V3-C with CFA-013 dual circuit with digital compressor



Line Sizing Options



Advanced Selection



Line Specific Characteristics

ECat Split System Software

- AAON ECat Split System Selection Software
  - Outputs of selection

Cooling Section

	Gross	Net
Total Capacity:	*152.75*	*149.88 MBH*
Sensible Capacity:	*105.80*	*102.93 MBH*
Latent Capacity:	*46.95 MBH*	
Mixed Air Temp:	*95.00 °F DB*	*75.00 °F WB*
Entering Air Temp:	*95.00 °F DB*	*75.00 °F WB*
Lv Air Temp (Coil):	*58.48 °F DB*	*58.28 °F WB*
Lv Air Temp (Unit)	*59.41 °F DB*	*58.63 °F WB*
Evap Suction Temp:	*47.74 °F*	
Supply Air Fan:	*1 x 450AQ @ 0.97 BHP*	
SA Fan RPM / Width:	*1283 / 8.030"*	
Evaporator Coil:	*7.1 ft² / 6 Rows / 12 FPI*	
Evaporator Face Velocity:	*393.8 fpm*	

Split System Rating

Suction Line Selections

	Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min. Tons For Oil Return	Qty. of Req. Traps
	0.75	87	5.69	2940	0.7	0
	0.875	89	2.66	2117	1.09	0
▶	1.125	92	0.78	1241	2.27	0

Suction Line Loss (F)	Resulting Gross Capacity (MBH)	% Capacity Loss from 0.50
0.50	153.2	0
0.78	152.8	0.3%
2.01	150.7	1.6%
4.01	147.4	3.8%
6.00	144.1	5.9%

ECat Split System Software

- AAON ECat Split System Selection Software
  - Outputs of selection

Reheat Line Data

Elbow Qty: 10 Line Length: 75'

Pipe OD	Equiv. Length	Temp. Loss (°F)	Velocity (fpm)	Min Tons For Oil Return	Qty. of Req. Traps
0.625"	94'	3.32	1843	0.63	3

Suction Line Data

Elbow Qty: 10 Line Length: 75'
Flow Direction of Suction Line: Down

Pipe OD	Equiv. Length	Temp. Loss (°F)	Velocity (fpm)	Min Tons For Oil Return	Qty. of Req. Traps
1.125"	92'	0.78	1241	2.27	0

Liquid Line Data

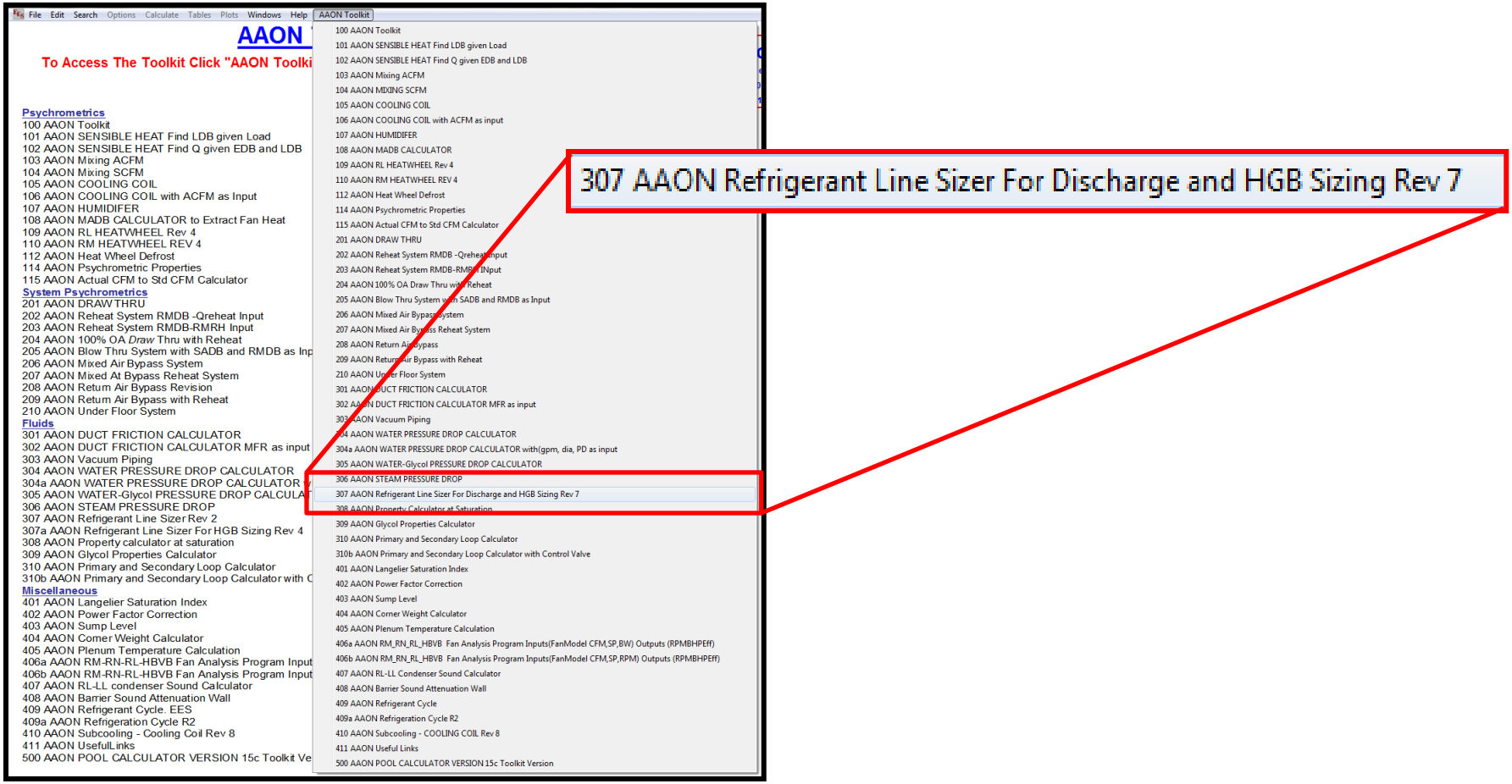
Elbow Qty: 10 Line Length: 75'
Vertical Lift: 20'

Pipe OD	Equiv. Length	Temp. Loss (°F)	Velocity (fpm)	Min Subcooling For Vertical Lift
0.5"	84'	1.23	264	3.24

Split System Refrigerant Line Selections

AAON Engineering Toolkit

- AAON Engineering Toolkit – 307
  - Available through ECat interface

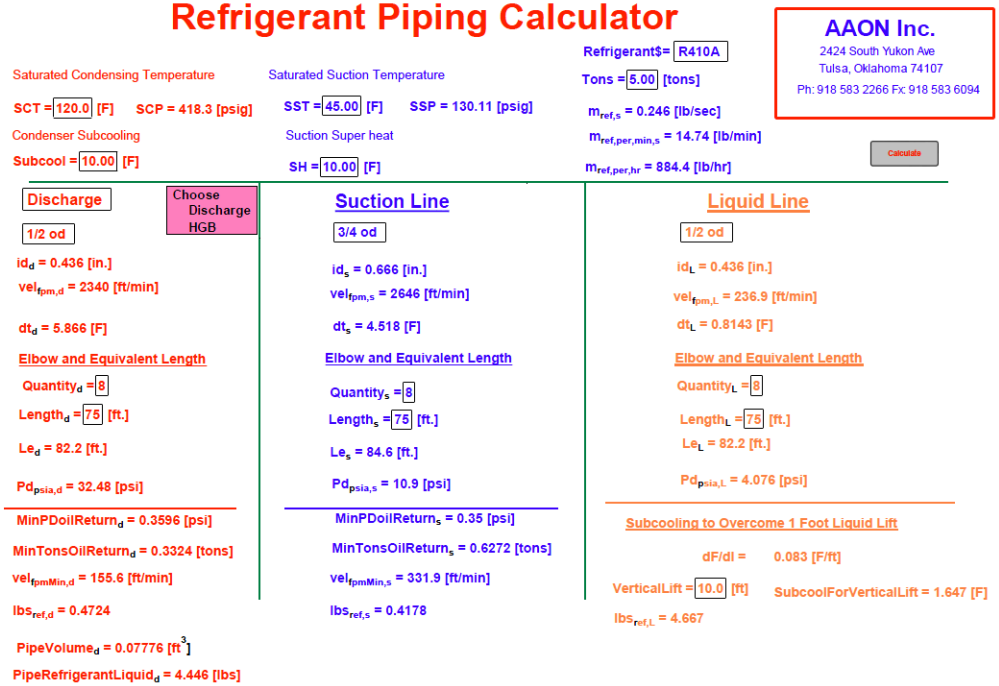


AAON Engineering Toolkit

- AAON Engineering Toolkit – 307

- Inputs
  - Refrigerant type
  - System capacity
  - # of elbows
  - Line lengths
  - Liquid line lift
  - Compressor type
  - Choose
    - Discharge for Hot Gas Reheat or Heat Pump Discharge line
    - HGB for Hot Gas Bypass line

- Change line size to see effects on the system



Selection Scenario #1

- Air Cooled with Modulating Reheat
  - CU below AHU
  - Digital compressor
  - 13 ton MUA with 95/75 EAT
  - 100 ft line length, 20 ft vertical rise
  - Priority is Efficiency, Minimize Operating Cost

- ECat Suction Line Selection

Reheat | **Suction** | Liquid

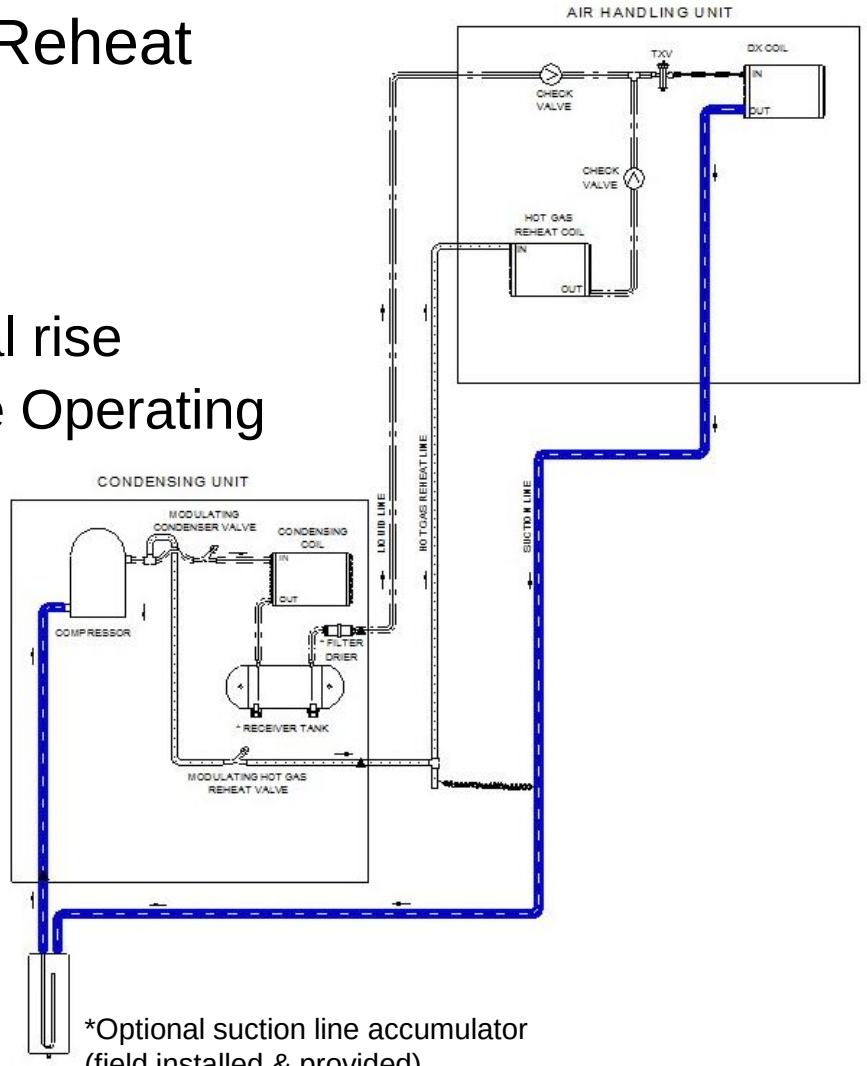
Elbow Quantity: 10 Suction Line Flow: Down

Line Length: 100

Vertical Lift: 20

Suction Line Selections

Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min. Tons For Oil Return	Qty. of Req. Traps
0.875	114	3.41	2117	1.09	0
1.125	117	0.99	1241	2.27	0



*Optional suction line accumulator (field installed & provided)

Selection Scenario #1

- Valid Suction Line Selections

	7/8”	1 1/8”
Total Net Capacity (MBH)	146.6	150.6
Leaving Air Temp (°F)	59.1	58.5
EER (at operating conditions)	11.6	11.9
Fluid Velocity (fpm)	2117	1241

Selection Scenario #1

- ECat Liquid Line Selections
  - 1/2” Liquid Line is only valid option

Reheat | Suction | **Liquid**

Elbow Quantity:	10
Line Length:	100
Vertical Lift:	20

Liquid Line Selection

Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min Subcooling For Vertical Lift
0.5	109	1.59	264	3.6

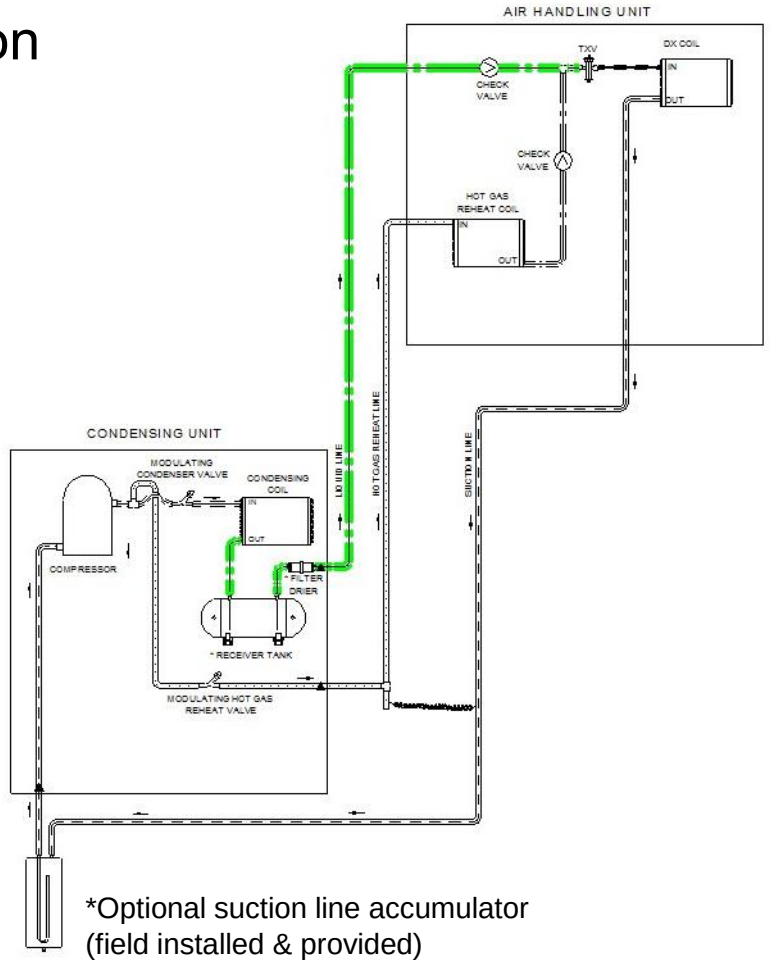
  - Changing to 50 ft vertical lift

Reheat | Suction | **Liquid**

Elbow Quantity:	10
Line Length:	100
Vertical Lift:	50

Liquid Line Selection

Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min Subcooling For Vertical Lift
0.5	109	1.59	264	6.62



*Optional suction line accumulator (field installed & provided)

Selection Scenario #1

- ECat Reheat Line Selection
  - Purge circuit required

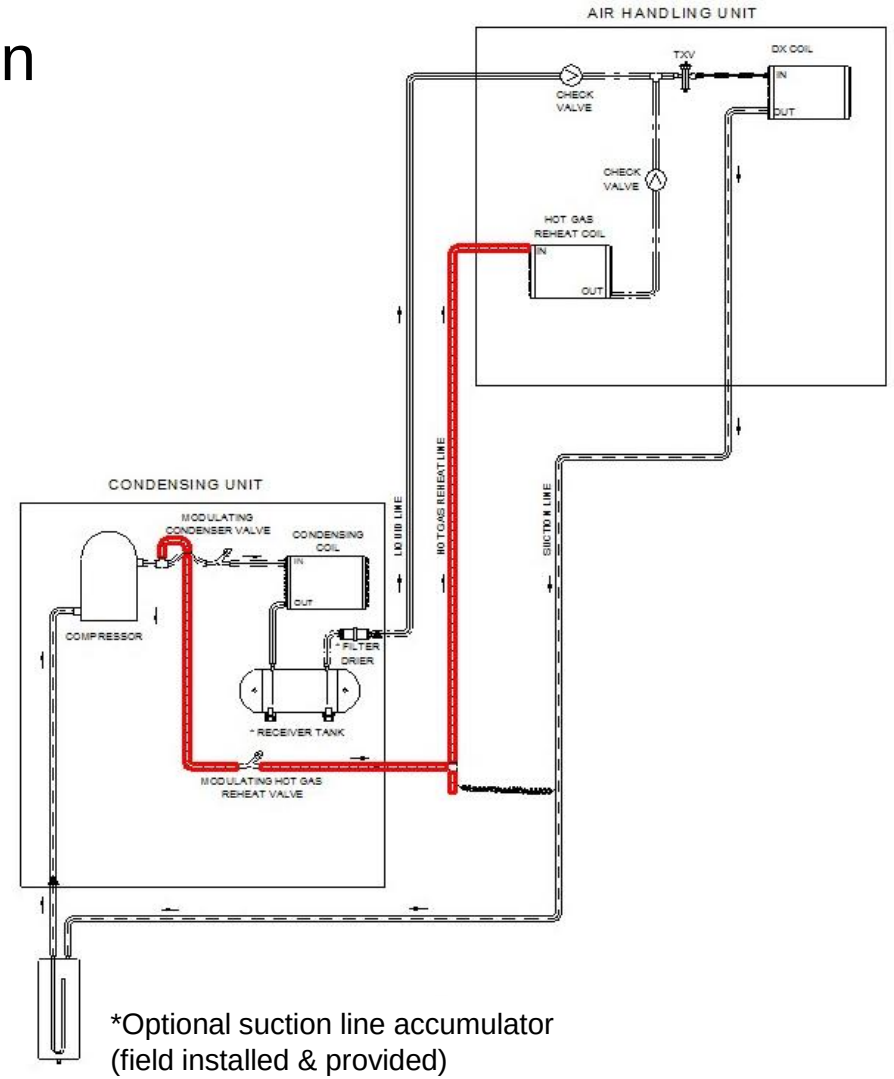
Reheat | Suction | Liquid

Elbow Quantity: **10**

Line Length: **100**

Hot Gas Reheat Line Selection

Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min. Tons For Oil Return	Qty. of Req. Traps
0.625	119	4.21	1843	0.63	3
0.75	122.8	1.82	1280	1	3
0.875	126.6	0.86	921	1.51	3



*Optional suction line accumulator (field installed & provided)

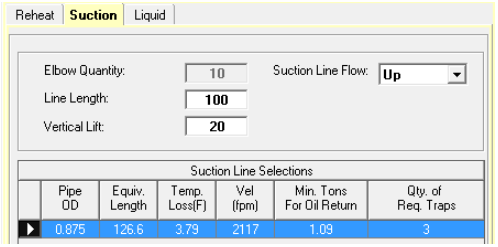
Selection Scenario #1

- Valid Reheat Line Selections

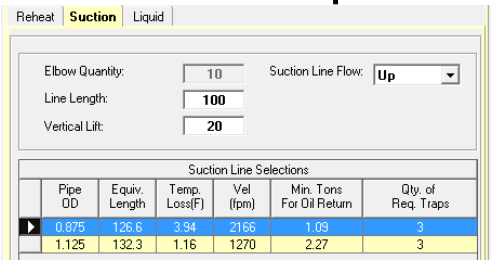
	5/8”	3/4”	7/8”
Temp Loss (°F)	4.21	1.82	0.86
Fluid Velocity (fpm)	1843	1280	921

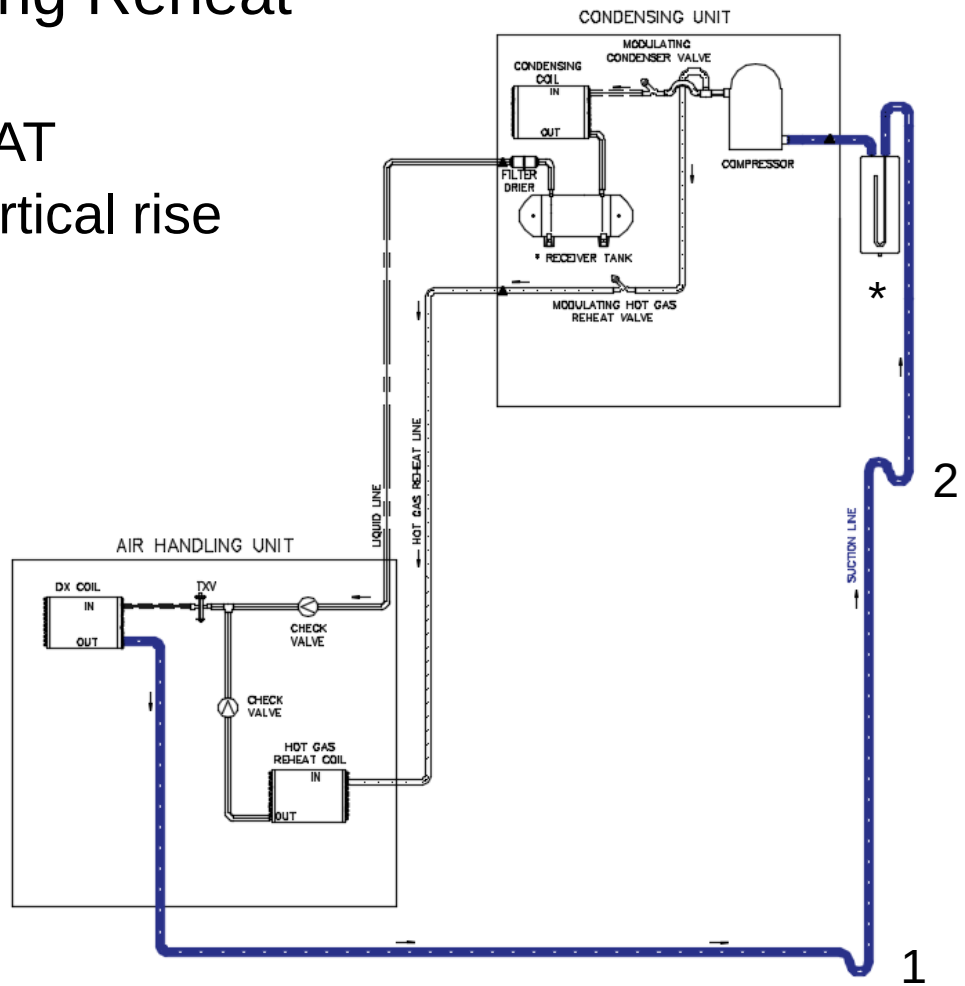
Selection Scenario #2

- Air Cooled with Modulating Reheat
  - CU above AHU
  - 13 ton MUA with 95/75 EAT
  - 100 ft line length, 20 ft vertical rise
- Suction Line Selection
  - Digital Compressor



  - On / Off Compressor





*Optional suction line accumulator (field installed & provided)

Selection Scenario #2

- ECat Liquid Line Selection
  - 1/2” Liquid Line is only valid option
  - Liquid Line flows down – gain subcooling

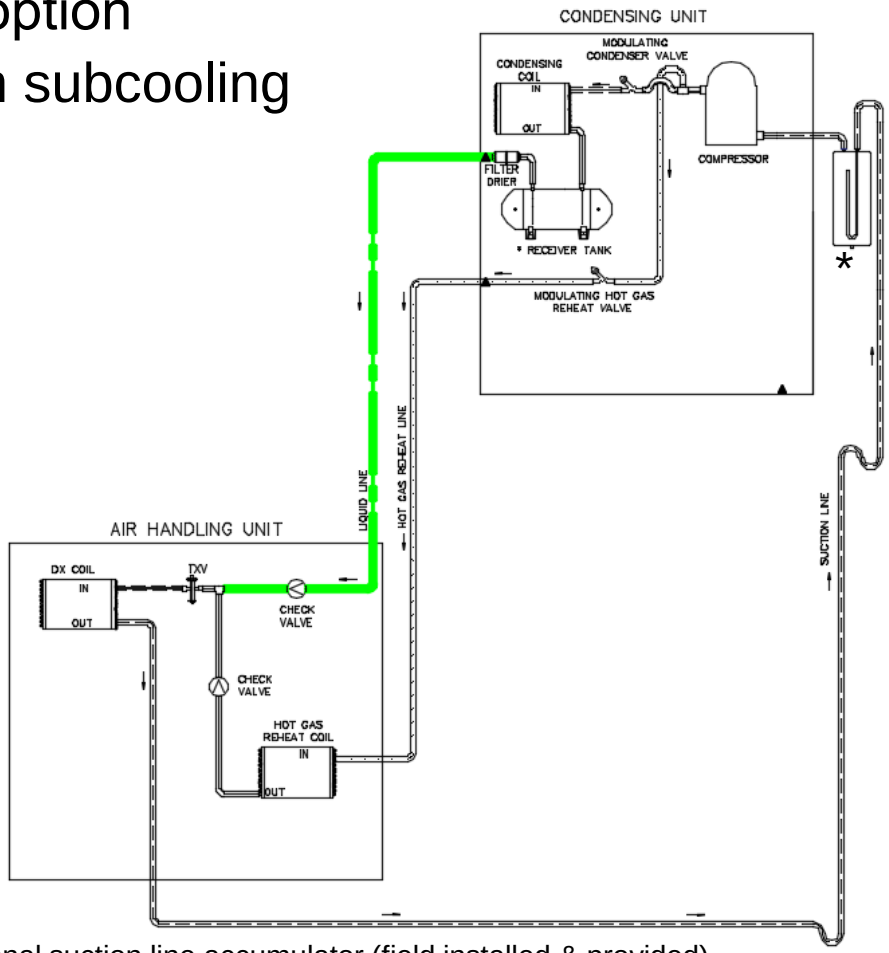
Basic | **Advanced**

Reheat | Suction | **Liquid**

Elbow Quantity:	10
Line Length:	100
Vertical Lift:	20

Liquid Line Selection

	Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min Subcooling For Vertical Lift
▶	0.5	109	1.59	264	3.6



*Optional suction line accumulator (field installed & provided)

Selection Scenario #2

- ECat Reheat Line Selection

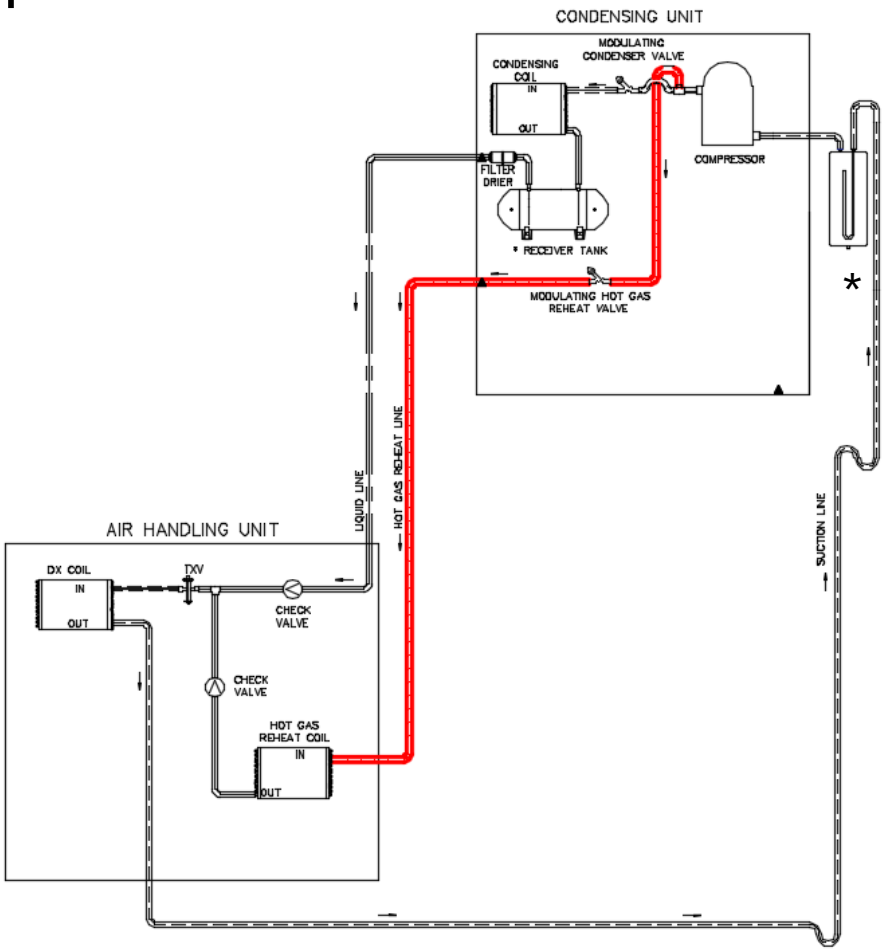
Reheat | Suction | Liquid

Elbow Quantity: **10**

Line Length: **100**

Hot Gas Reheat Line Selection

	Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min. Tons For Oil Return	Qty. of Req. Traps
	0.625	110	3.89	1843	0.63	0
▶	0.75	112	1.66	1280	1	0
	0.875	114	0.78	921	1.51	0



*Optional suction line accumulator (field installed & provided)

Selection Scenario #3

- Air Cooled with Tandem On/Off compressors
  - CU above AHU
  - 31 ton
  - 100 ft line length, 20 ft vertical rise

- ECat Suction Line Selection

HGB | **Suction** | Liquid

Elbow Quantity: 8 Suction Line Flow: Up

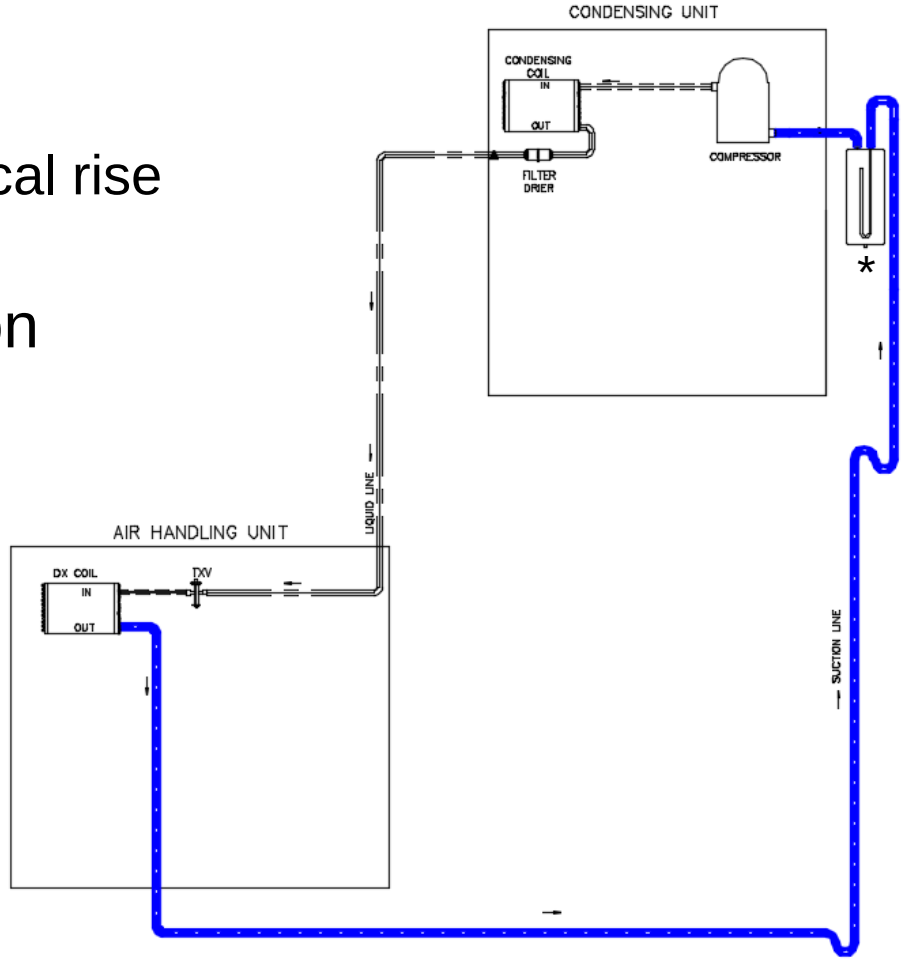
Line Length: 100

Vertical Lift: 20

Suction Line Selections

Pipe OD	Equiv. Length	Temp. Loss(F)	Vel (fpm)	Min. Tons For Oil Return	Qty. of Req. Traps
1.125	128.9	5.33	3088	2.05	3
1.375	139.1	2.28	2093	3.49	3
1.625	144.2	1.04	1479	5.61	3

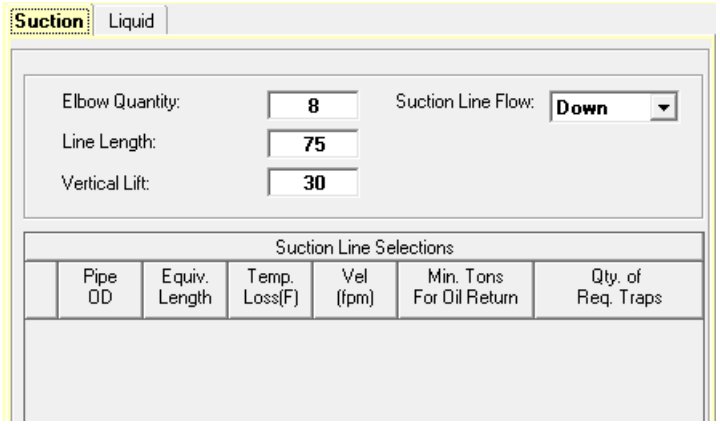
  - Divide Velocity by 2
    - On/off velocity > 1000 fpm
    - Digital velocity > 2000 fpm



*Optional suction line accumulator (field installed & provided)

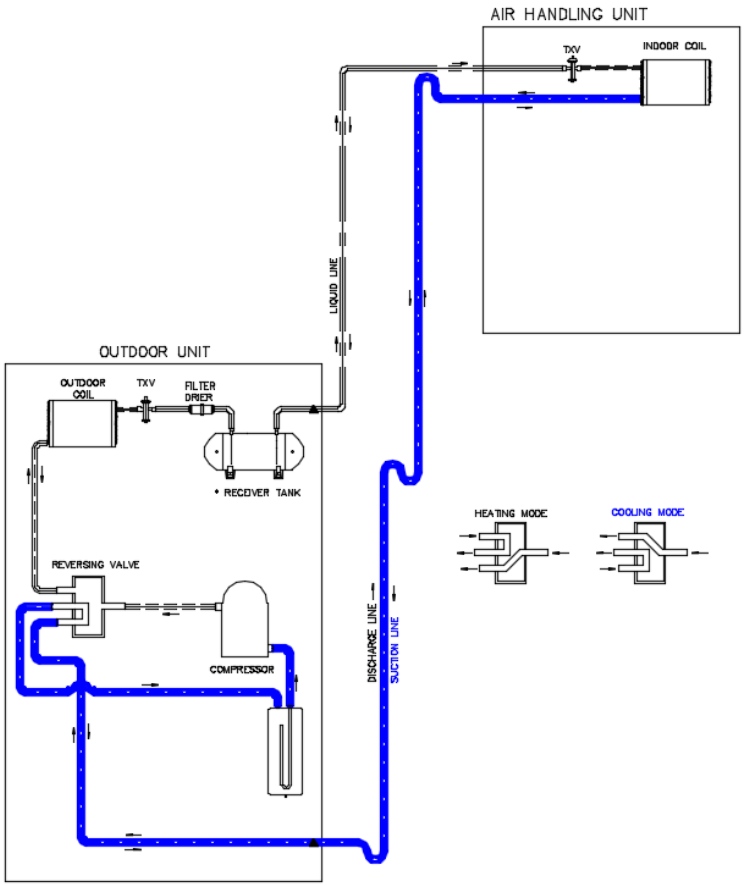
Selection Scenario #4

- Heat Pump
  - CU below AHU
  - 20 ton with digital compressors
  - 75 ft line length, 30 ft vertical rise
  - No solution from ECat
    - Option 1 – relocate the units – HIGHLY RECOMMENDED
    - Option 2 – use EES Toolkit

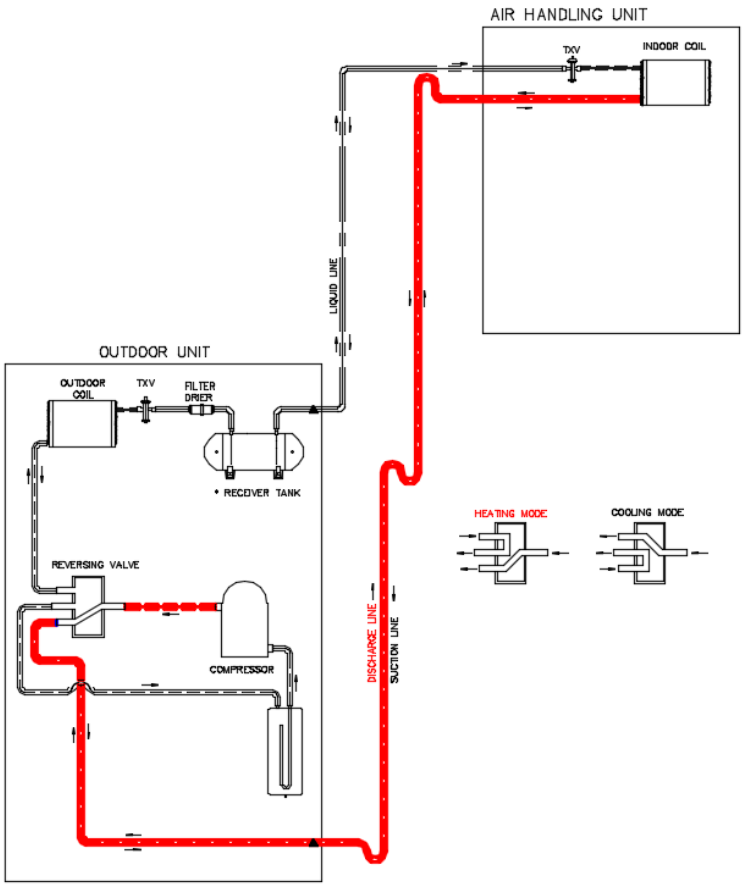


Selection Scenario #4

- Cooling Mode
  - Suction Line Down



- Heating Mode
  - Discharge Line Up



Selection Scenario #4

- Heating Mode
  - Functions as Discharge Line

Heating Section

Primary Heat Type*:	*Heat Pump*
Total Capacity:	*146.3 MBH*
OA Temp:	*10.0 DB / 9.0°F WB*
Entering Air Temp:	*55.5 DB / 53.0 °F WB*
Leaving Air Temp:	*85.5 DB / 64.2°F WB*

Tonnage per circuit = (146.3) / 12 / 2

= 6.1 tons per circuit

- Cooling Mode
  - Functions as Suction Line

Cooling Section

	Gross
Total Capacity:	*211.76*
Sensible Capacity:	*143.25*
Latent Capacity:	*68.51 MBH*
Mixed Air Temp:	*84.50 °F DB*
Entering Air Temp:	*84.50 °F DB*
Lv Air Temp (Coil):	*53.46 °F DB*
Lv Air Temp (Unit)	*54.66 °F DB*
Evap Suction Temp:	*43.70 °F*

Tonnage per circuit = (211.8) / 12 / 2

= 8.8 tons per circuit

Selection Scenario #4

- Heating Mode 6.1 tons per circuit
  - Functions as Discharge Line

Saturated Condensing Temperature
SCT = 120.0 [F] SCP = 418.3 [psig]

Saturated Suction Temperature
SST = 23.90 [F] SSP = 85.32 [psig]

Condenser Subcooling
Subcool = 10.00 [F]

Suction Super heat
SH = 10.00 [F]

3/4" line

Discharge | Choose Discharge HGB

3/4 od

id_d = 0.666 [in.]

$vel_{fpm,d}$ = 1333 [ft/min] ✓

dt_d = 1.171 [F]

Elbow and Equivalent Length

$Quantity_d$ = 8

$Length_d$ = 75 [ft.]

Le_d = 84.6 [ft.]

$Pd_{psia,d}$ = 6.513 [psi]

7/8" line

Discharge | Choose Discharge HGB

7/8 od

id_d = 0.785 [in.]

$vel_{fpm,d}$ = 959.3 [ft/min] ✗

dt_d = 0.5287 [F]

Elbow and Equivalent Length

$Quantity_d$ = 8

$Length_d$ = 75 [ft.]

Le_d = 86.2 [ft.]

$Pd_{psia,d}$ = 2.94 [psi]

Velocity < 1000 fpm

- Cooling Mode 8.8 tons per circuit
  - Functions as Suction Line

Saturated Condensing Temperature
SCT = 118.0 [F] SCP = 407.3 [psig]

Saturated Suction Temperature
SST = 41.60 [F] SSP = 122.04 [psig]

Condenser Subcooling
Subcool = 10.00 [F]

Suction Super heat
SH = 10.00 [F]

3/4" line

Suction Line

3/4 od

id_s = 0.666 [in.]

$vel_{fpm,s}$ = 4909 [ft/min] ✗

dt_s = 13.58 [F]

Elbow and Equivalent Length

$Quantity_s$ = 8

$Length_s$ = 75 [ft.]

Le_s = 84.6 [ft.]

$Pd_{psia,s}$ = 31.39 [psi]

7/8" line

Suction Line

7/8 od

id_s = 0.785 [in.]

$vel_{fpm,s}$ = 3534 [ft/min] ✓

dt_s = 6.074 [F]

Elbow and Equivalent Length

$Quantity_s$ = 8

$Length_s$ = 75 [ft.]

Le_s = 86.2 [ft.]

$Pd_{psia,s}$ = 14.04 [psi]

Velocity > 4000 fpm

STILL NO SOLUTION!!

Selection Scenario #4 (option 1)

- Double Discharge Riser
  - Choose best size for Discharge
  - Choose best size for Suction
    - Calculate 2nd riser based on difference

6.1 tons per circuit
At heating conditions

8.8 tons per circuit
At cooling conditions

Discharge
5/8 od
id_d = 0.555 [in.]
$vel_{fpm,d}$ = 1919 [ft/min]
dt_d = 2.85 [F]

Choose Discharge HGB

Suction Line

1-1/8 od
id_s = 1.025 [in.]
$vel_{fpm,s}$ = 2073 [ft/min]
dt_s = 1.659 [F]

$$Internal\ Area\ Discharge = \pi(\frac{0.555}{2})^2 = 0.242 in^2$$

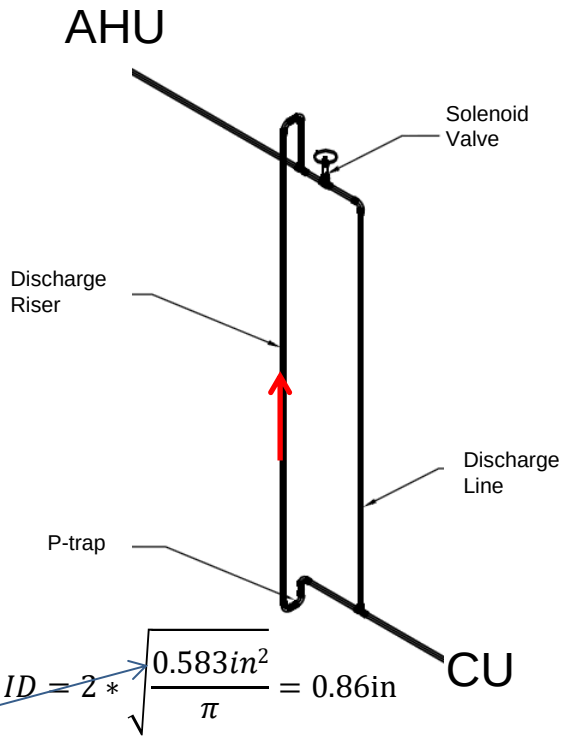
$$Internal\ Area\ Suction = \pi(\frac{1.025}{2})^2 = 0.825 in^2$$

$$Internal\ Area\ 2nd\ riser = 0.825 in^2 - 0.242 in^2 = 0.583 in^2$$

$$2nd\ Riser\ Calcualted\ ID = 2 * \sqrt{\frac{0.583 in^2}{\pi}} = 0.86 in$$

Closest nominal size is 7/8" = 0.785 in

Solution:
Discharge line = 5/8"OD
Discharge riser = 7/8"OD



Selection Scenario #4 (option 2)

- Double Discharge Riser
  - Make Life Easier on Contractor
    - Choose one size of tubing for both risers

Solution (only for on/off compressors):
Discharge line = 3/4”OD
Discharge riser = 3/4”OD

6.1 tons per circuit

8.8 tons per circuit

Discharge

3/4 od

id_d = 0.666 [in.]

$vel_{fpm,d}$ = 1333 [ft/min]

dt_d = 1.171 [F]

Choose Discharge HGB

Suction Line

7/8 od

id_s = 0.785 [in.]

$vel_{fpm,s}$ = 3534 [ft/min]

dt_s = 6.074 [F]

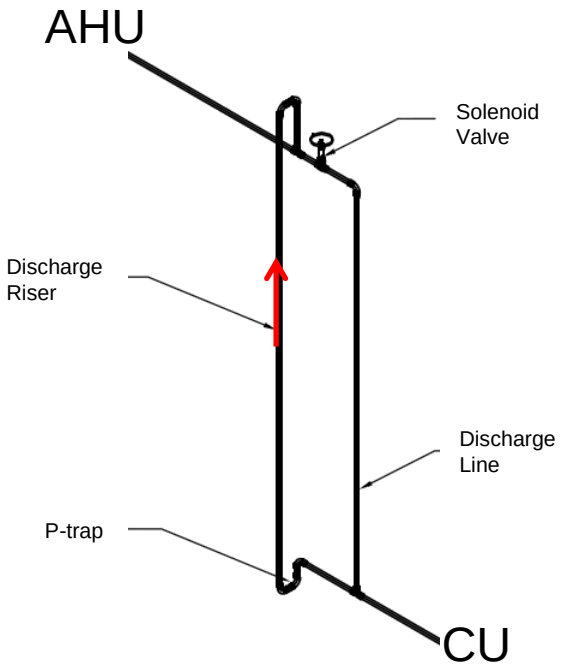
Suction Line

1-1/8 od

id_s = 1.025 [in.]

$vel_{fpm,s}$ = 2073 [ft/min]

dt_s = 1.659 [F]



$$Internal\ Area = \pi(\frac{0.666}{2})^2 = 0.348\text{in}^2 \text{ x } 2 = 0.697\text{in}^2$$

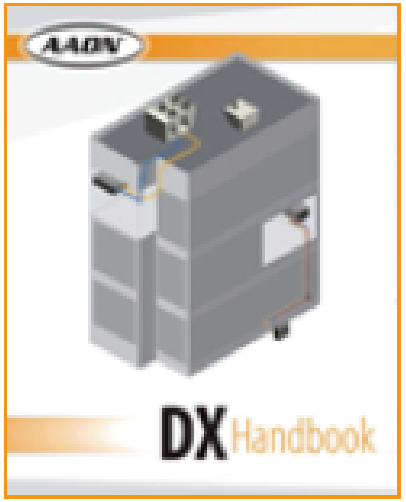
$$Calcualted\ New\ ID = 2 * \sqrt{\frac{0.697in^2}{\pi}} = 0.94\text{in}$$

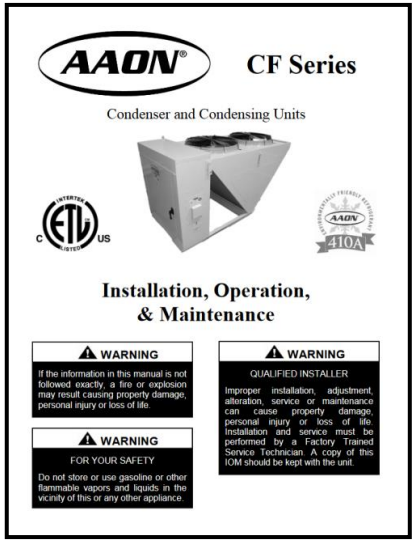
Conclusion

- Split System Refrigerant Line Design Matters!
  - Vapor / Liquid / Reheat Lines should be reviewed ahead of time to understand effects on the overall system.
- Choose your Design Priority
  - Know that it comes with a compromise
- Designing Split System Refrigerant Lines saves You…
  - Time, Money, and Headaches

More information???

- AAON-Applications
  - (918) 382-6274
  - aaonapps1@aaon.com
- DX Handbook
  - https://www.aaon.com/EngineeringBook
- AAON Website
  - Product Literature and Presentations
- 2010 ASHRAE Handbook - Refrigeration Chapter 1





Split System Selection 3.1 MB
- S. Andersen

Training Materials

Questions?