The Installation of VRF

Steve Leister
Service Operations Manager
Jacco & Assoc.

Who is Jacco

- Established 1968
  - Hudson, Ohio
  - Columbus, Ohio
  - Toledo, Ohio
- Focused on the Engineered Environment
- Systems Knowledgeable
  - HVAC Systems
  - Service & Maintenance
  - Parts

JACCO

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.

JACCO

Who is Jacco

- Operations
  - –Brenda Homjak
  - –Mike Spangler
  - –Chad Russell
  - –Mike Mueller
- Contractor Owning Experience
  - –Maggie Sawicki
  - –Rick Baker
- Engineering Owning Experience
  - –Greg Drensky
  - –Jerry Cohen
- Owning Experience
  - –Steve Leister
  - –Gloria Schwartz
  - –Jeff Watson

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Who is Jacco

- 30 Minute Design
  - Unit Performance
  - Drawing
  - Weights
  - Electrical
  - Specifications?
  - Sequence of Operation?
  - Cartoon?
  - Narrative?

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Who is Jacco

2016 Seminars

Psychrometrics	Jerry Cohen	13-Jan
The Refrigeration Cycle	Jerry Cohen	10-Feb
Best Practices for VRF Systems - Design	Greg Drensky	9-Mar
Best Practices for VRF Systems - Installation	Steve Leister	13-Apr
Best Practices for Applied Rooftop Systems, Applications & Installation	Jerry Cohen	11-May
Applying Energy Recovery Systems	Greg Drensky	14-Sep
OFCC Applicable Systems - Pro's & Con's	Greg Drensky	12-Oct
Applying Building Pressure & Air Flow Measurement Instrumentation	Greg Drensky	9-Nov
Controlling HVAC Systems with Special Emphasis on Sequence of Operations	Jerry Cohen	14-Dec

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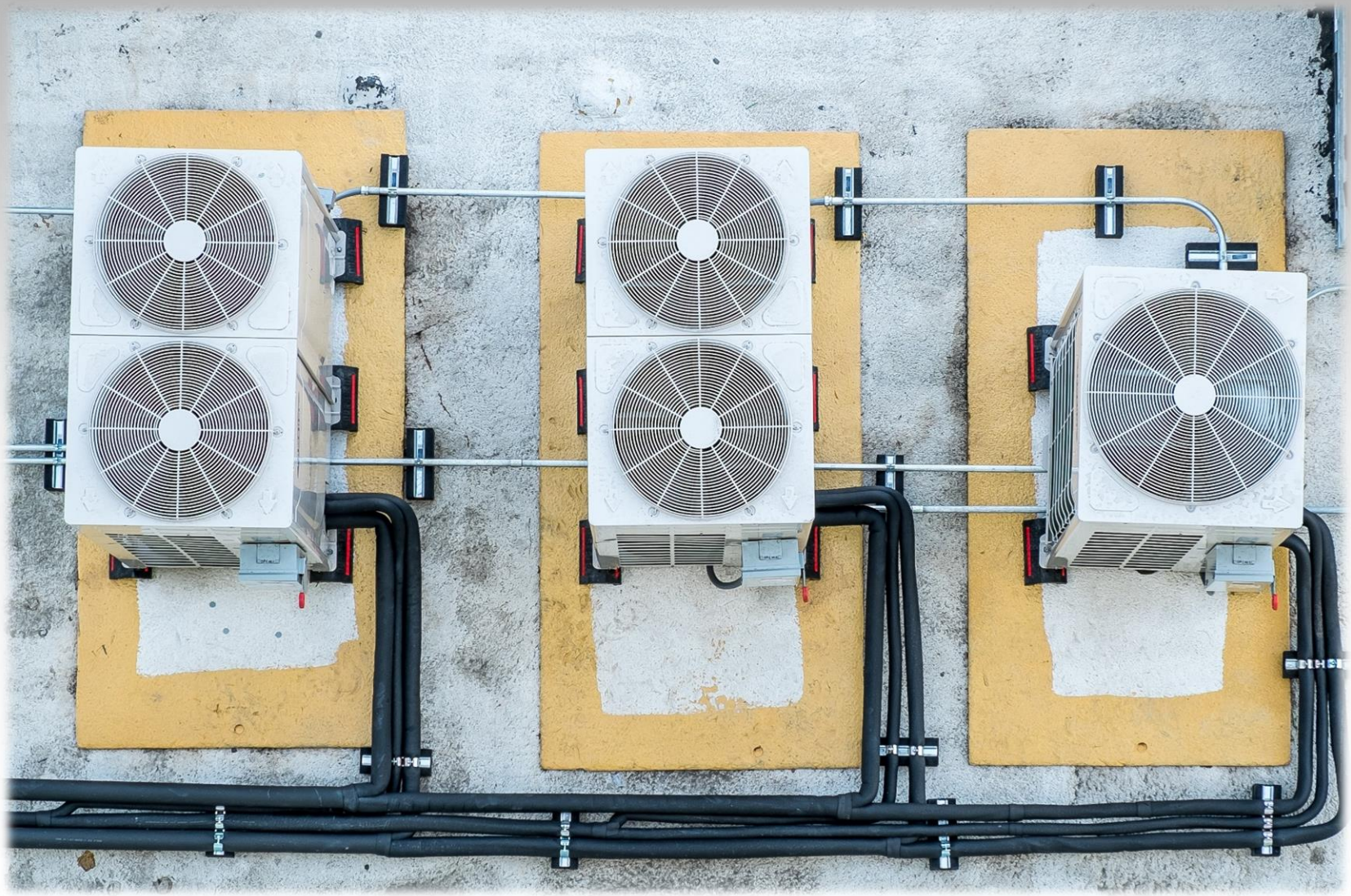
DVM S Installation



DVM S

Outdoor Unit Space Requirements

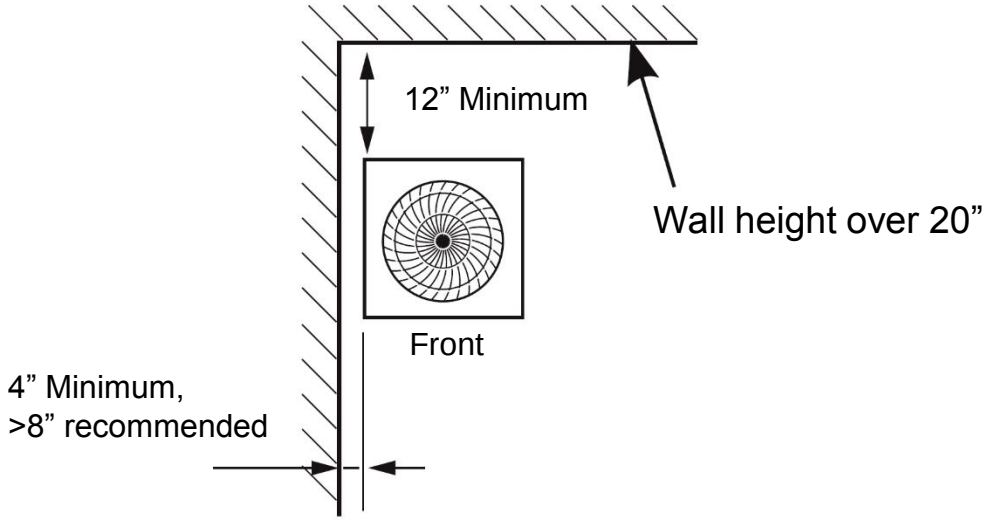
- It is important to follow Samsung's outdoor unit placement guidelines
- Failure to follow these recommendations can impact capacity and performance
- Improper placement can also decrease equipment life

Samsung clearances are recommendations to ensure proper performance. Check national, state, and local HVAC and electrical codes to ensure compliance.

DVM S

Space Requirements

Single Unit Installation – Unrestricted Wall Height



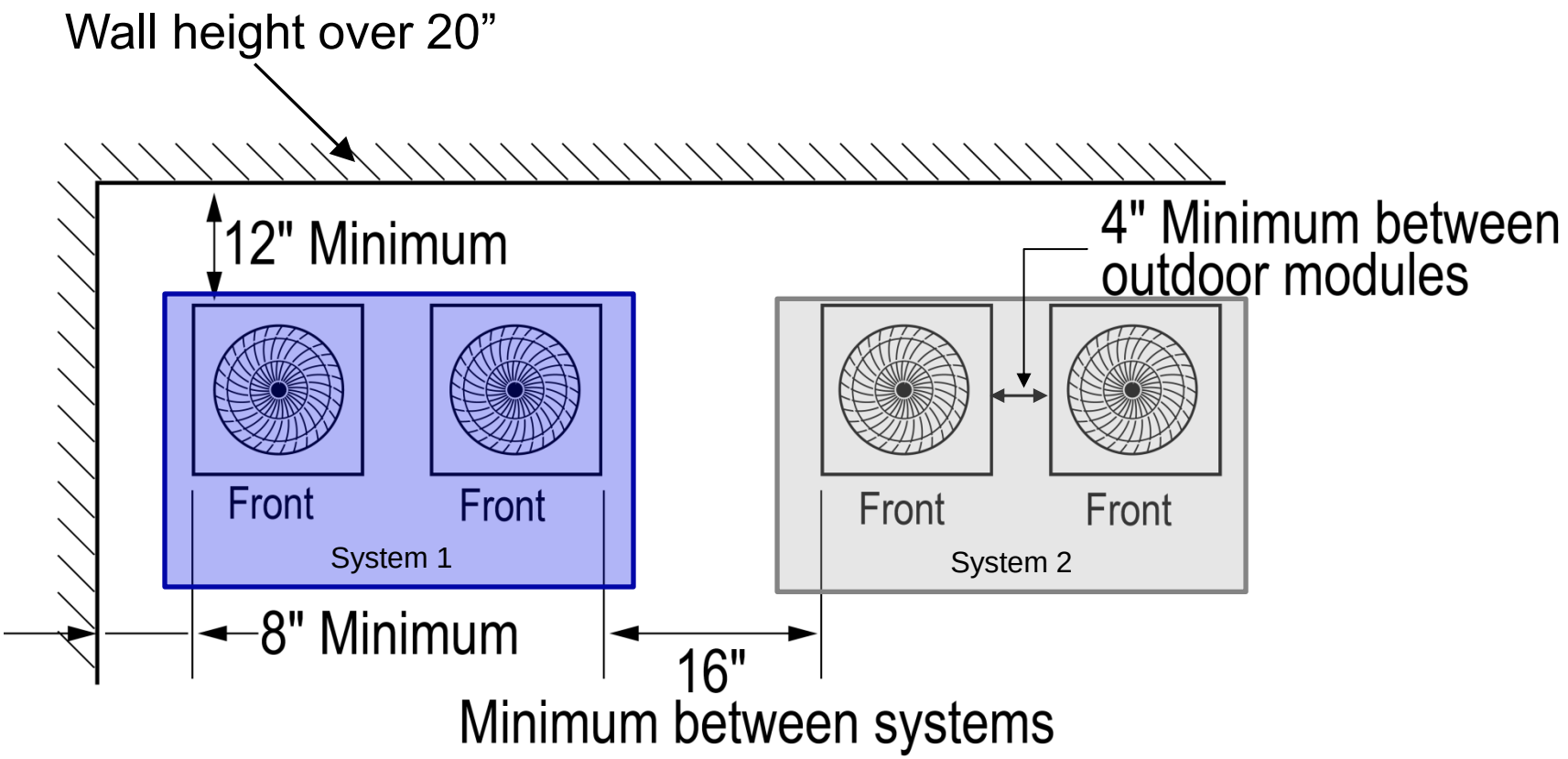
If outdoor temperatures are >95˚F, provide more space

Subject to change, consult installation manual before setting units.

DVM S

Space Requirements

Group Installation - Unrestricted Wall Height



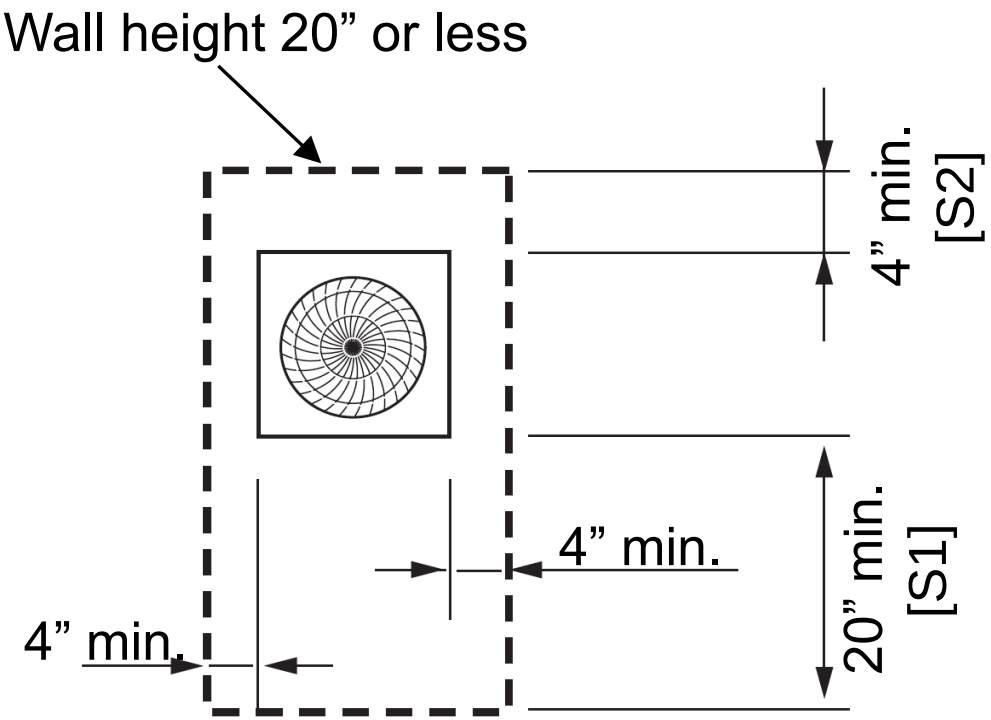
Note

- The installation space mentioned above is minimum suggested clearance.
- To secure enough service space and performance of system, take account of more sufficient space.
- The required minimum space between outdoor units for service and performance of system is at least 100mm(4in).

DVM S

Space Requirements

Single Unit Installation - Restricted Wall Height

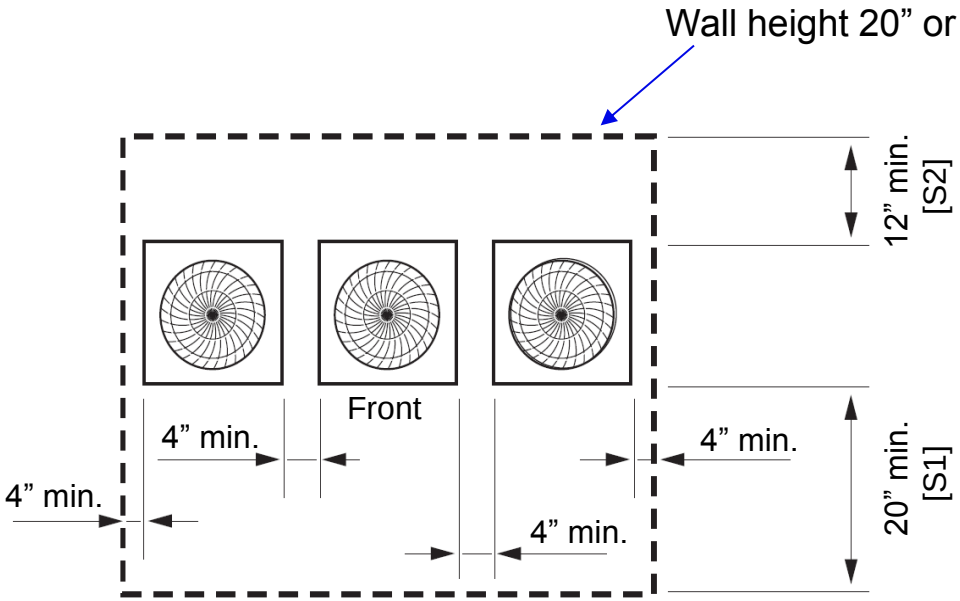


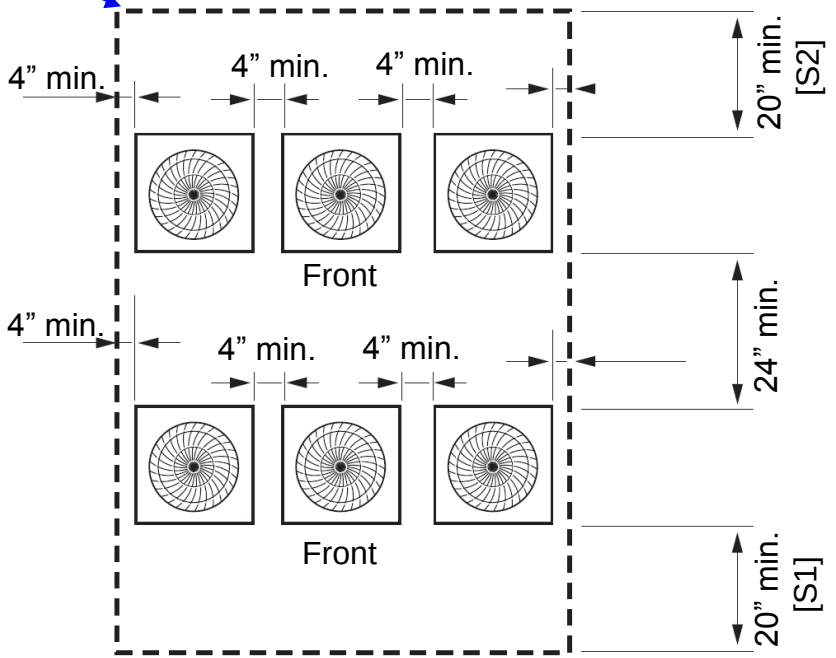
- Wall height in front of unit: maximum 60”
- Wall height on air inlet sides: 20”
- Verify NEC conformance
- If wall height is greater than 60” in the front or 20” on the back, the distance from the unit to the front/back walls will vary [S1, S2]
- More details on following slides

DVM S

Space Requirements

Group Installation - Restricted Wall Height





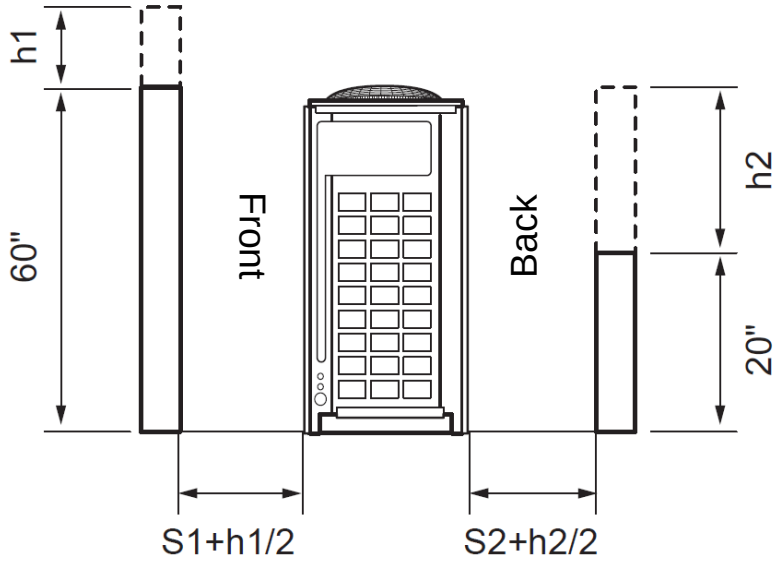
- Wall height in front of unit: maximum 60”
- Wall height on air inlet sides: 20”
- Maintain 16” between separate systems.
- Verify NEC conformance
- If wall height is greater than 60” in the front or 20” on the back, the distance from the unit to the front/back walls will vary [S1, S2]
- More details on following slides

DVM S

Space Requirements

Restricted Wall Heights

- Wall height on the front should not exceed 60”.
- Wall height on the back should not exceed 20”.
- Wall height on the sides is not restricted.
- If the height of the wall exceeds 60” on the front (h1) or 20” (h2) on the back, additional clearance between the walls and unit must be added.
- Half of the exceeded distance should be added to the service space (S1, S2).



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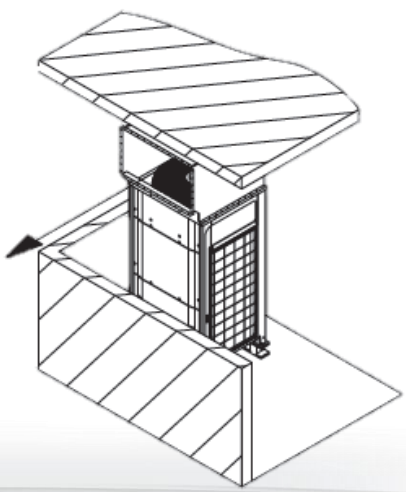
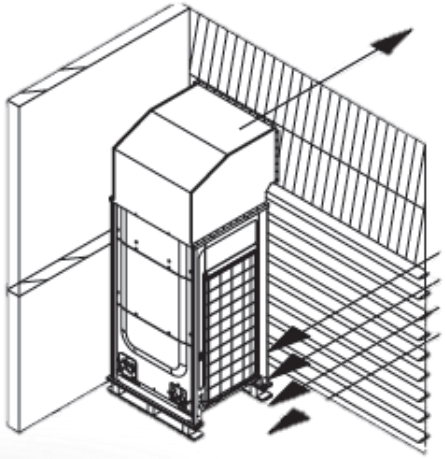
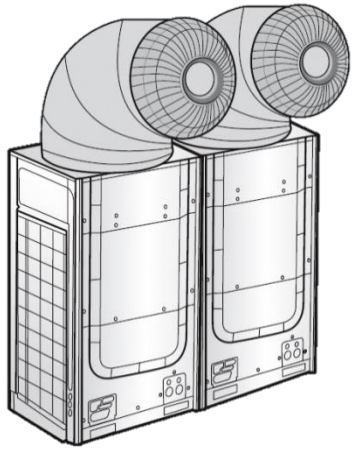
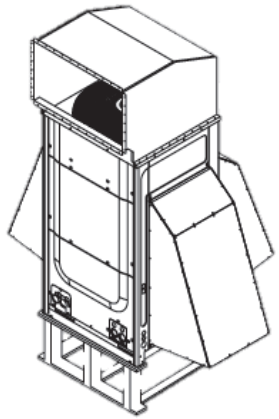
Ducted Outdoor Unit Discharge Air

- If proper discharge clearance cannot be achieved, ducting of discharge air is an option
- If located in an area where debris will fall into unit, fabricate and install discharge air hood (dimensions available in installation manual and technical data books).
- Maximum 0.32” ESP
- Sufficient inlet air must be present
- Minimum 6.5’ between discharge outlet and nearby obstacle



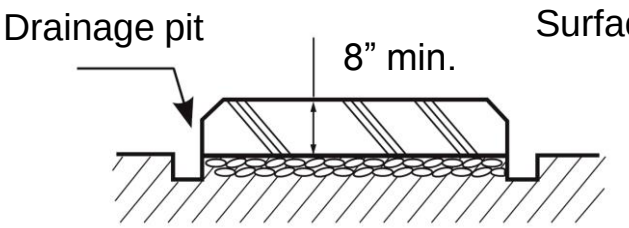




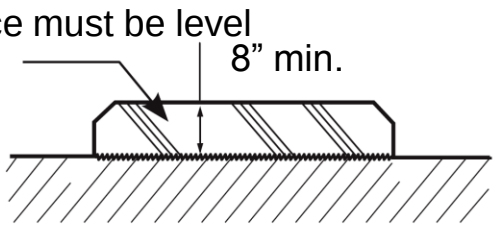


DVM S

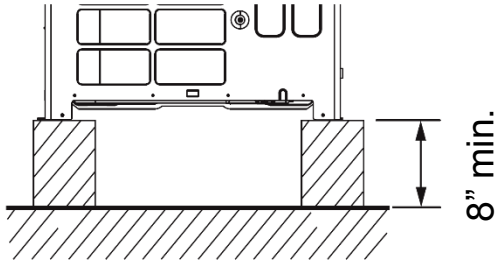
Installing Outdoor Unit - Securing

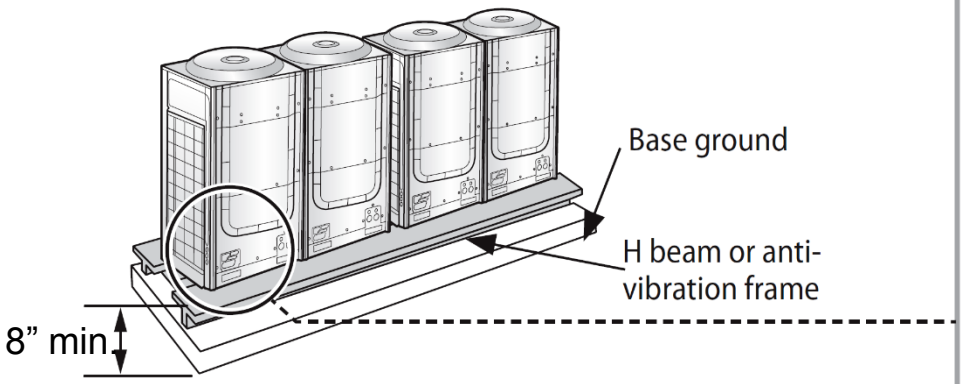


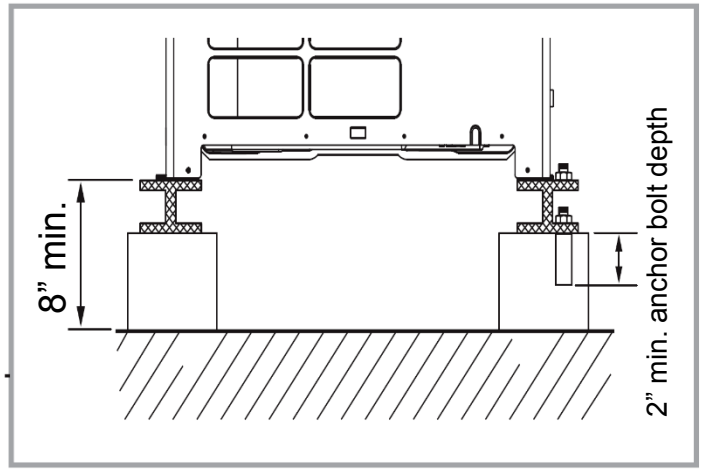
Ground installation



Roof installation







DVM S

Installing Outdoor Unit - Securing

- Make sure outdoor unit is secured to the building or ground appropriately for regional requirements

- Be aware of local and state regulations

DVM S

Installing Outdoor Unit - Securing

- The outdoor units must be secured to the building or ground, especially in areas with high winds
- The systems in this example have structural bracing to prevent the units from tipping over
- Vibration isolation should also be considered when placing units on a rooftop

DVM S

Installing Outdoor Unit

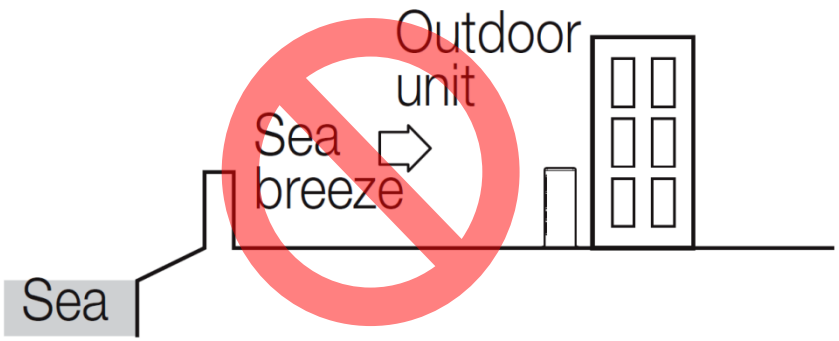
Install the outdoor unit(s) making sure that:

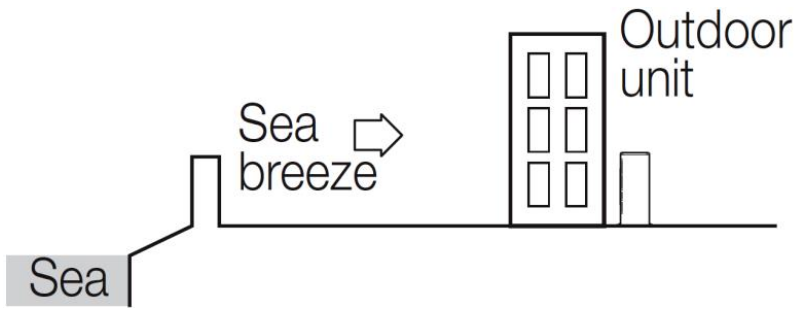
- Snowfall will not obstruct air flow
- Prevailing winds will not damage the equipment or diminish performance
- Building exhaust (bathroom, kitchen, combustion, oxides, sulfur, etc.) are not near
- The unit(s) are serviceable in the future for maintenance and repair

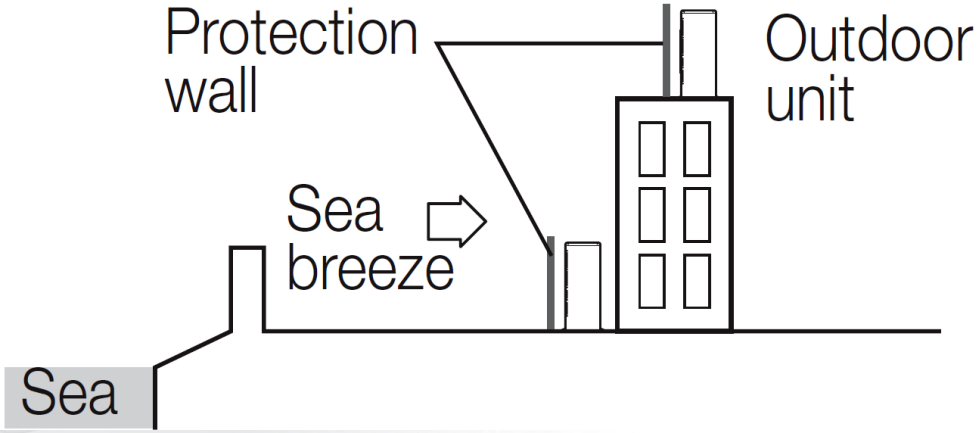
DVM S

Installing Outdoor Unit

- Do not install outdoor units in direct line of ocean/sea winds to avoid damage.
- Refer to installation and technical guides for exact specifications
- Place unit behind the building, a screen, or other obstructions to prevent these direct winds



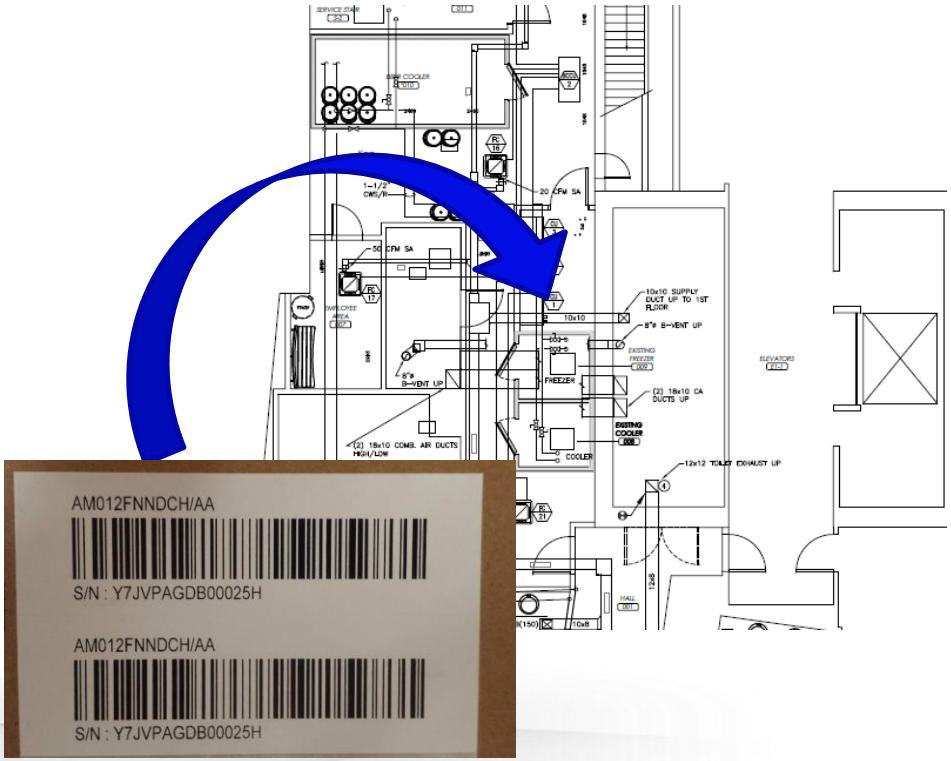




Indoor Unit Placement and Recommendations

Indoor Units

- While placing indoor units in the building, keep a good record of indoor unit serial numbers and where they will be physically installed in the building (room number, zone, etc.)
- Use a floor plan to place the indoor unit serial number sticker on the appropriate rooms or use an installation spreadsheet to log indoor unit locations



PROJECT NAME _____

BUILDING _____

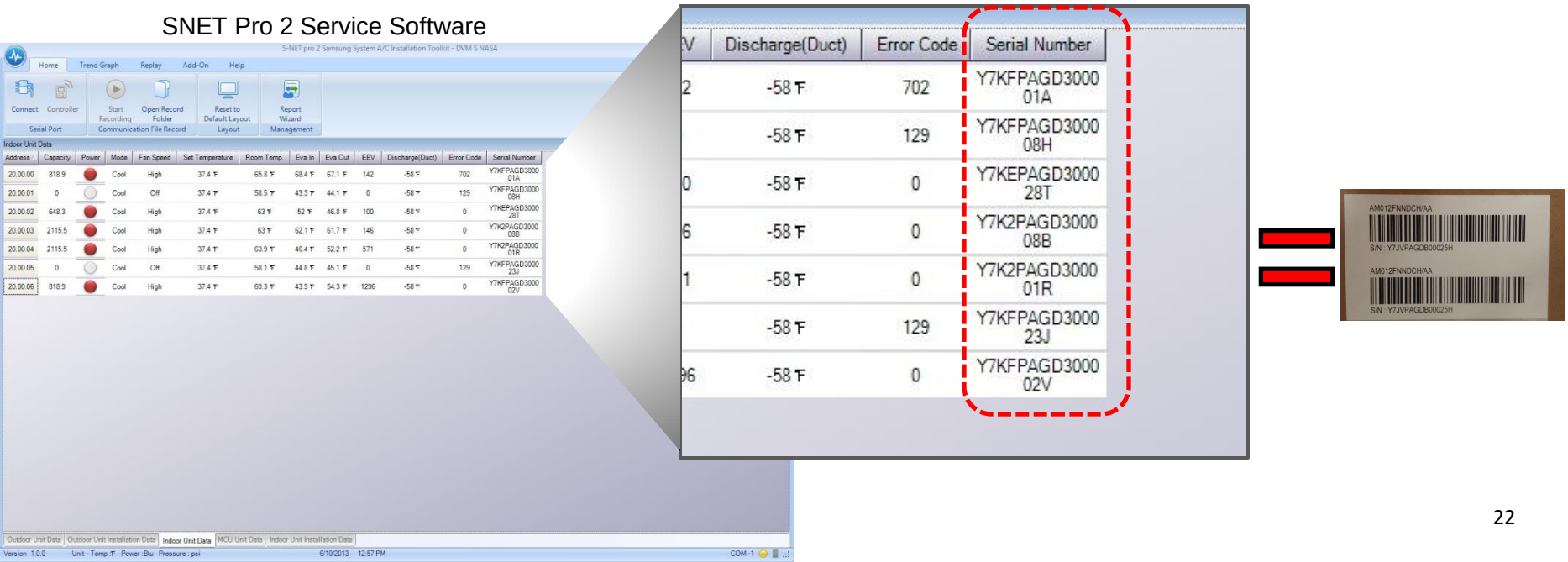
MODEL/SERIAL NUMBER	ROOM	SYSTEM ID	NOTES
AM012FNNDCH/AA S/N : Y7JVPAGDB00025H	203	HP-3	

Indoor Units

- Later, during setup and commissioning, address setting and unit naming will be quick and easy if good records are kept

- With SNET Pro 2 Service Software, we can view all indoor units based on their serial number

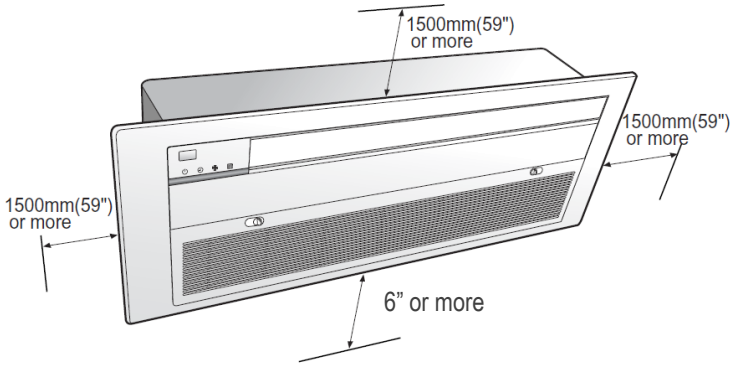
SNET Pro 2 Service Software

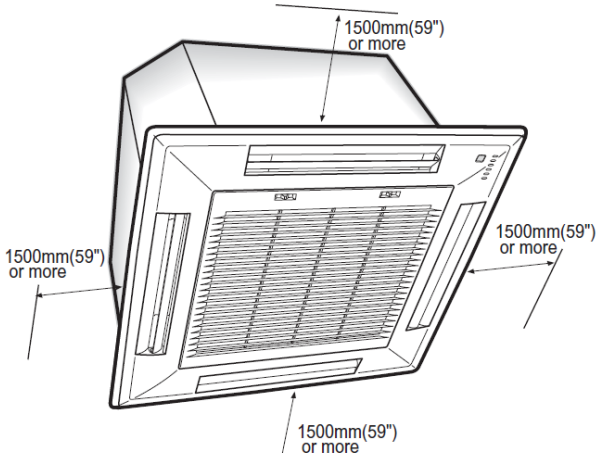


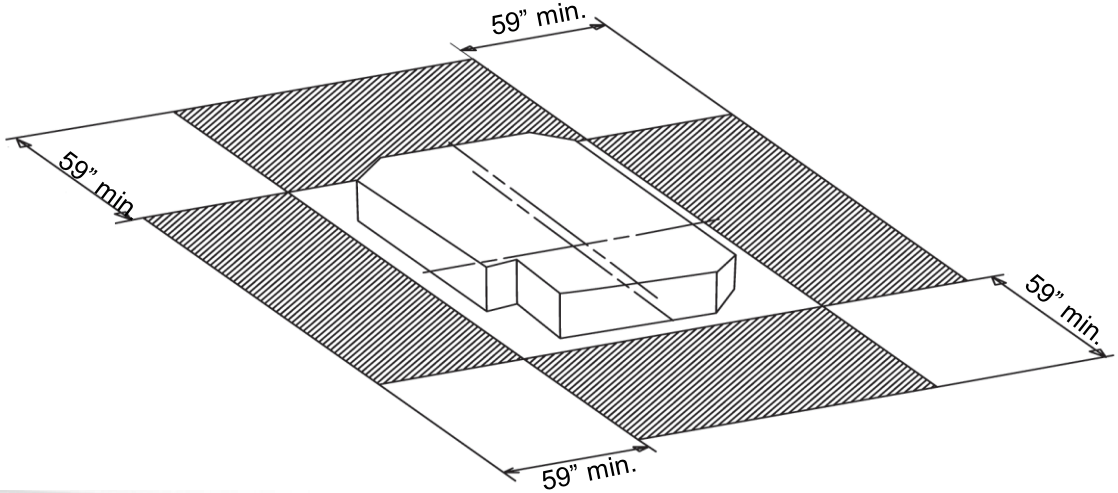
Indoor Units

Cassette Unit Clearances

- 59” minimum from smoke alarms, avoid installing in the direction of supply discharge air
- 5’ from walls and other obstructions
- 10’ from other cassette units







Indoor Units

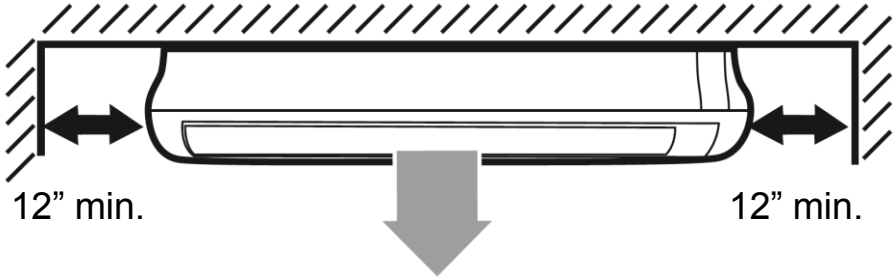
Cassette Unit Clearances

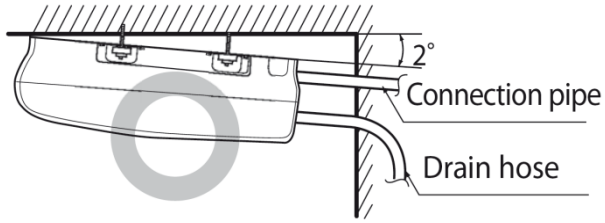
- An 18” X 18” (minimum) inspection hole is recommended on the pipe side of the unit if installed where pipes will not be accessible after installation
- This is to allow access to the refrigerant and condensate pipe connections for service and preventative maintenance.
- Local code may require this

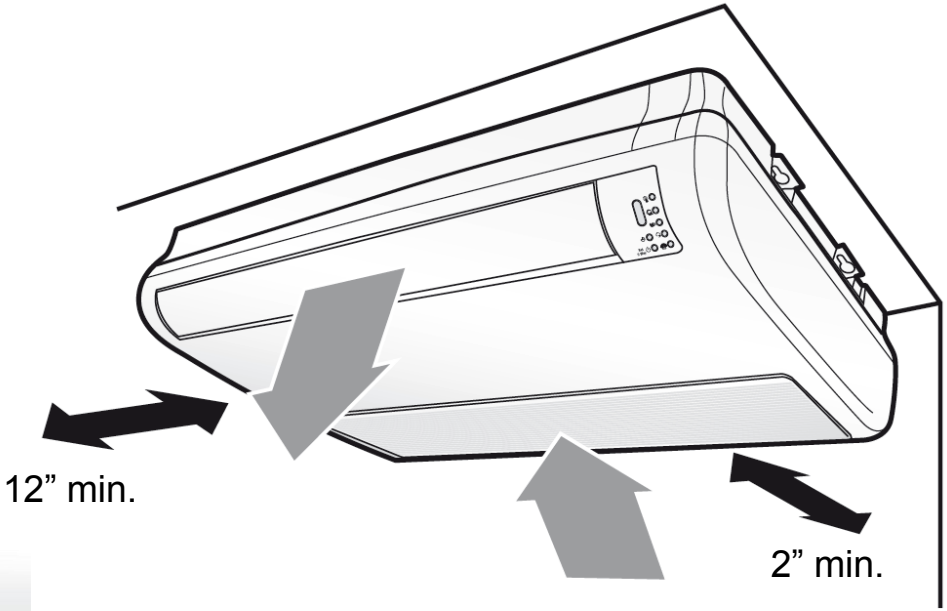
Indoor Units

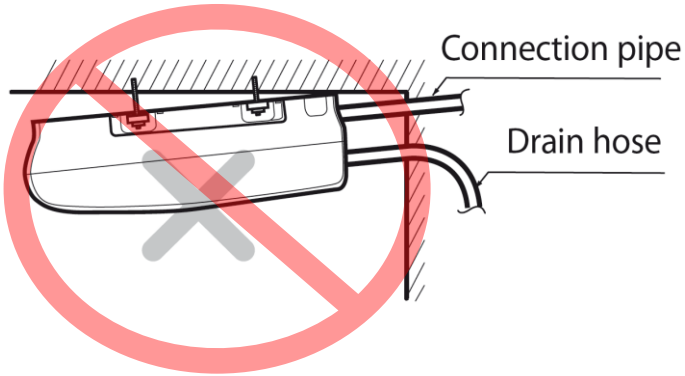
Ceiling Unit Clearances – Ceiling Installation

- Ceiling units can be installed under the ceiling or on a wall (low-wall near floor)
- Maintain 12” minimum clearance on sides and 2” on back





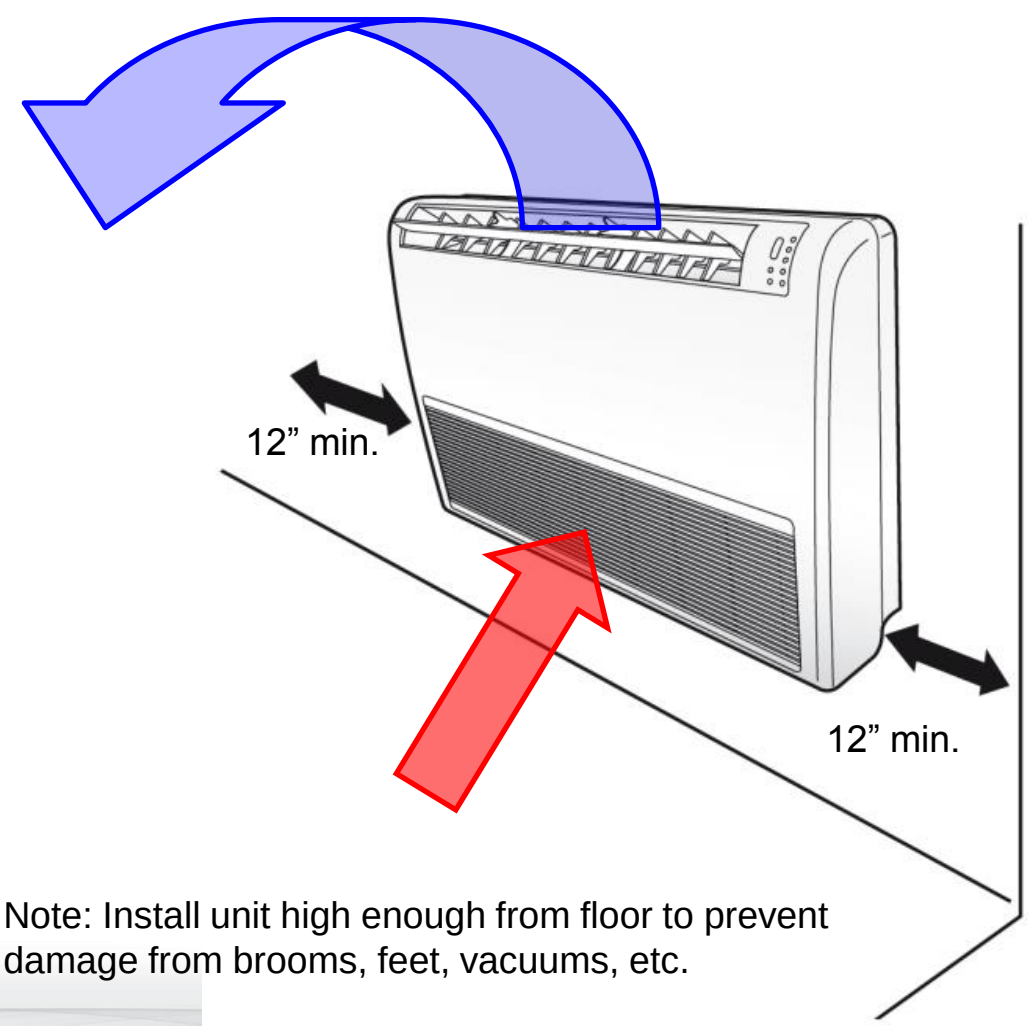


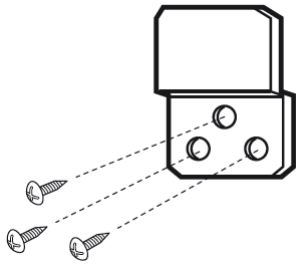


Indoor Units

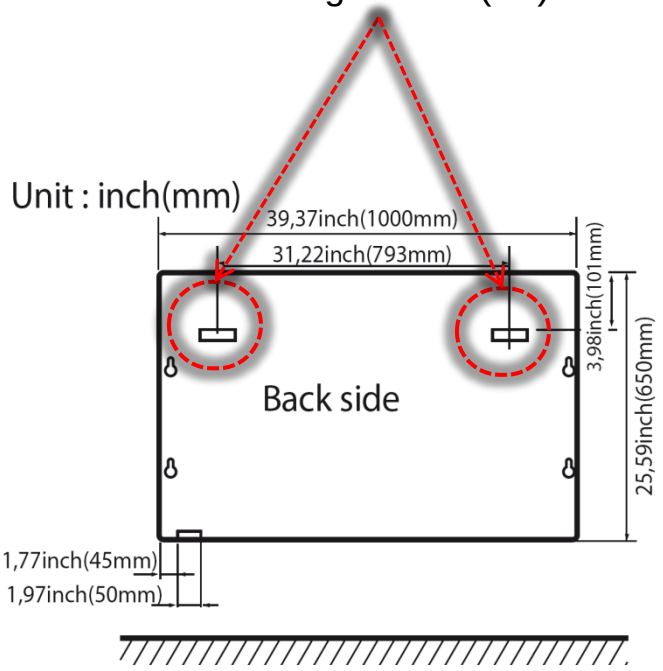
Ceiling Unit Clearances – Wall Installation

When hanging on the wall, use supplied hanging brackets





Wall hanger hook (X2)

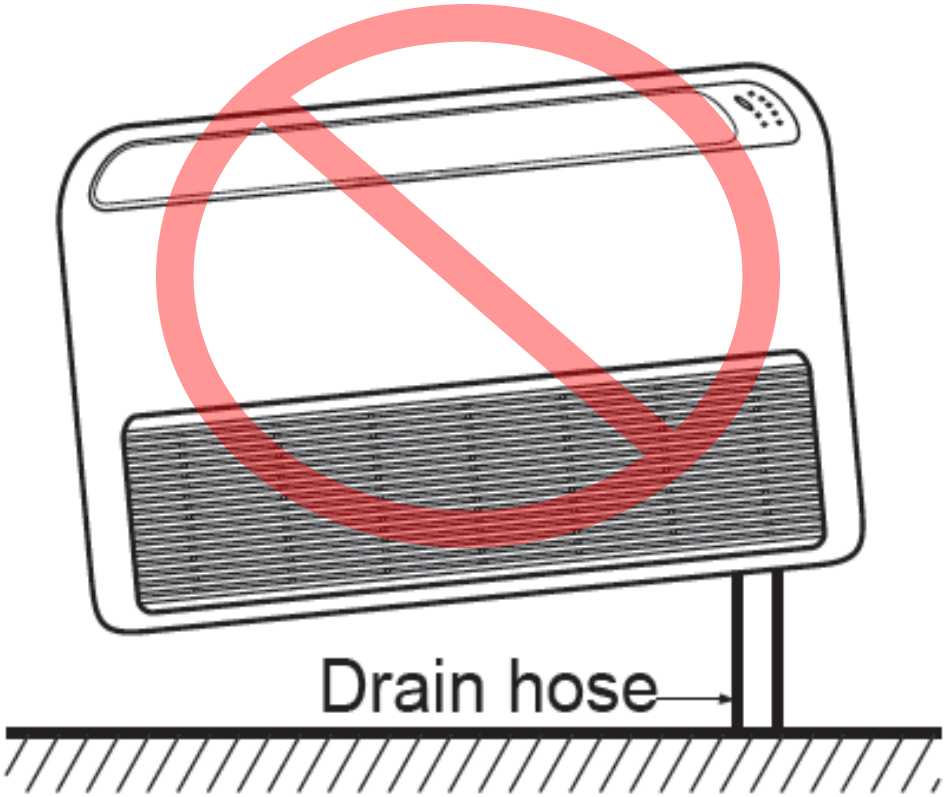


Note: Install unit high enough from floor to prevent damage from brooms, feet, vacuums, etc.

Indoor Units

Ceiling Unit Clearances – Wall Installation

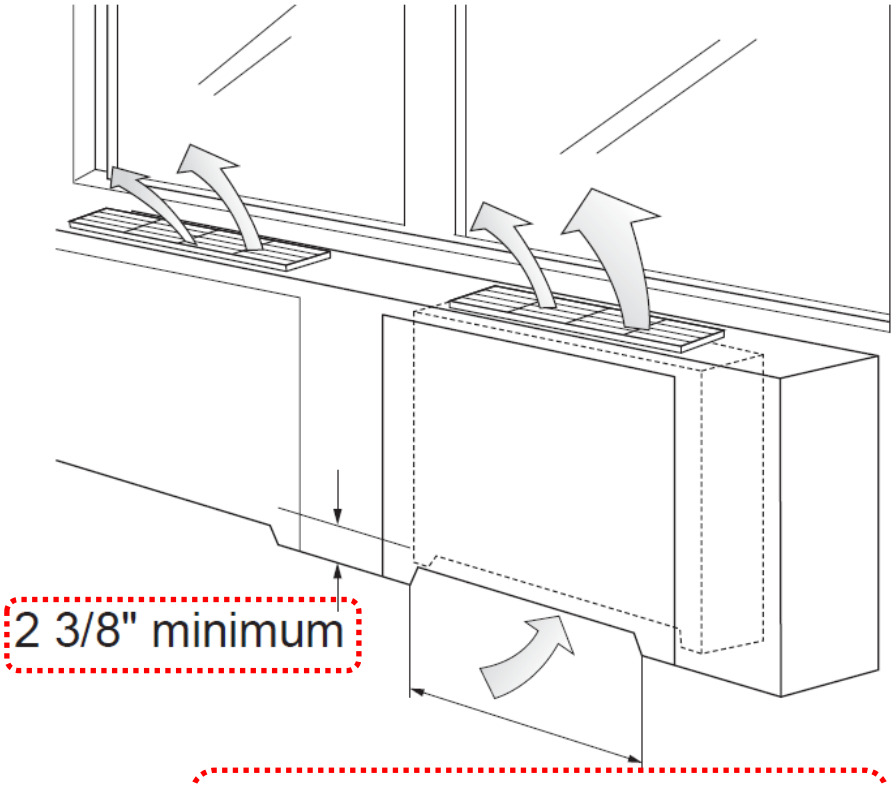
Make sure unit does not slope away from the drain pan outlet once hung



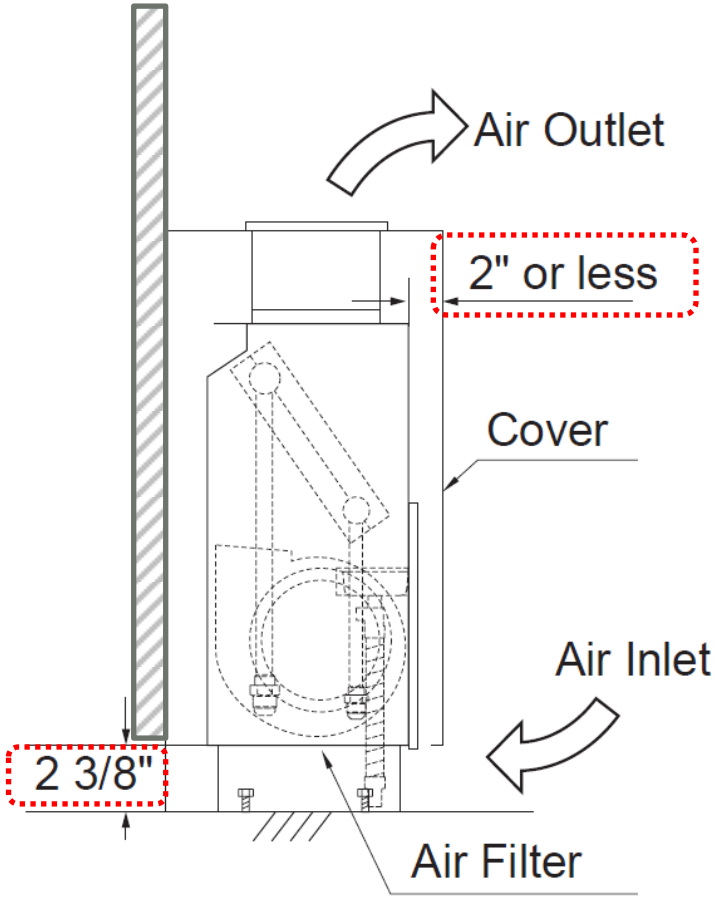
Indoor Units

Concealed Floor Standing Unit Placement

Allow sufficient inlet air when concealing the indoor unit

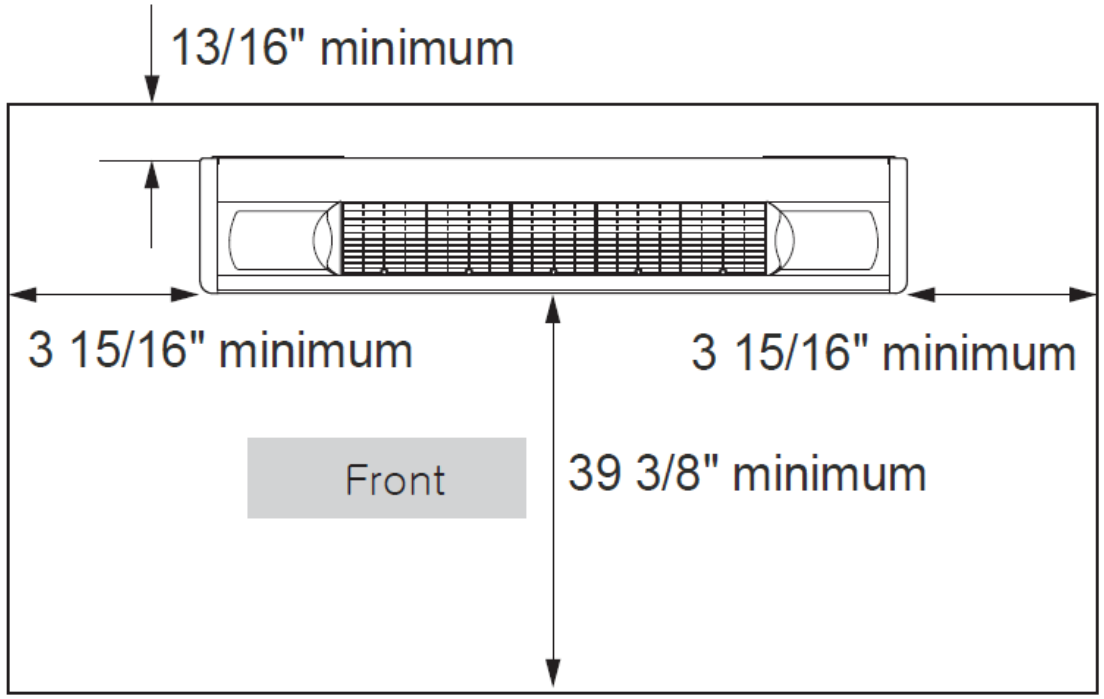


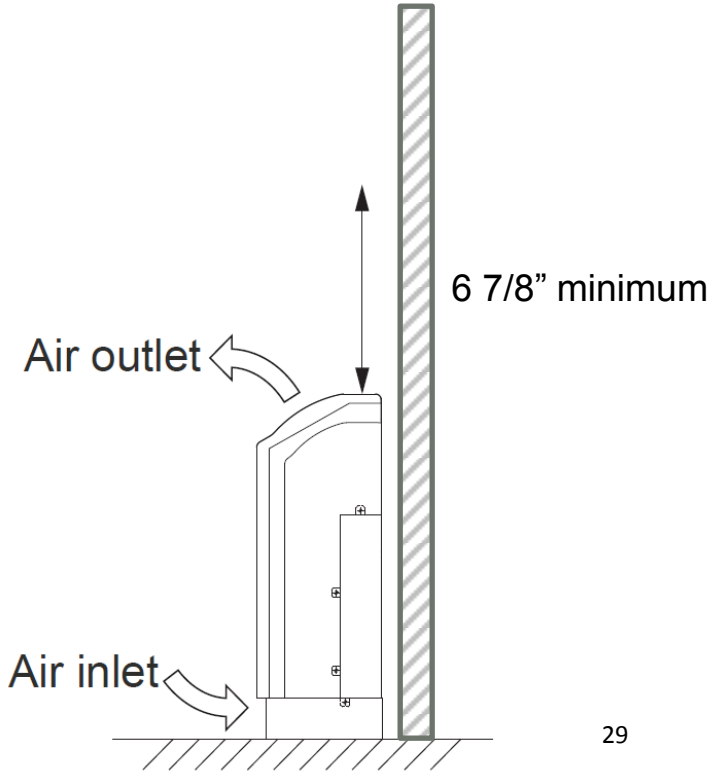
6,000 ~ 12,000 Btu/h: 28 3/4”
8,000 ~ 24,000 Btu/h: 39 3/4”



Indoor Units

Floor Standing Unit Clearances

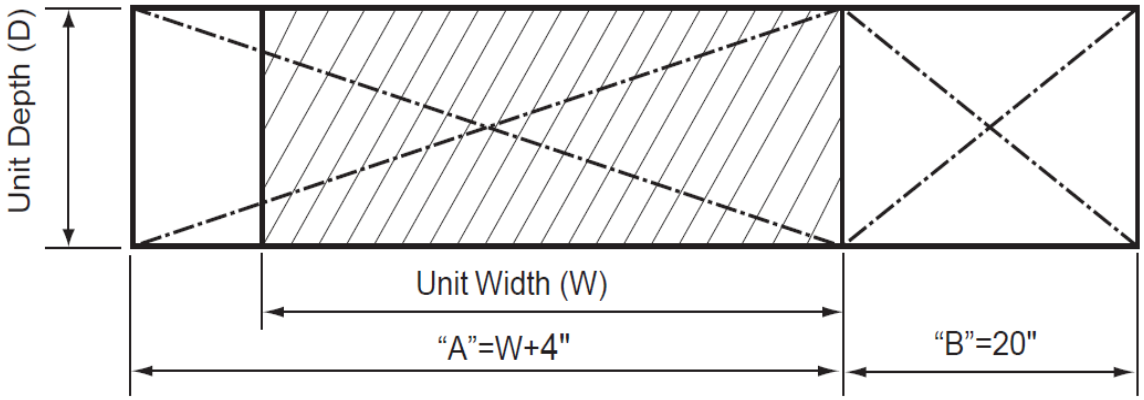




Indoor Units

Ducted Unit Clearances

View from bottom

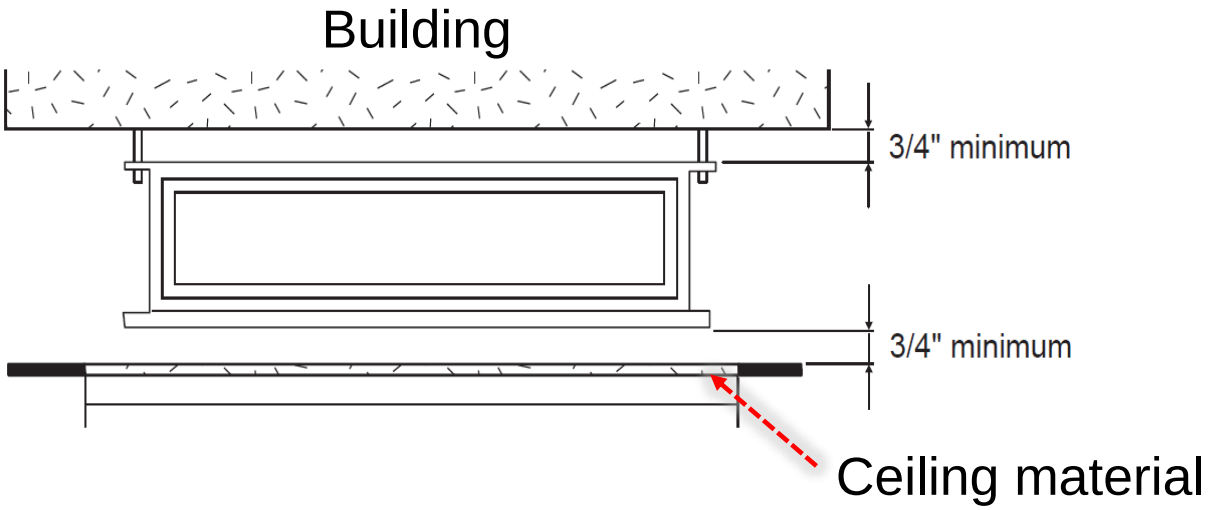


- Samsung recommends installing an access under duct units for future service and replacement if unit is installed in an inaccessible area (ex: above sheetrock)

- Samsung also recommends installing a service access door on the PCB and pipe side for future maintenance and inspection providing at least 20" of clearance (verify NEC compliance)

Indoor Units

Ducted Unit Clearances



- Keep 3/4” minimum between a duct unit and the structure above and ceiling material below to prevent noise transmission

- If humidity of duct unit installation is over 80%, additional insulation of the indoor unit may be necessary (3/8” minimum)

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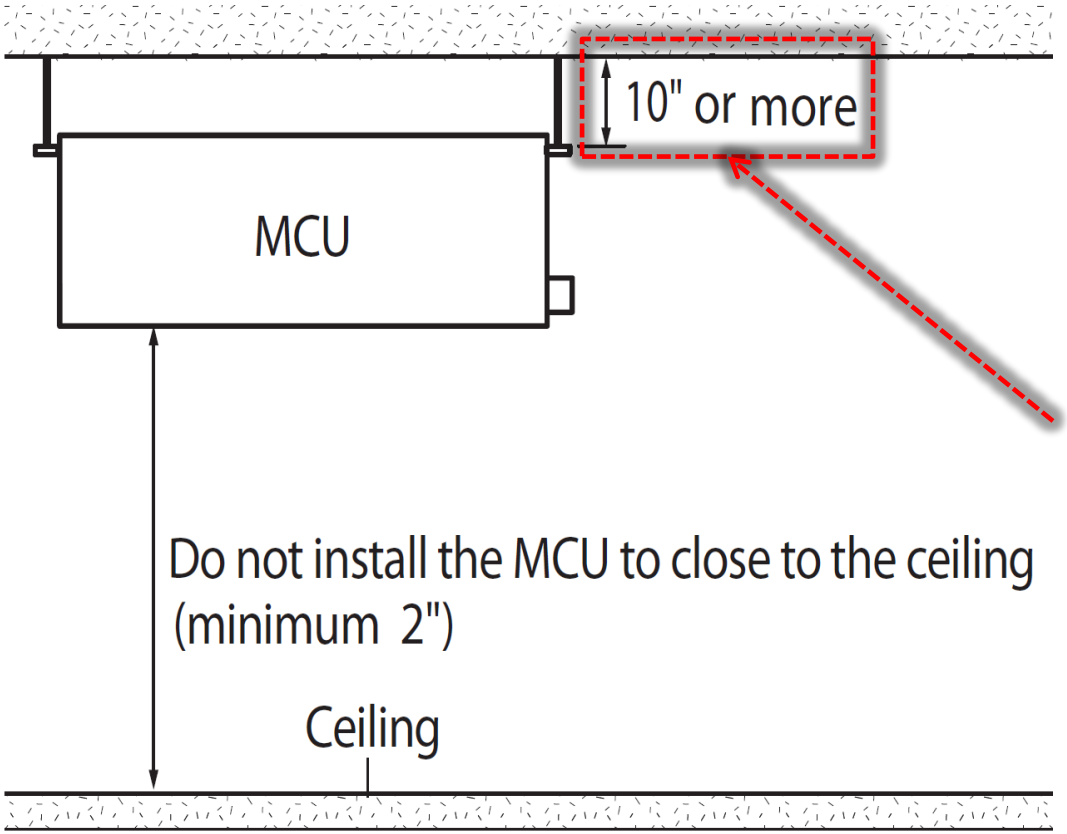
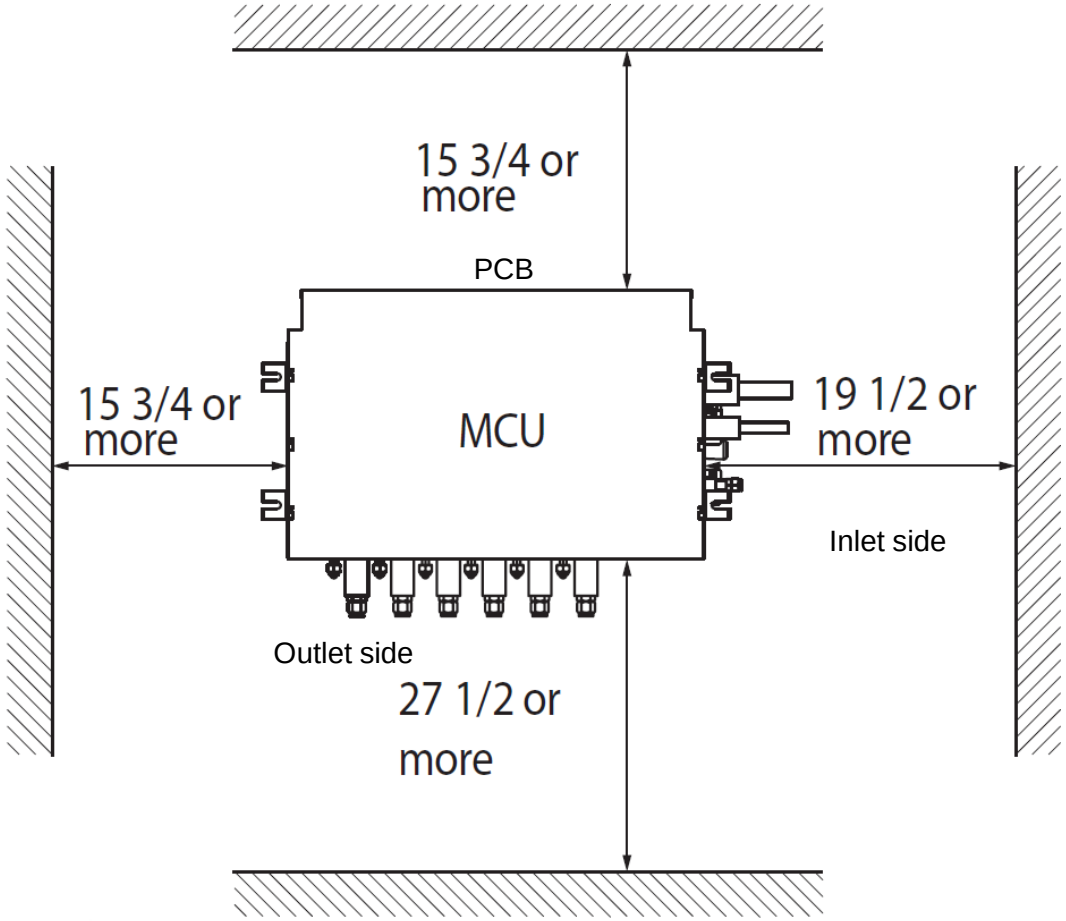
MCU Clearances



- 10” minimum
- Remember, you may need to service the MCU which may require access through the top

DVM S

MCU Clearances

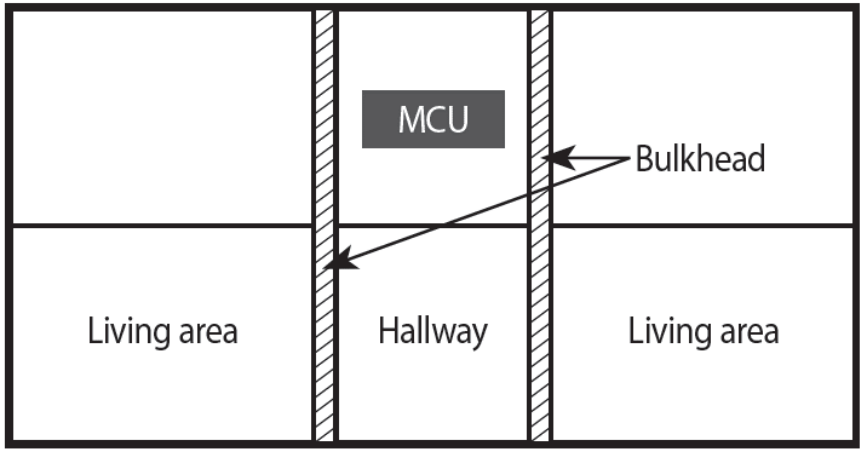


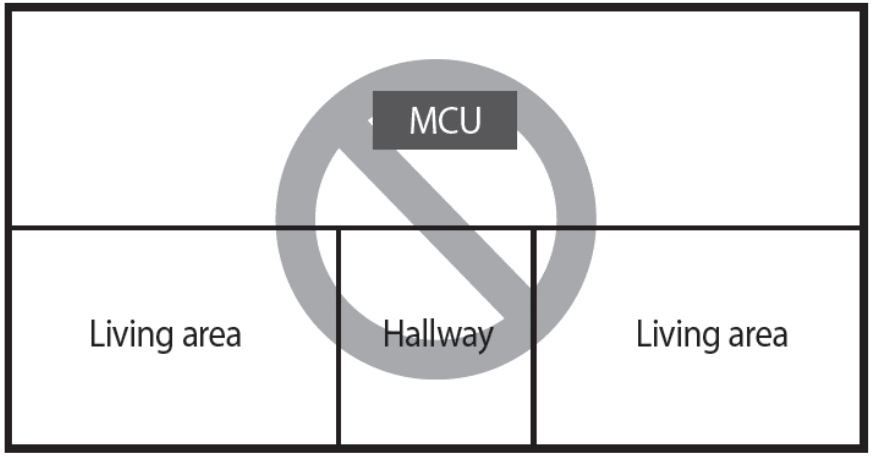
Top view

DVM S

MCU Clearances

- Install MCU's in an area where sounds can be tolerated
- Ideal locations include above ceilings in hallways, bathrooms, mechanical rooms, storage areas, etc.
- Never install above quiet areas like guest rooms, patient rooms, sleeping quarters, living spaces, or individual office's



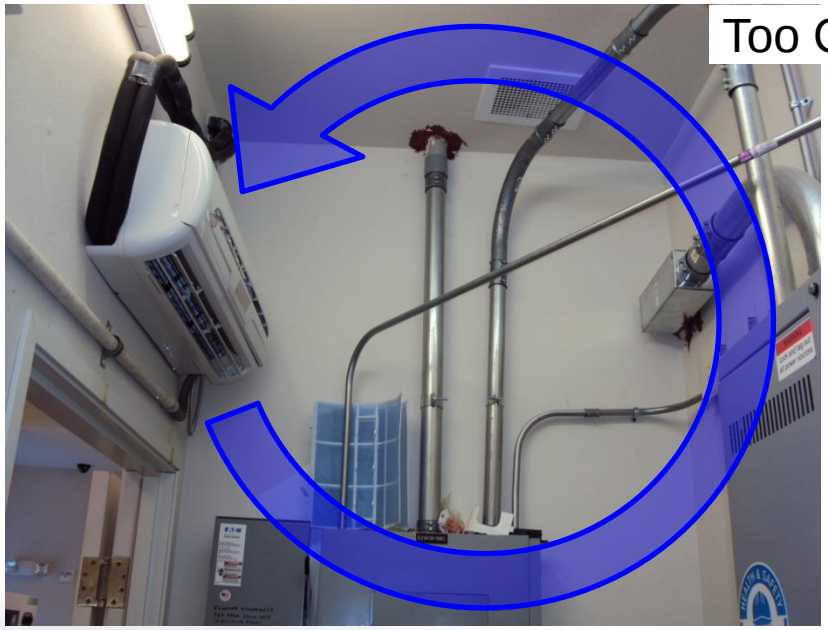


34

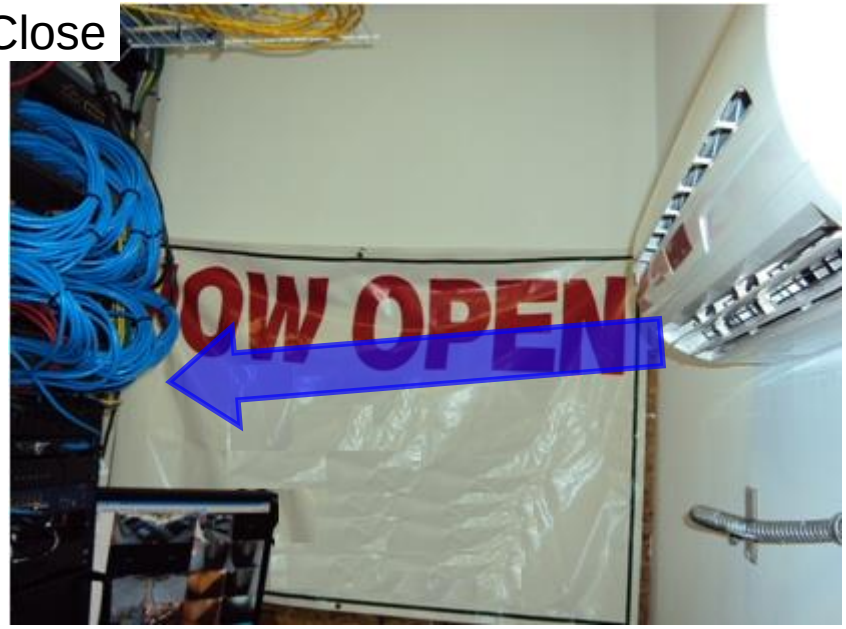
DVM S

Basic Sizing – “Bounce Back”

- Make sure sufficient space is provided in front of high-wall units to allow air to distribute as designed throughout the space.
- This is done to avoid a “bounce back” situation that is similar to short cycling which effects temperature control and decreases equipment life



Too Close



DVM S

Basic Sizing – “Bounce Back” Example

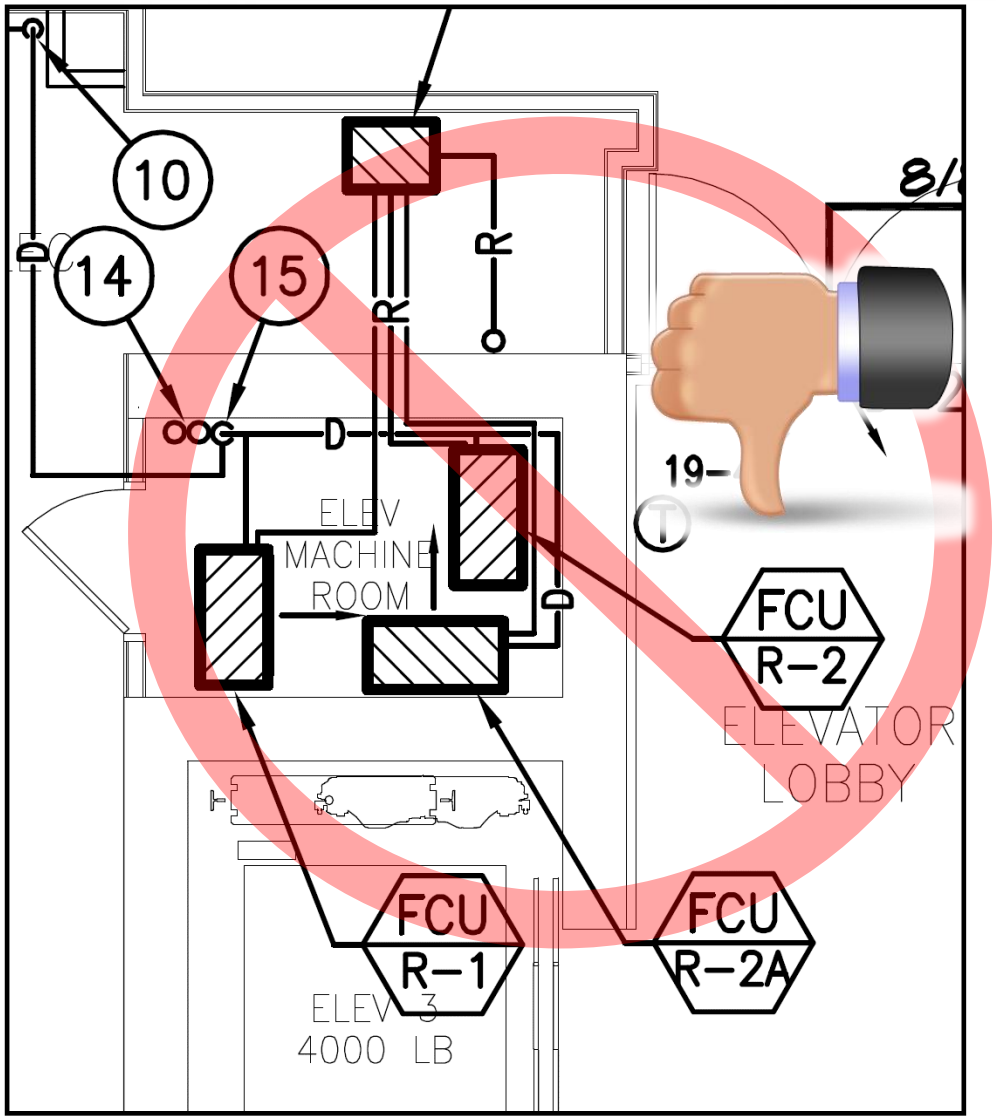
- While operating, the louver will direct air up and down.
- In this example, the wall-mounted unit will create a bounce-back effect as the air is directed at the top of the shelving causing sporadic operation and uncomfortable occupants

DVM S

Basic Sizing – “Bounce Back” in a small room

Example:

- Approximately 6’ X 10’
- 3 X 24,000 Btu/h wall units
- Supply air direction pointed toward other units in a small space
- 6 tons total specified capacity
- Even with a high load, the likelihood of bounce-back is very high
- The equipment is designed for comfort cooling/heating, not heavy machinery cooling



DVM S

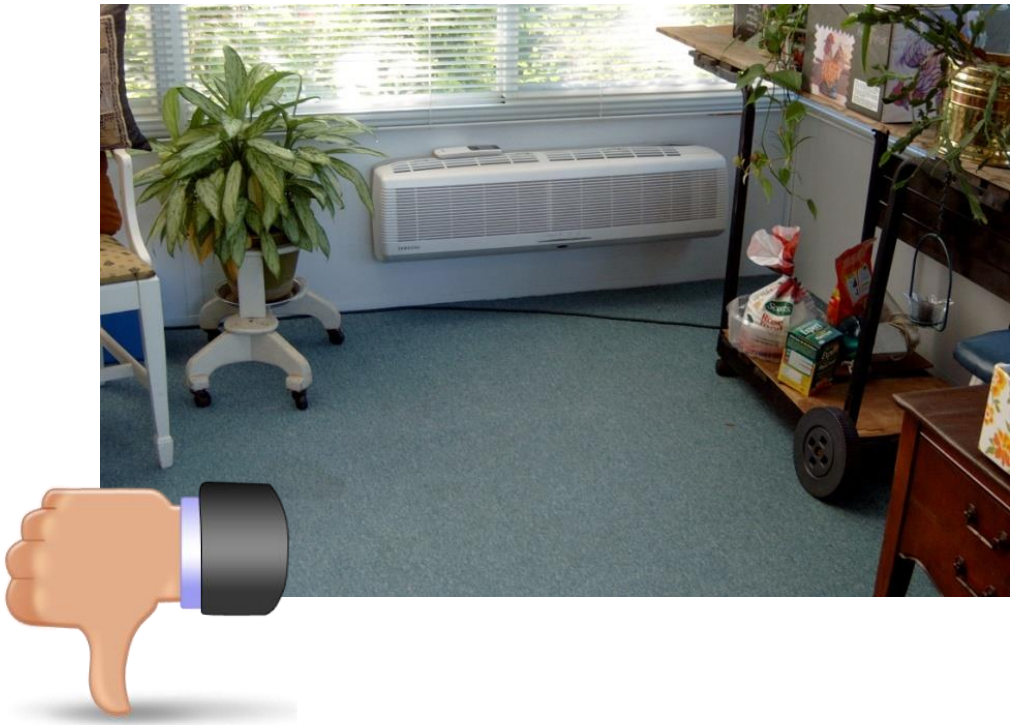
Basic Sizing – “Bounce Back” Example

Too close for comfort

DVM S

Wall mounted unit guidelines

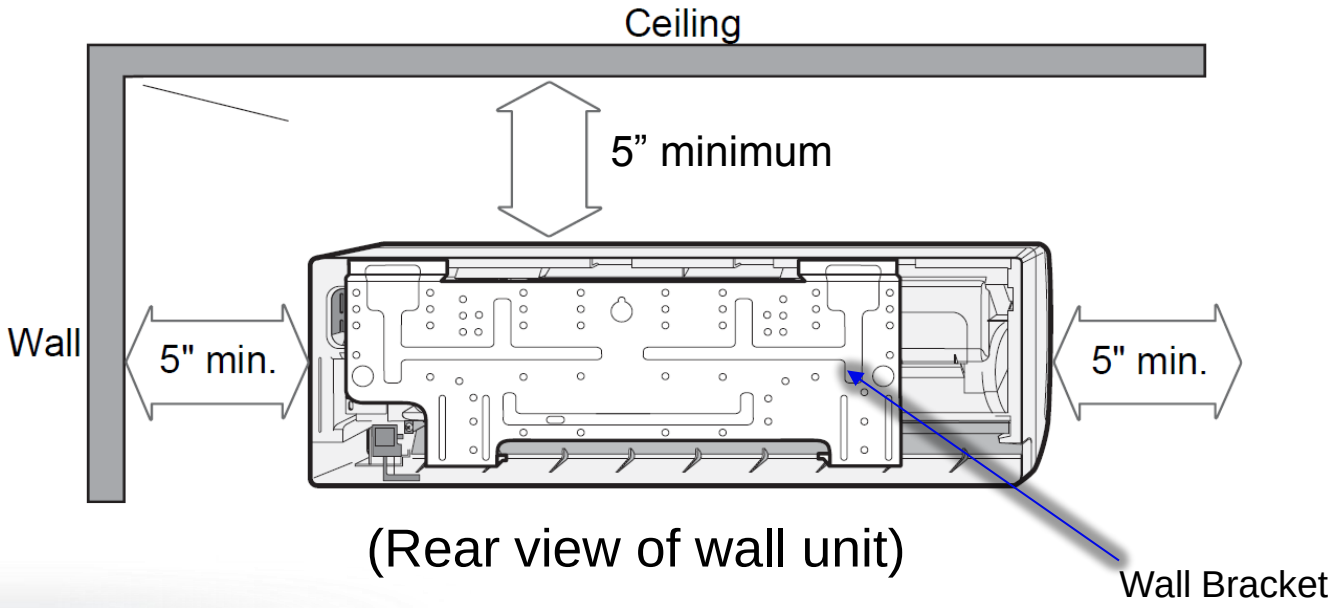
- NOT PTAC's - Indoor units MUST be installed a minimum of 5 feet from the floor



DVM S

Wall Unit Clearances

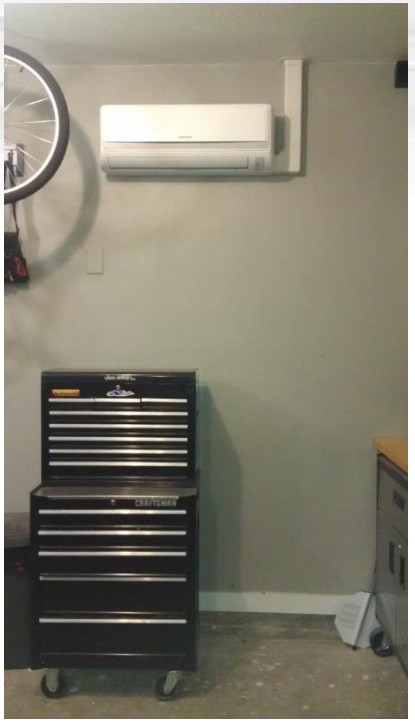
- Mount wall bracket (included) to wall
- Ensure that unit is secured to framing or appropriate anchors are used to support the weight of the unit
- Maintain the following clearances around the wall unit



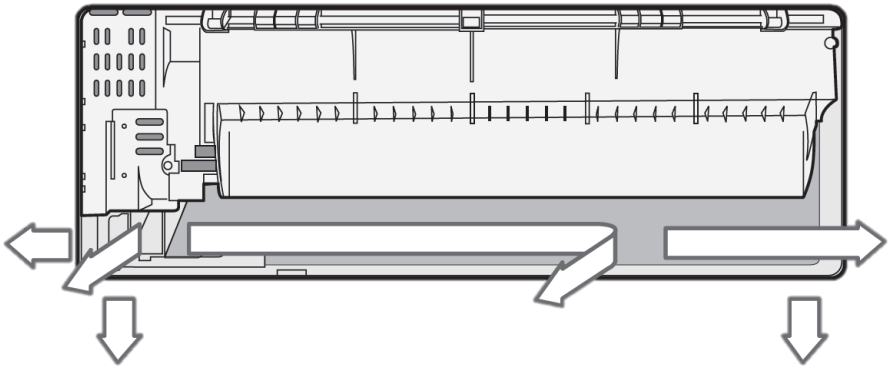
(Rear view of wall unit)

DVM S

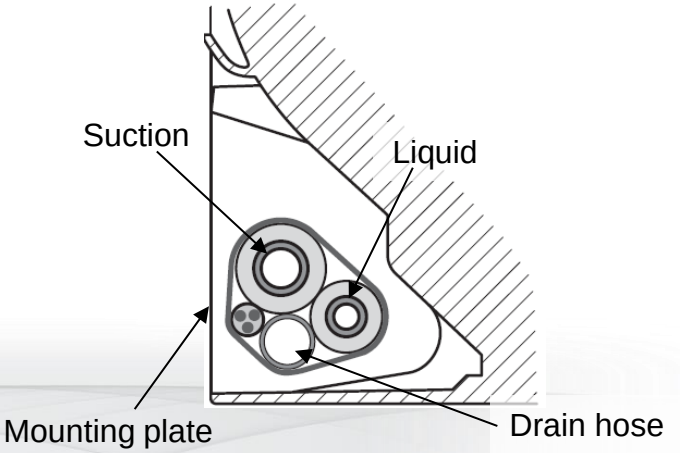
Installing wall mounted unit

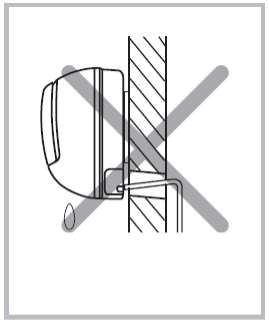


- Gently rotate line copper pipes to the required position (right, left, bottom, or back sides)

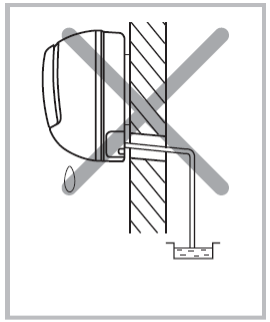


- Locate condensate hose and tape it to line set **BELOW** refrigerant lines keeping it as low as possible

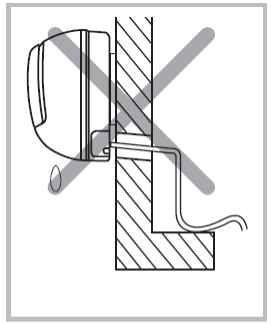




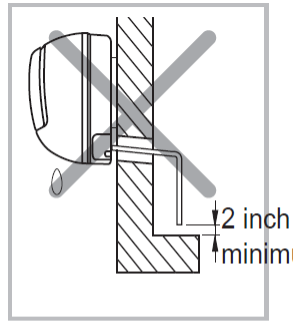
The hose must NOT slant upwards.



The end of the drain hose must NOT be placed under water.



Do NOT bend the hose in different directions.

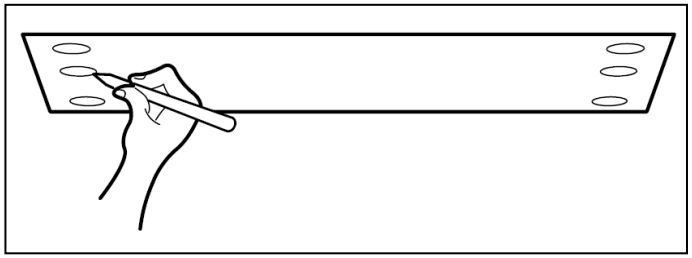


Keep a clearance of at least 2 inches between the end of the hose and the ground.

DVM S

Installing duct and cassette units

- Use provided template to mark anchor position in ceiling

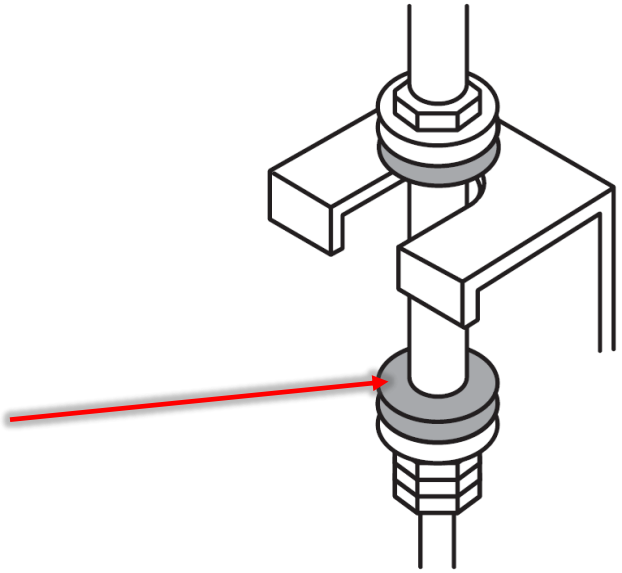


- Install anchors and threaded rods ensuring the weight of the unit can be supported

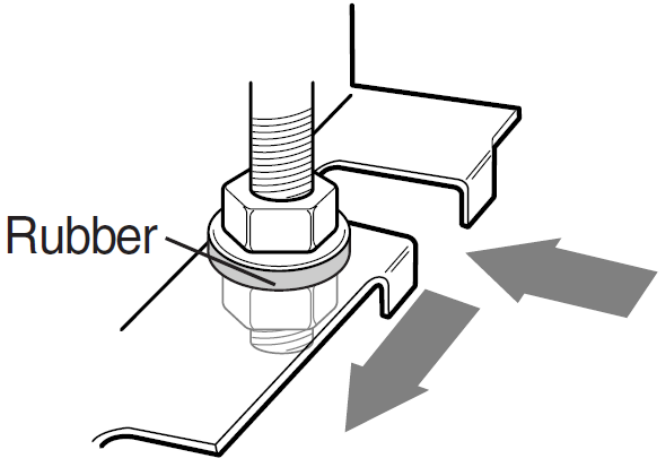
DVM S

Installing duct and cassette units

- Use provided rubber vibration absorbers (included with most units) to help reduce vibration resonance (6 and 8 ton HSP units have larger absorbers included)



- Install 2 nuts on the bottom and tighten together to ensure safety of occupants below



DVM S

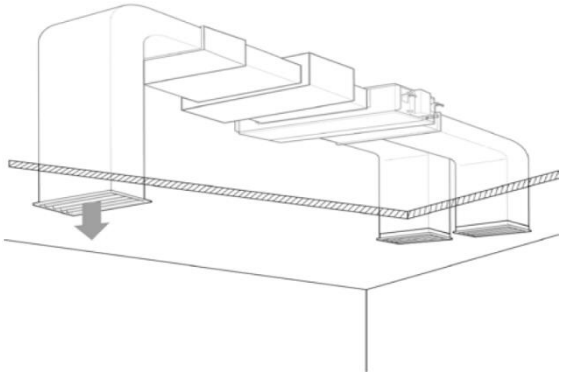
Installing ducted units

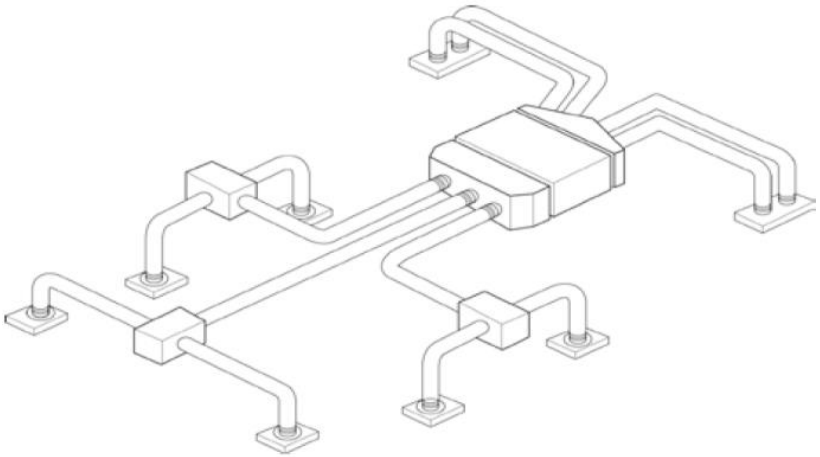
- Basic filtration is supplied with the unit
- Field installed filtration is recommended - either at the unit or installed at the return air grille

DVM S

Installing ducted units

- Return air ductwork can be either free or ducted to the rear or bottom as required – ductwork added to the return will need to be subtracted from total length of ducting on the system





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- After indoor units are suspended and connected, protect from dust and debris with included covers

- Never operate indoor units during construction as this can damage indoor unit pumps and coils

External EEV's and Heat Recovery MCU's

DVM S

Refrigerant Piping

- Samsung piping guidelines and restrictions must be strictly adhered to

- Failure to follow Samsung piping guidelines may result in decreased capacity, poor performance, equipment damage, and/or premature failure

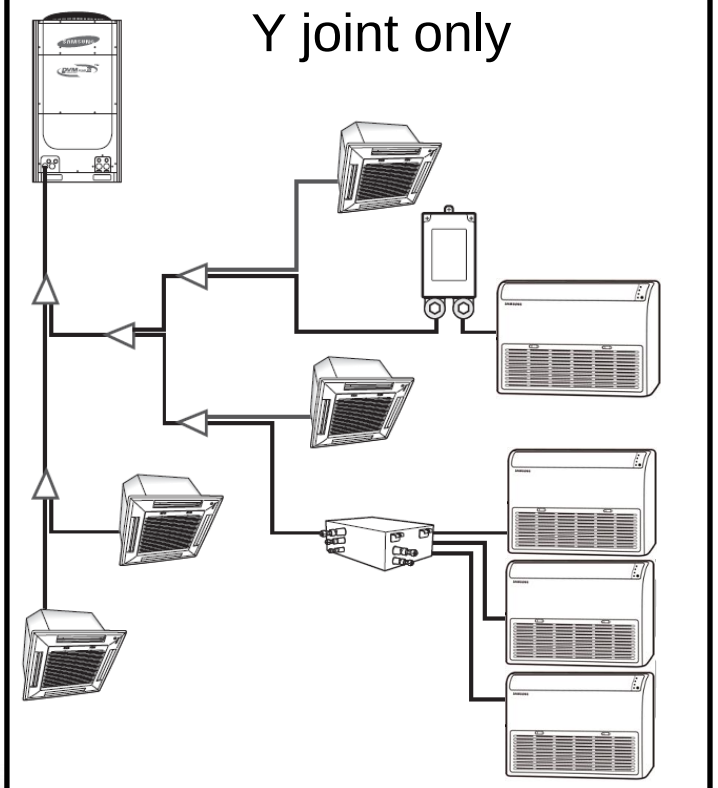
DVM S

Piping Layout (Heat Pump)

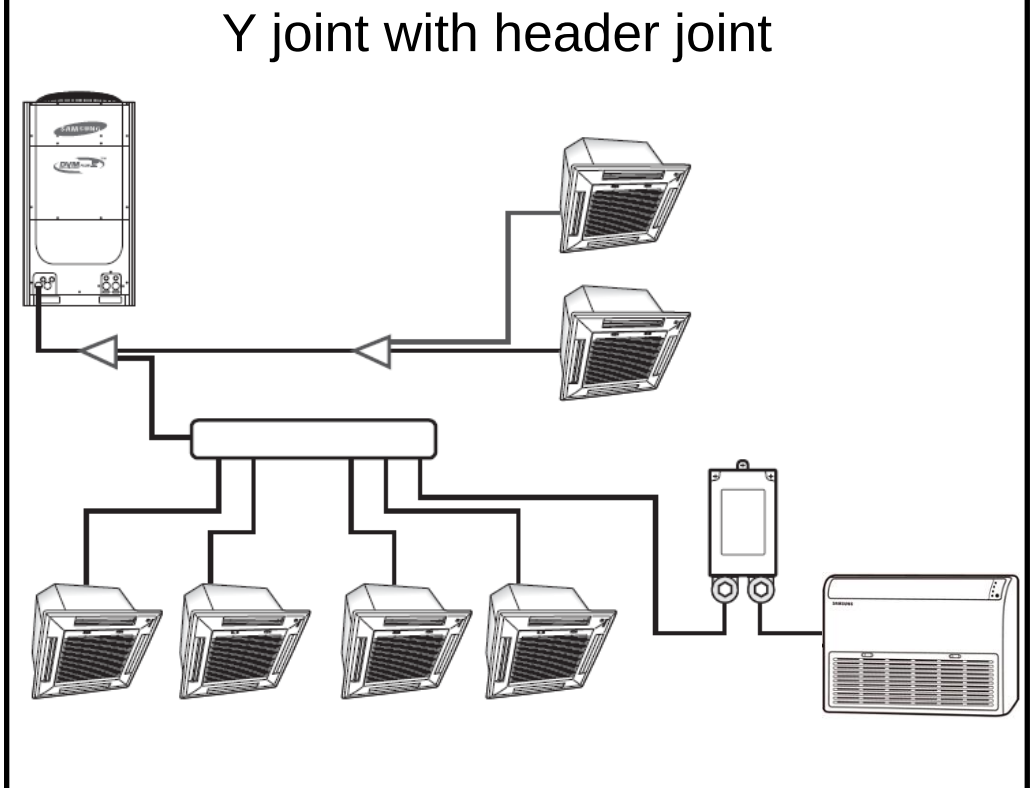
- Heat pump refrigerant systems will consist of copper pipe and Samsung Y-joints and/or headers

- Aluminum pipe is NOT allowed

Y joint only



Y joint with header joint



DVM S

EEV Kits (for under-ceiling units only)

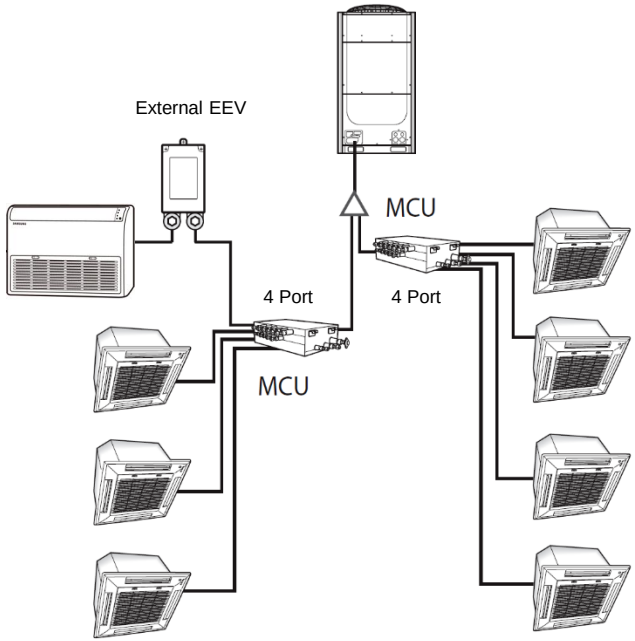
- EEV kits are selected based on connected indoor unit capacity

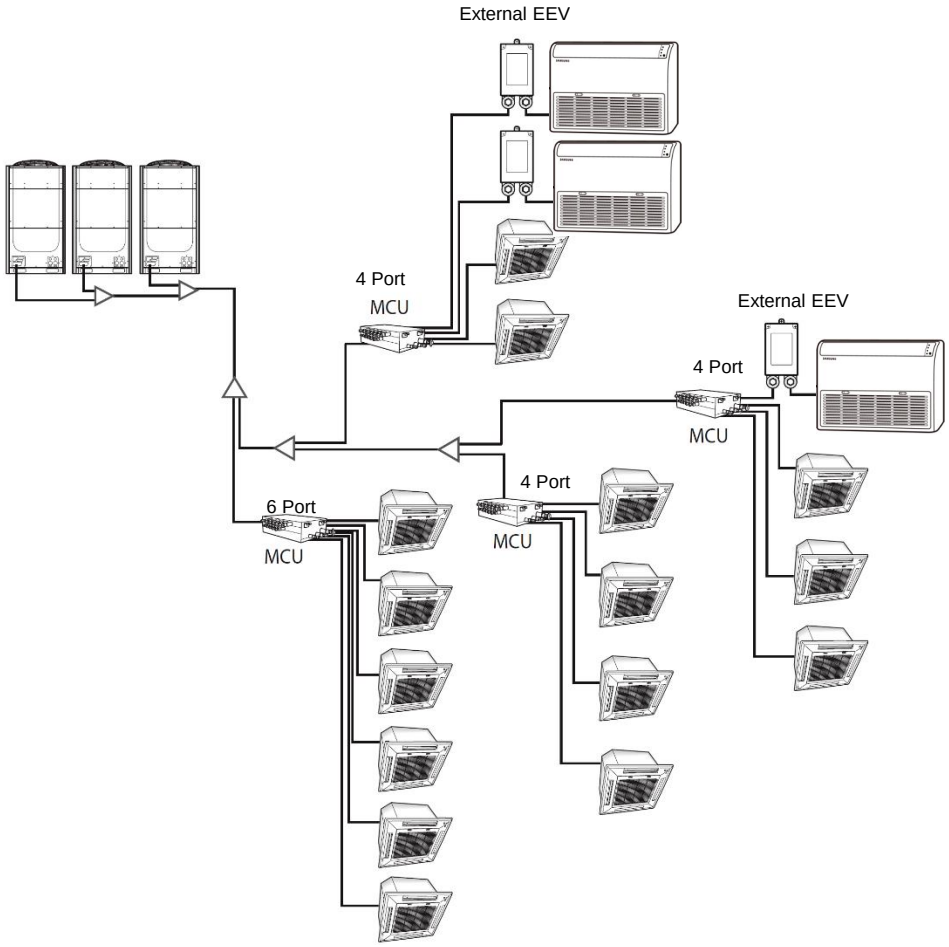
Connectable Indoor Unit Quantity	Model Number	Connectable Indoor Unit Capacity	Compatibility
2 unit 	MXD-E24K132A	1 X ≤ 12,000 BTU/H + 1 X 18,000 – 24,000 BTU/H	Heat Pump Systems Only
	MXD-E24K200A	2 X ≤ 12,000 BTU/H	
	MXD-E32K200A	2 X 18,000 – 24,000 BTU/H	
3 unit 	MXD-E24K232A	2 X ≤ 12,000 BTU/H + 1 X 18,000 – 24,000 BTU/H	
	MXD-E24K300A	3 X ≤ 12,000 BTU/H	
	MXD-E32K224A	1 X ≤ 12,000 BTU/H + 2 X 18,000 – 24,000 BTU/H	
	MXD-E32K300A	3 X 18,000 – 24,000 BTU/H	
1 unit 	MEV-A24SA	≤ 12,000 BTU/H	Heat Pump or Heat Recovery Systems
	MEV-A32SA	18,000 – 24,000 BTU/H	

DVM S

Piping Layout (Heat Recovery)

- Heat recovery refrigerant systems will consist of copper pipe, MCU's, and Samsung Y-joints
- Aluminum pipe is NOT allowed





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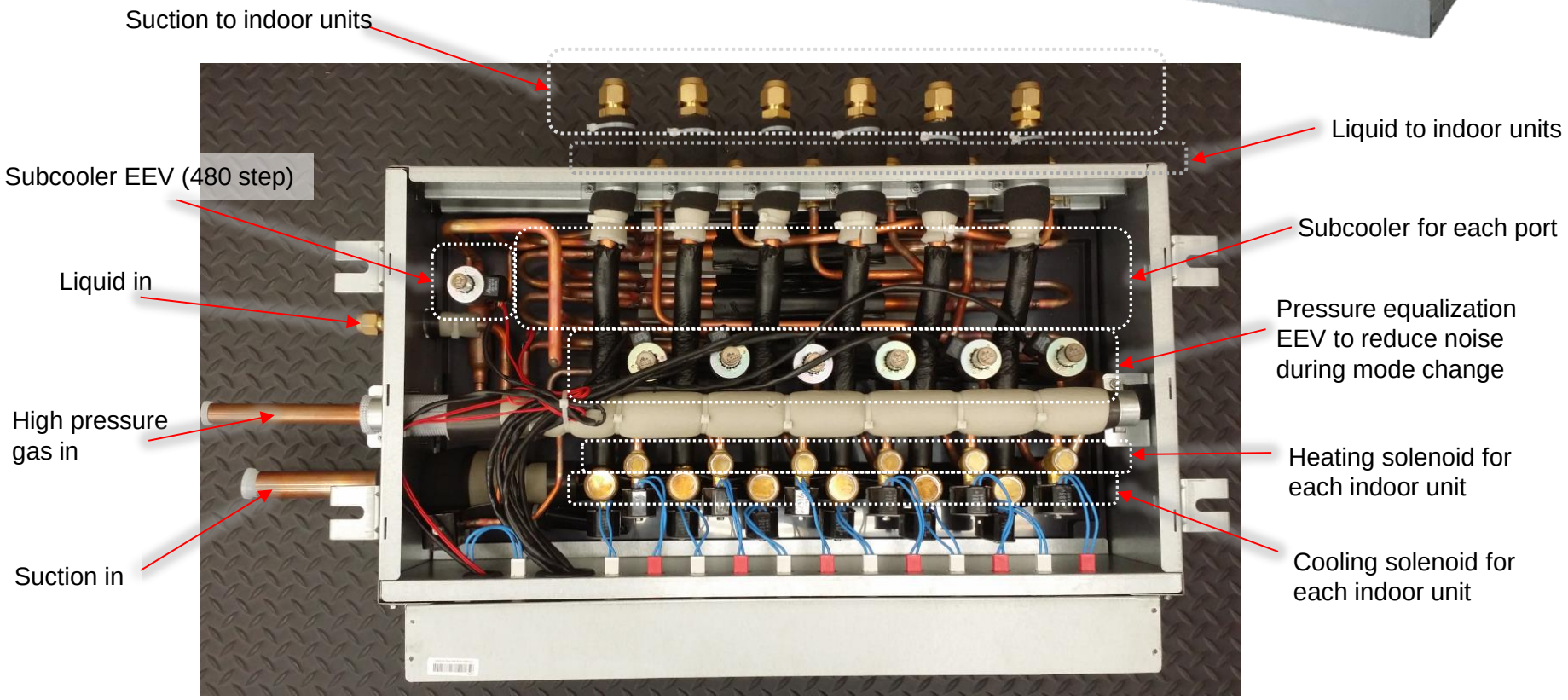
Heat Recovery MCU's



(Top view without cover)

- Mandatory for heat recovery systems.
- 3 pipes in from outdoor unit(s), 2 pipes out to indoor units.
- 2, 4, and 6 zone options (6 port pictured).
- MCU model details will be covered later in the presentation.

DVM S

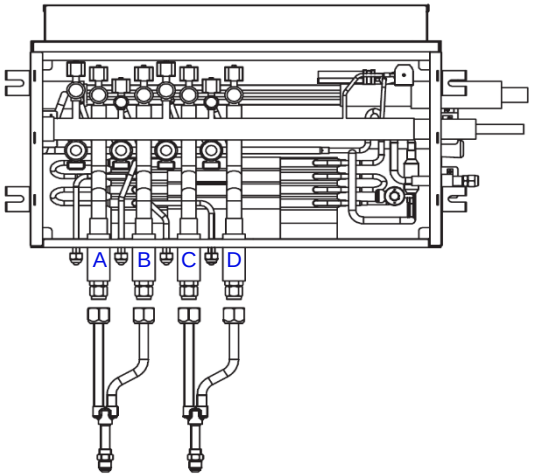
MCU connection of large indoor units

Additional fittings are included to connect 2 ports of the MCU to higher capacity units (≥ 36,000 Btu/h) with the MCU models listed below.

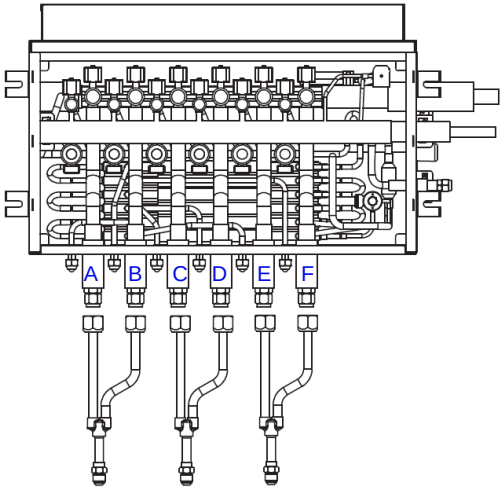
- MCU-S4NEE1N will include 2 X liquid and 2 X suction flare Y-joints
- MCU-S4NEE2N will include 2 X liquid and 2 X suction Y-joints
- MCU-S6NEE1N will include 3 X liquid and 3 X suction flare Y-joints

MCU-S2NEK1N will require part number DB97-19694A (not included) when connecting 1 indoor unit to 2 MCU ports that is over 48,000 Btu/h (48,000 Btu/h and smaller can connect to a single port).

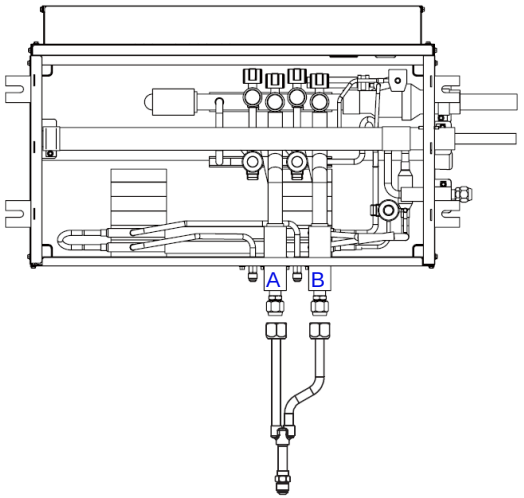
MCU-S4NEE1N, MCU-S4NEE2N



MCU-S6NEE1N



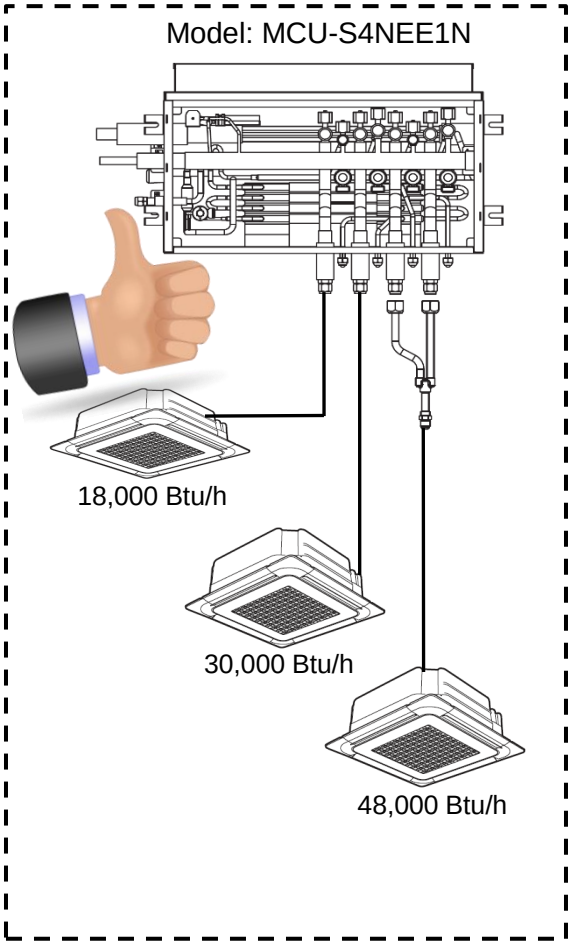
MCU-S2NEK1N

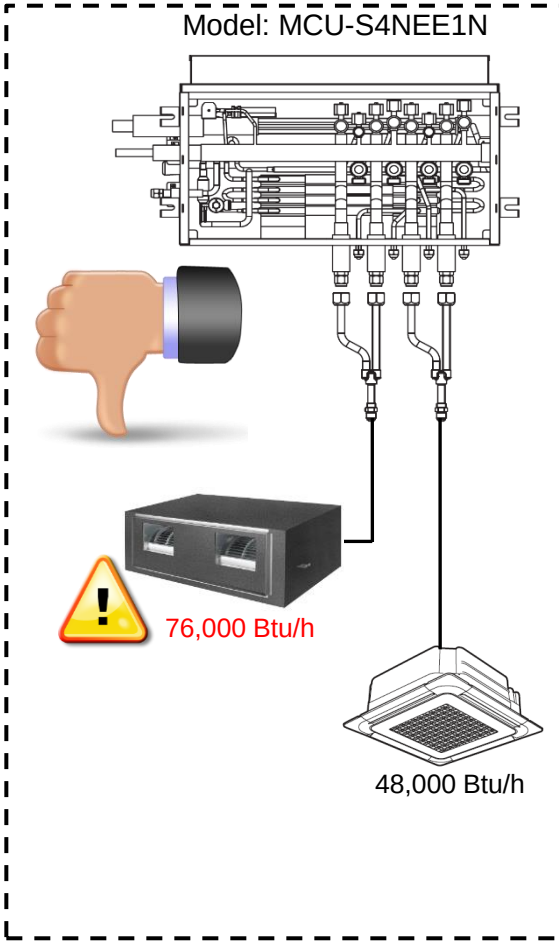


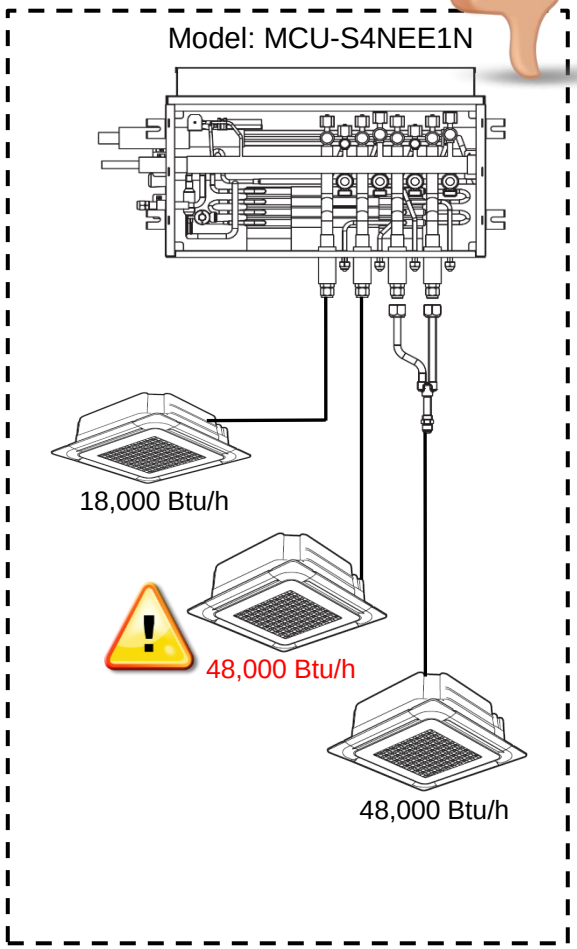
When twinning 2 ports together, the 2 sets of ports must be beside each other (ex: A&B)

DVM S

MCU-S4NEE1N connection examples



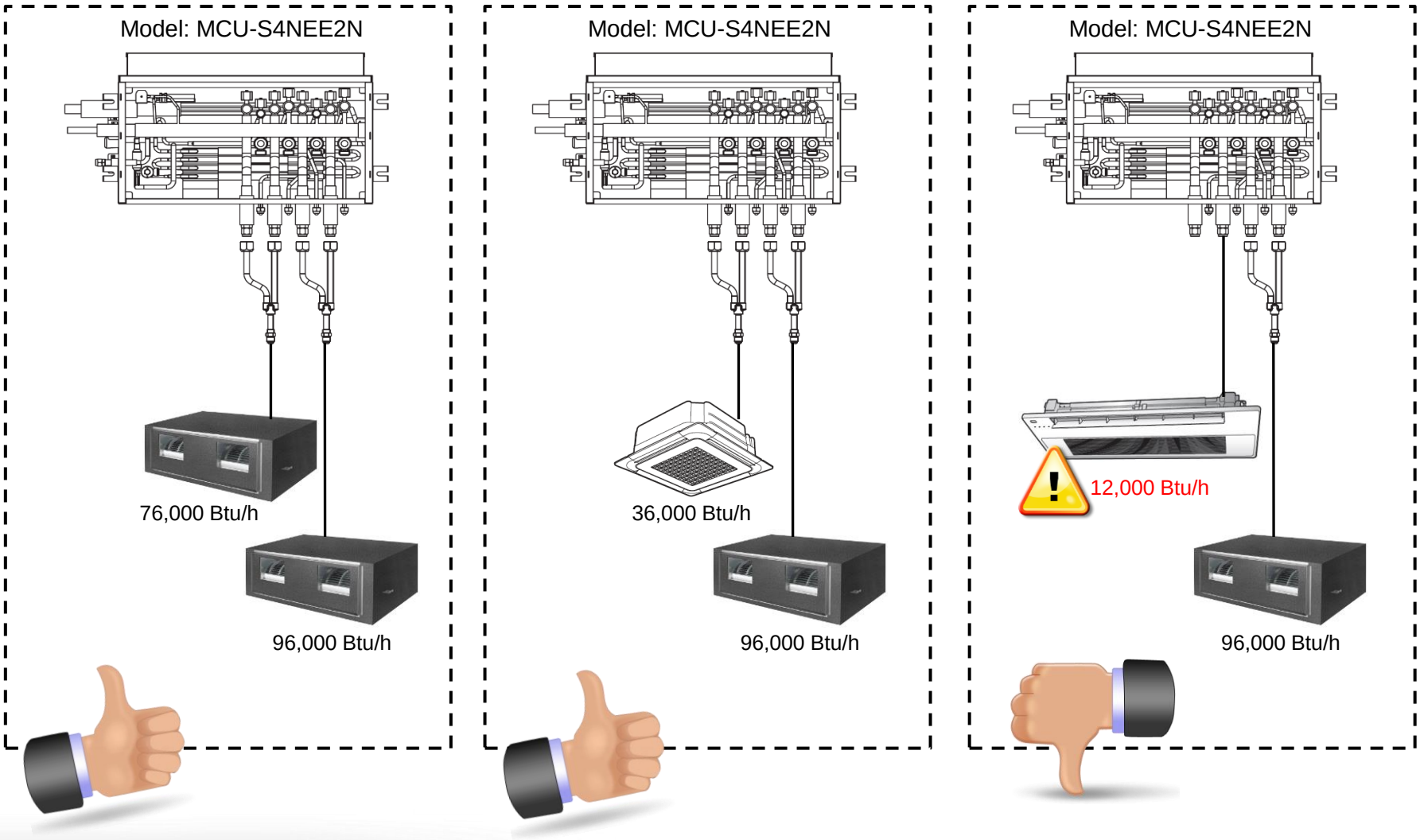




More details on following page

DVM S

MCU-S4NEE2N connection examples



DVM S Refrigerant Piping Limitations

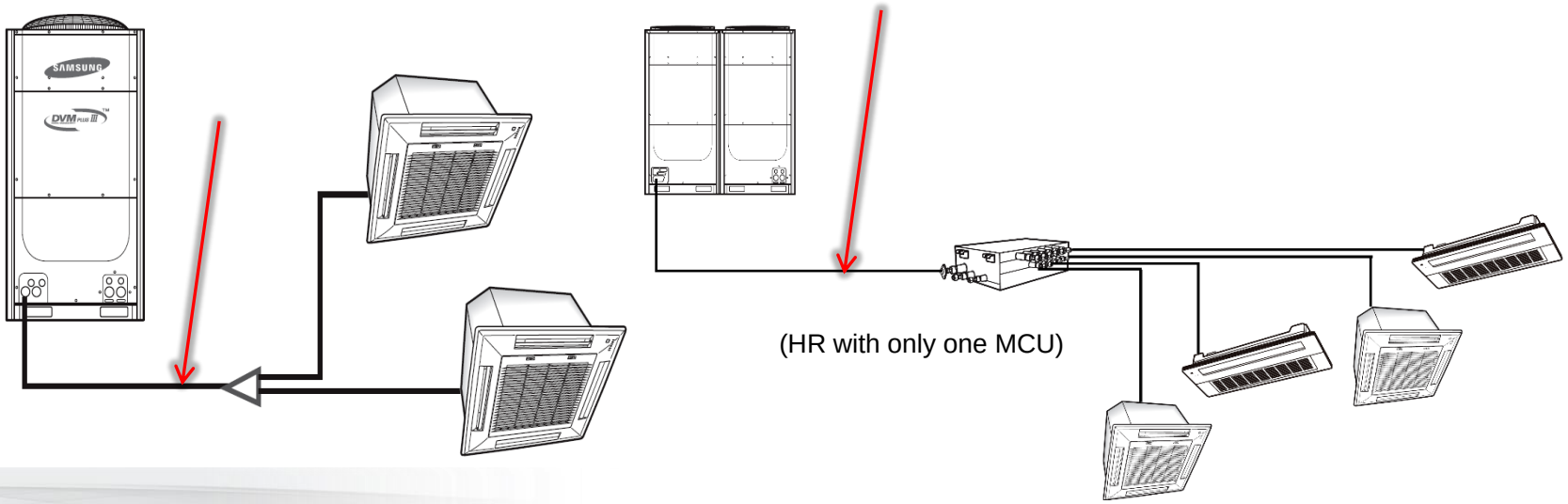
DVM S

"Main" Pipe

- When discussing pipe limitations, the term "main pipe" refers to the set of pipes that enter the building from the outdoor unit to the first Y-joint, EEV kit, or MCU (single MCU systems)

- Equivalent pipe length accounts for elbows in the liquid pipe.

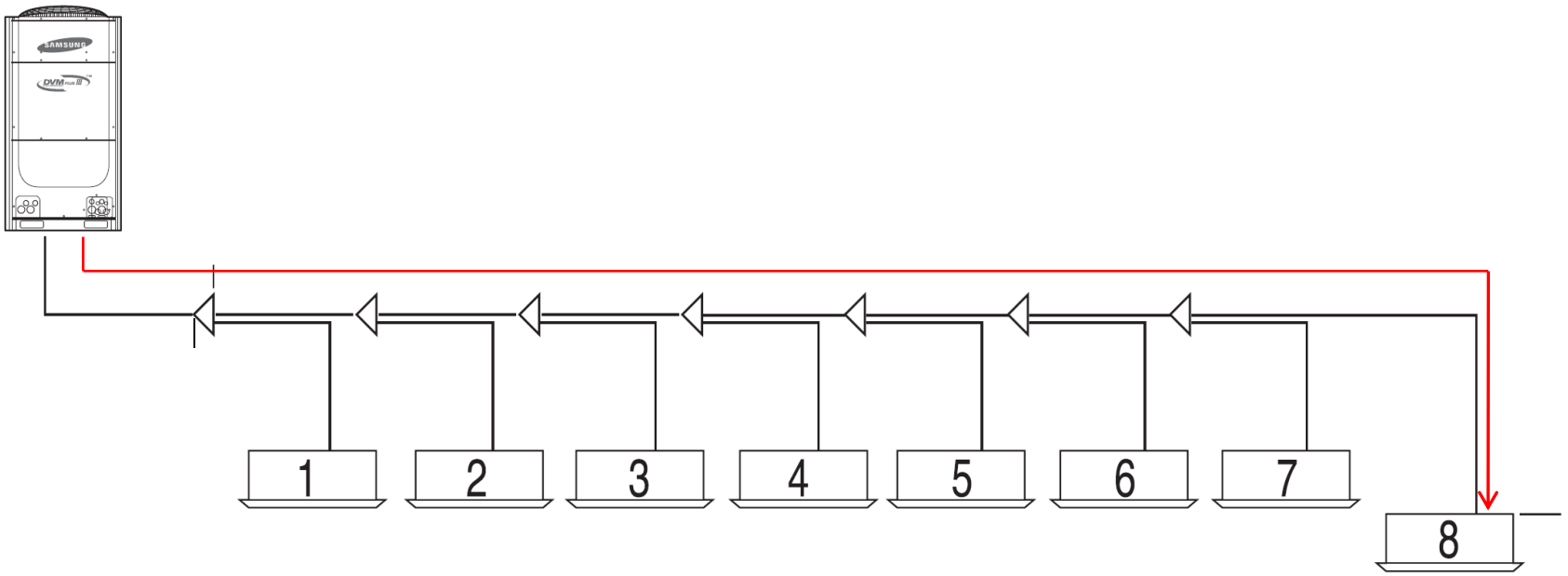
- Equivalent length of elbows for each pipe diameter will be discussed later in this course



DVM S

Maximum Piping Lengths

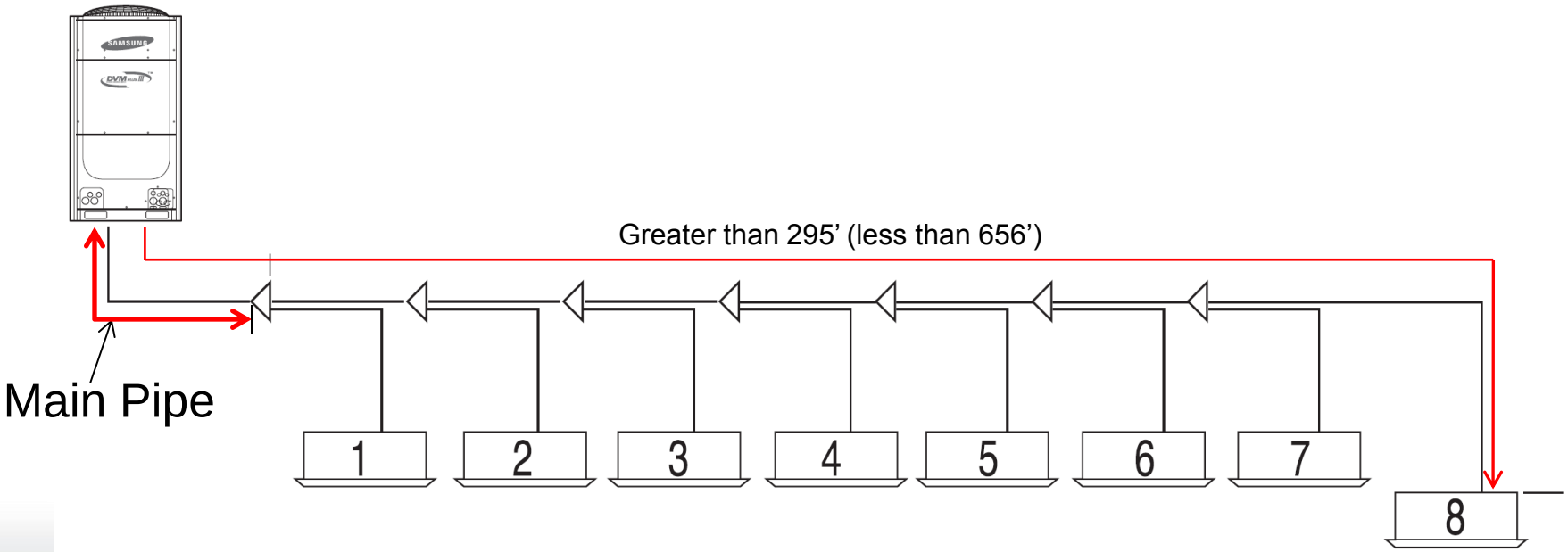
- Maximum 656’ actual, 722’ equivalent, from the outdoor unit(s) to the farthest indoor unit(s) (heat pump and heat recovery)



DVM S

Maximum Piping Lengths

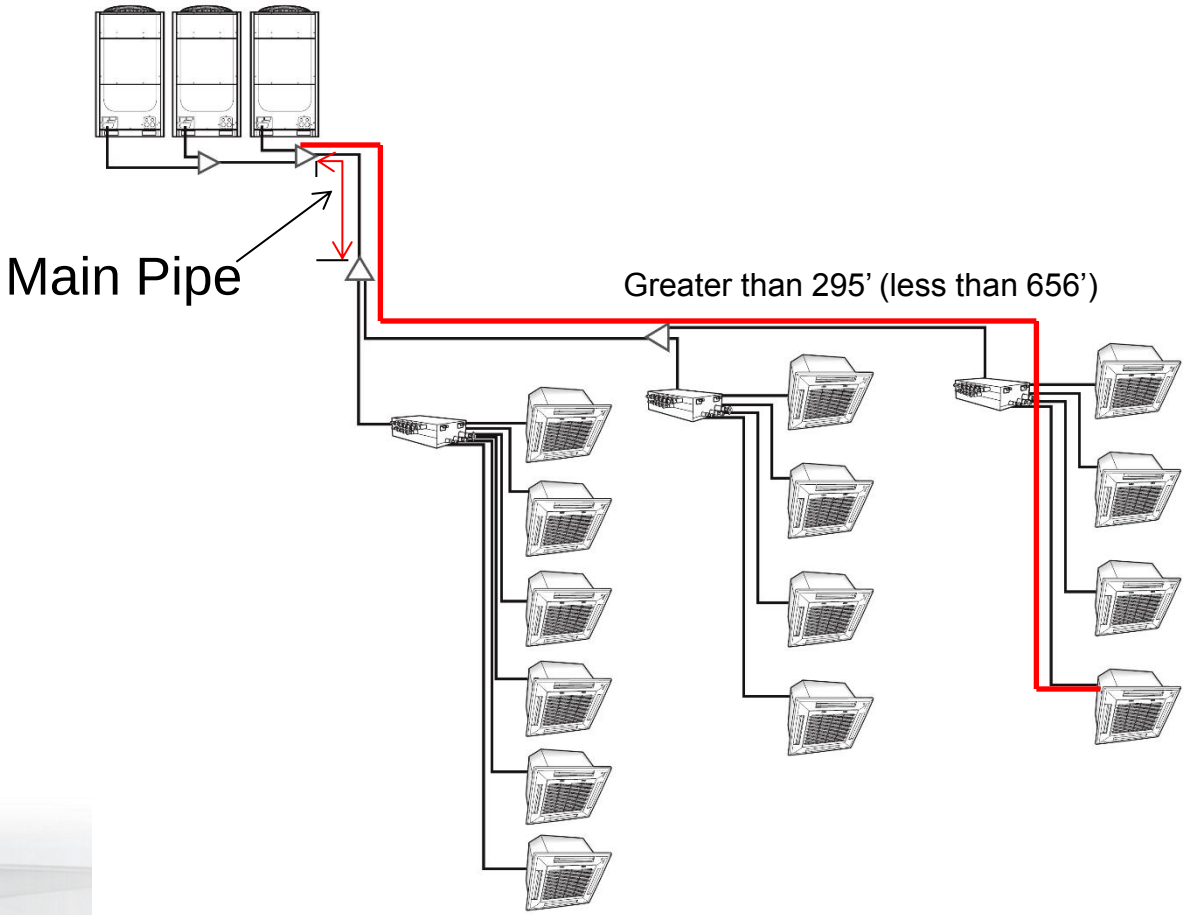
- For heat pump systems, if this distance from the outdoor unit(s) to the farthest indoor unit is over 295', increase the liquid and suction pipes one size for the "main pipe" section
- DVM Pro design software will do this for you automatically



DVM S

Maximum Piping Lengths

- For heat recovery systems, If this distance is from the outdoor unit(s) to the farthest indoor unit is over 295', increase the liquid pipe one size for the "main pipe" section
- DVM Pro design software will do this for you automatically

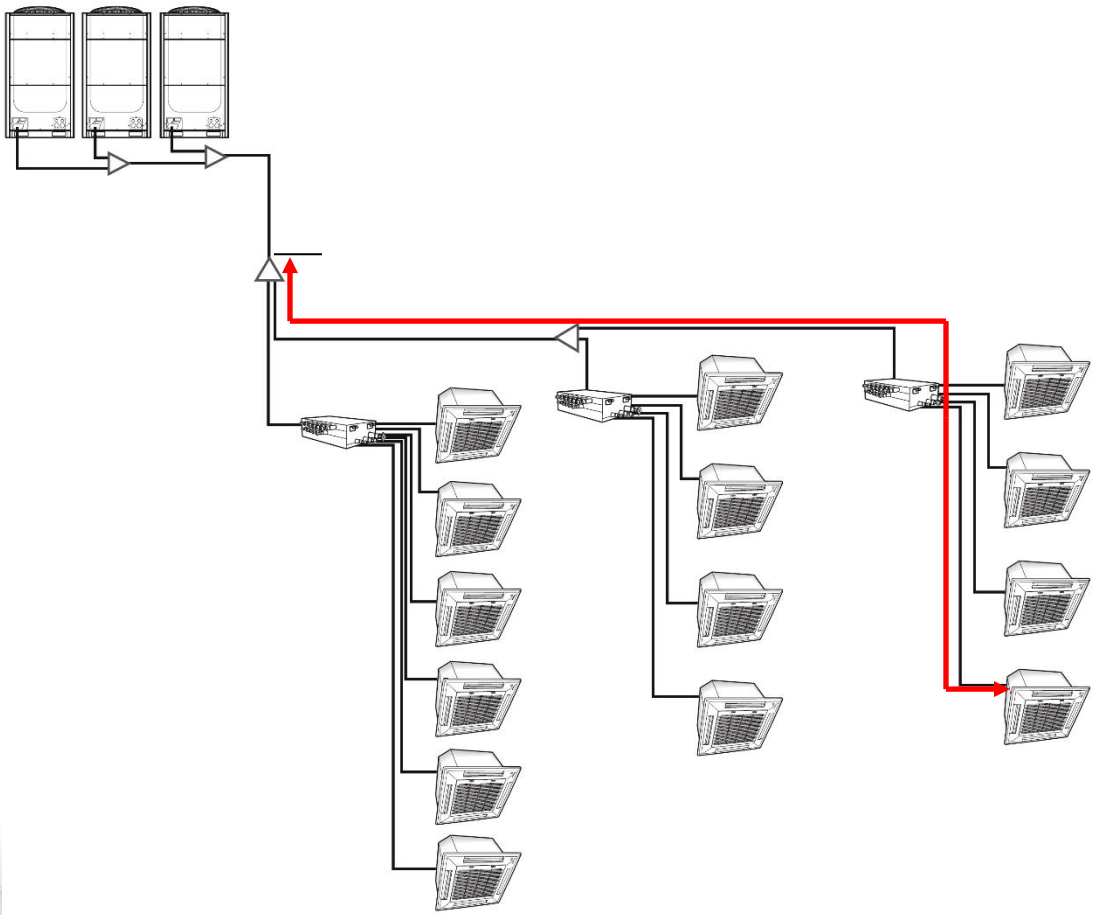


Explanation
on following page

DVM S

Maximum Piping Lengths

- For heat recovery systems, maximum 148’ from the first branch to the farthest indoor unit
- If this length is over 148’ while designing a system, consider putting the first branch joint further into the building



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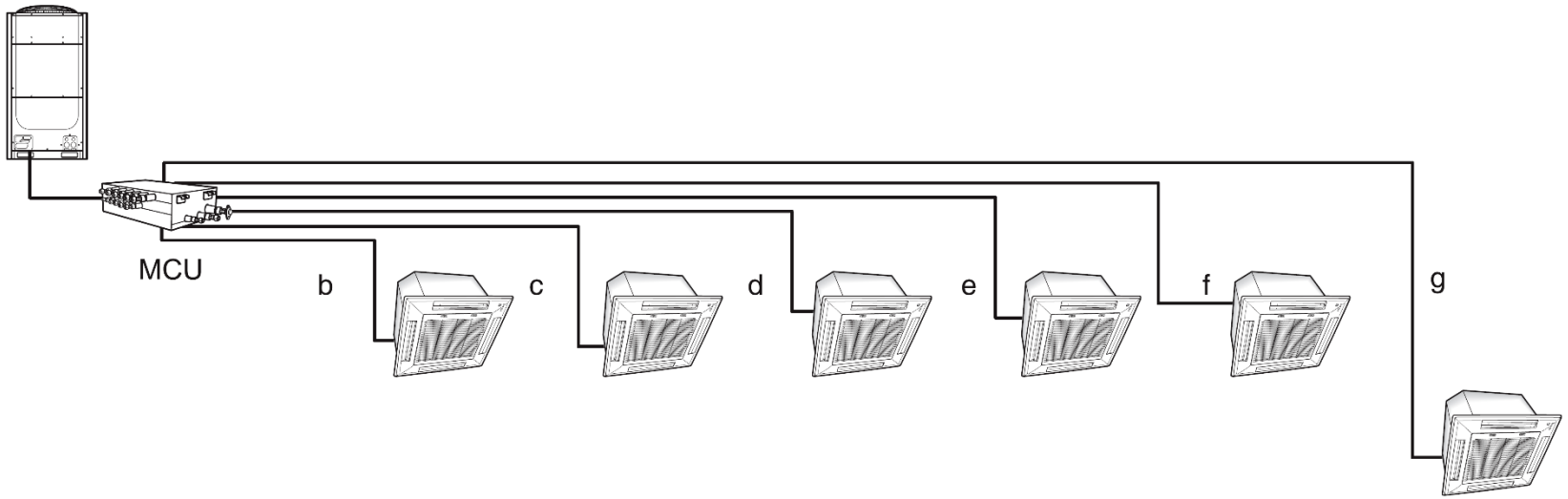
Maximum Piping Lengths (Heat Recovery, 1 MCU)

b, c, d, e, f, g ≤ 148’



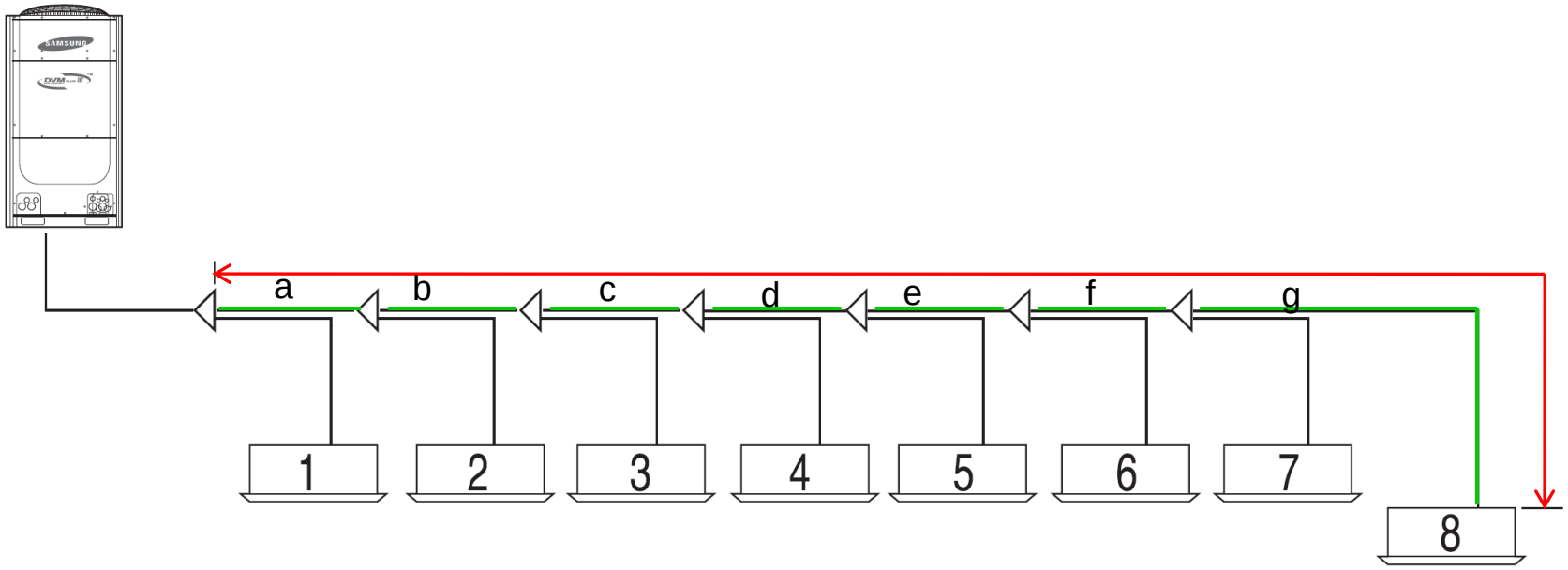
DVM S

Maximum Piping Lengths

- Maximum 295’ from the first Y-joint to the farthest indoor unit (heat pump systems)

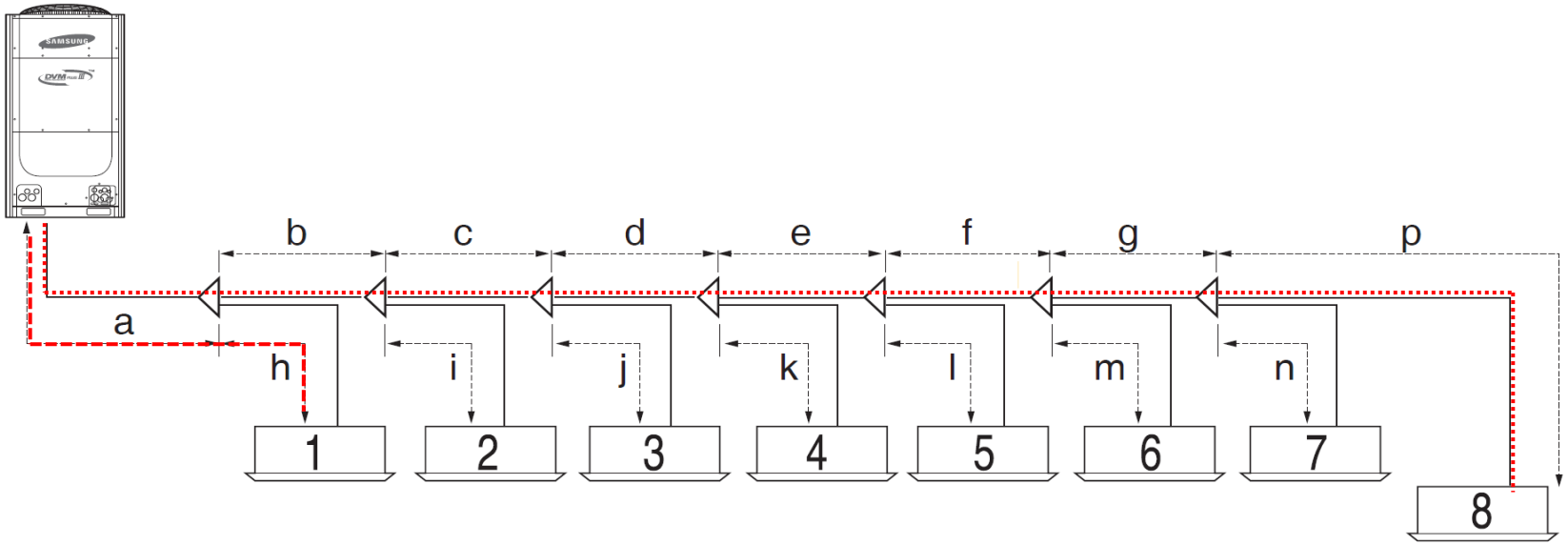
- If the distance from the first branch joint to the farthest indoor unit is ≥149’ increase the main branch liquid and suction pipes from the first branch joint throughout the system (sections: a,b,c,d,e,f,g below).

- DVM Pro design software will do this for you automatically



DVM S

Maximum Piping Length Between Indoor Units



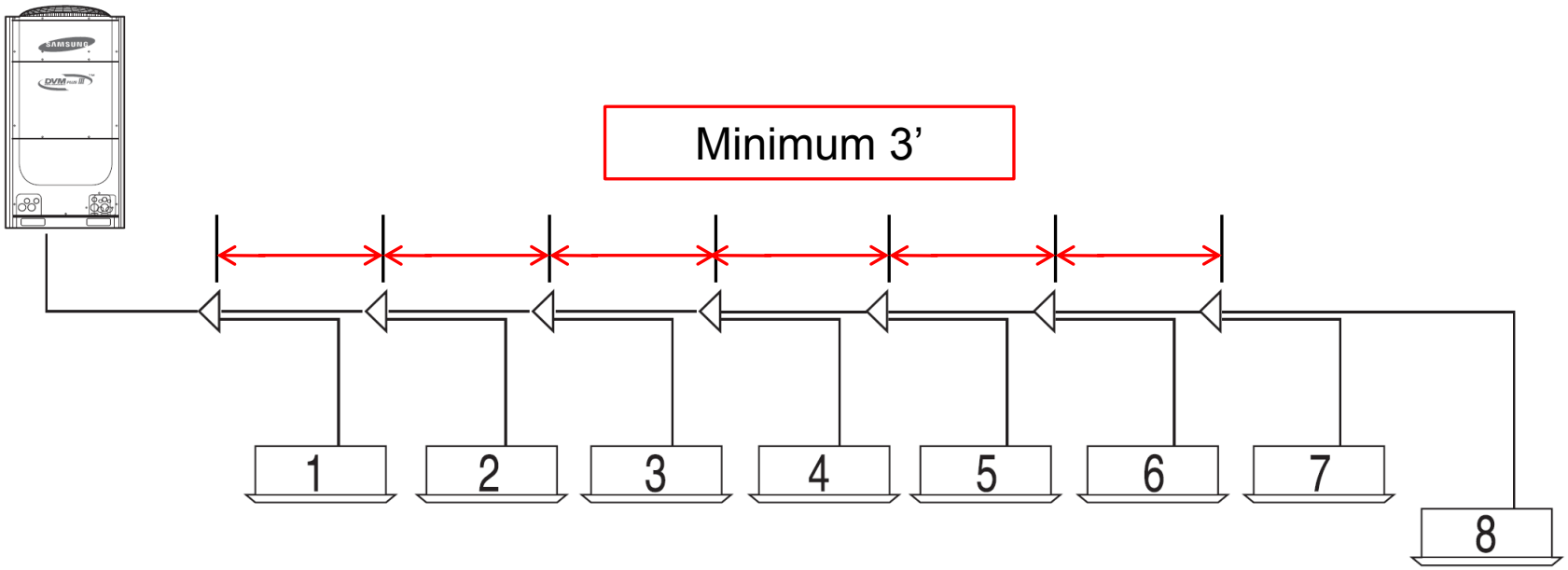
- (a+b+c+d+e+f+g+p) – (a+h) ≤ 148’
- Maximum 148’ from the closest to the farthest indoor unit
- Example from above: h+b+c+d+e+f+g+p ≤ 148’ if unit 1 is the closest to the outdoor unit and unit 8 is the farthest

DVM S

Maximum Piping Lengths

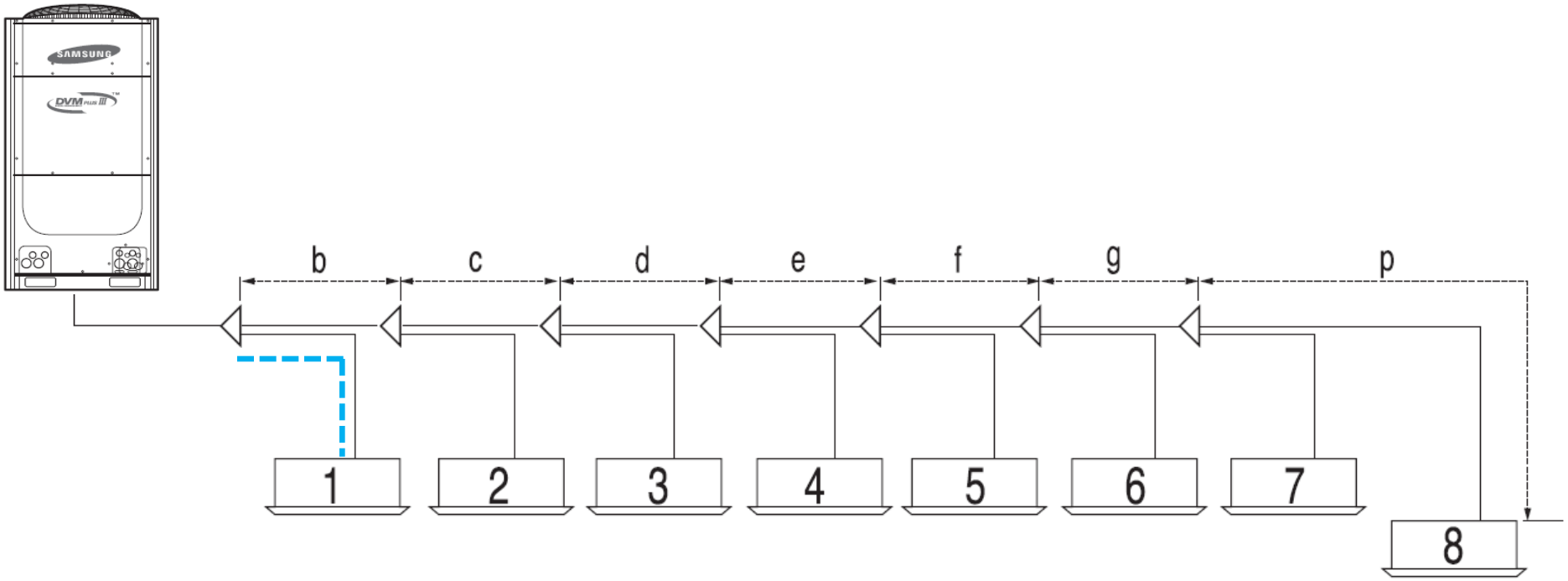
- Minimum 3’ between each Y-joint

- If Y-joints are too close noise and turbulence can occur creating noise and potential pipe damage



DVM S

Maximum Piping Lengths



- Maximum 149 feet from a Y-joint to an indoor unit ---------

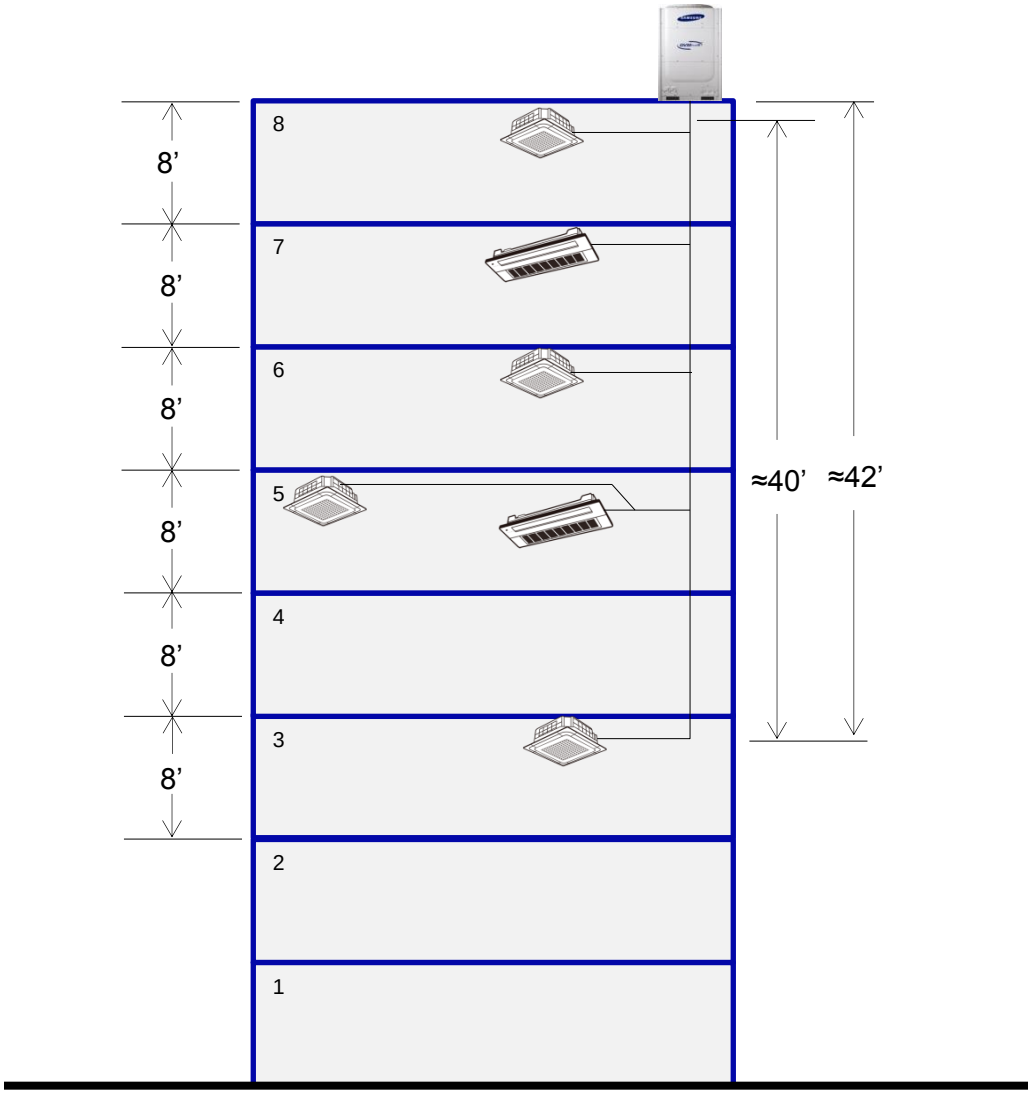
(as long as no other restriction has been exceeded)

DVM S

Maximum Piping Lengths – Vertical Separation

- Vertical separation refers to the vertical distance between 2 units
- When looking at vertical separation restrictions horizontal pipe lengths are not considered, just installed height differences

Example:
- 8 story building
- 8’ floors



DVM S

Maximum Piping Lengths – Heat Pump Vertical Separation

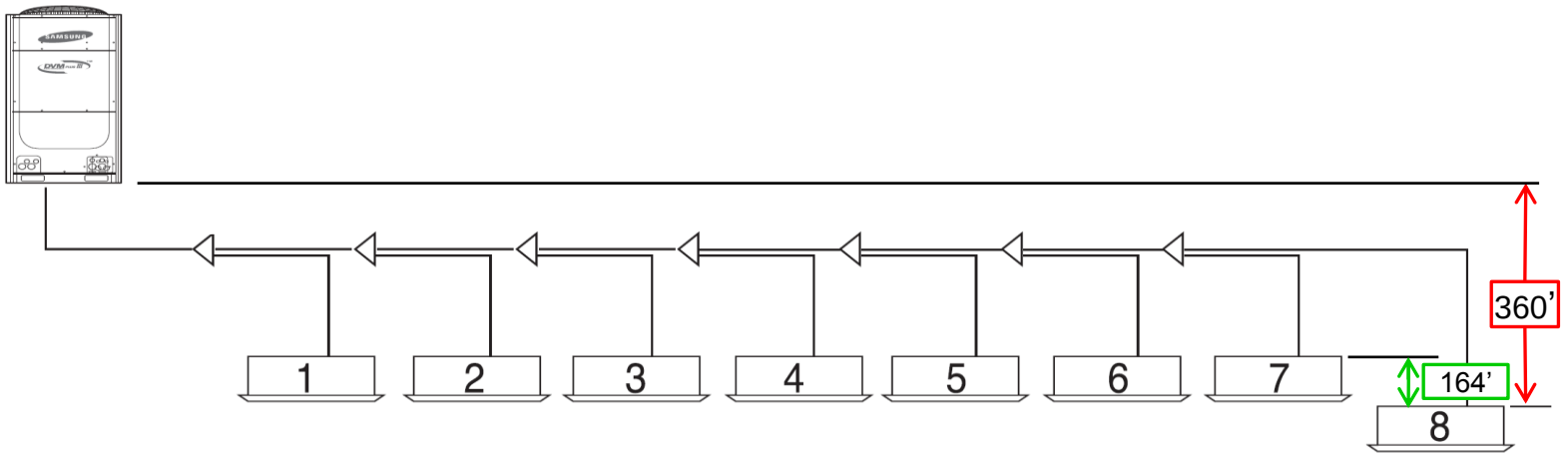
Standard maximum height difference from outdoor unit to lowest indoor unit:

- When condenser is above indoor units (ex: rooftop): 164’
- When condenser is below indoor units (ex: ground level): 131’

Maximum height difference from outdoor unit to lowest indoor unit with pipe modification:

- When condenser is above indoor units (ex: rooftop): 360’

Maximum height difference between indoor units: 164’ (exceptions exist, explained on next page)



- If vertical separation is ≥ 164’ but ≤ 360, contact Quietside for modified pipe design with PDM kit. (Pressure Drop Modulation)
- When vertical separation is >295 a PDM kit is required. Use Samsung’s DVM E-Solution software to select PDM kit

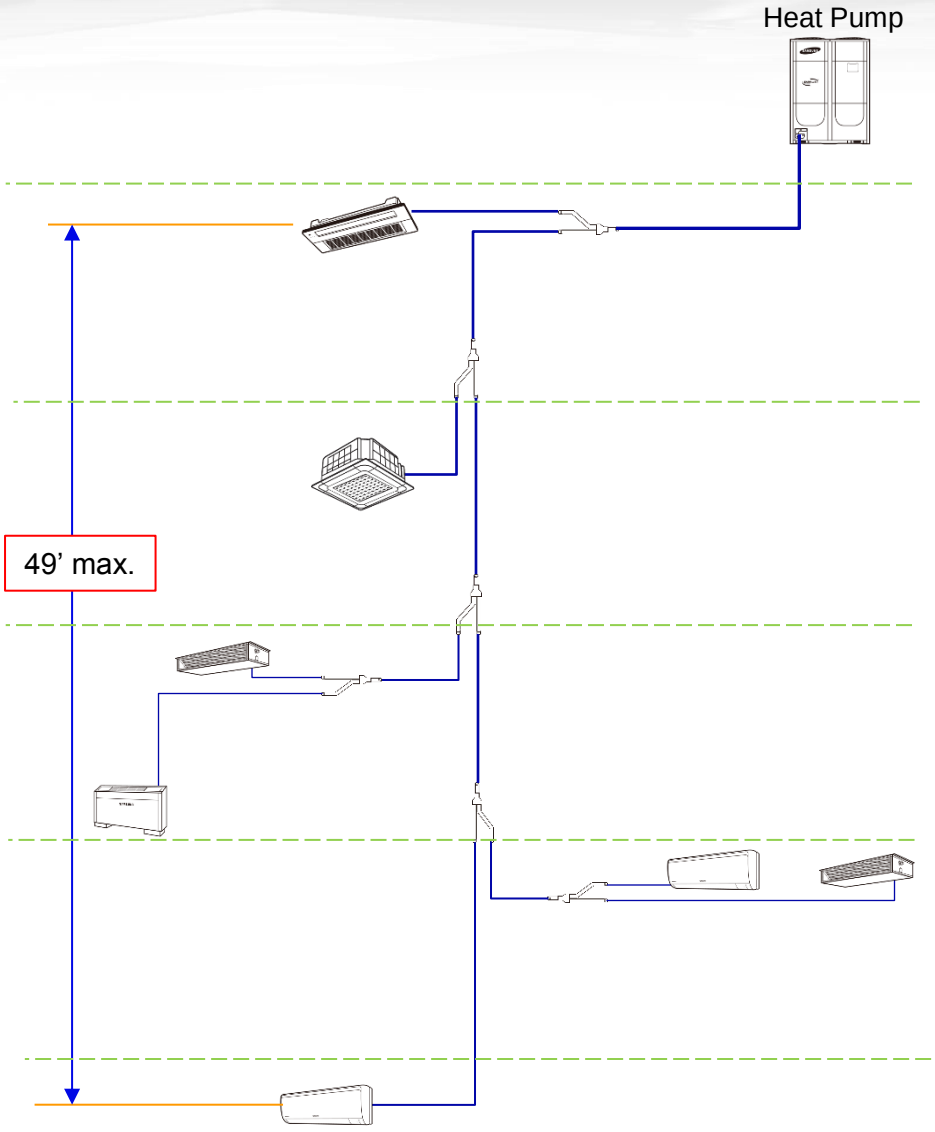
DVM S

Vertical Separation Exception

AM0**HNQDCH/AA

- If Neo Forte indoor units with internal EEV are installed (AM0**HNQDCH/AA), maximum vertical separation between the highest indoor unit and lowest indoor unit = 49’.

- This exception exists to prevent refrigerant noise from the internal EEV since it is not concealed/recessed into the ceiling like cassette and duct unit EEV’s.



DVM S

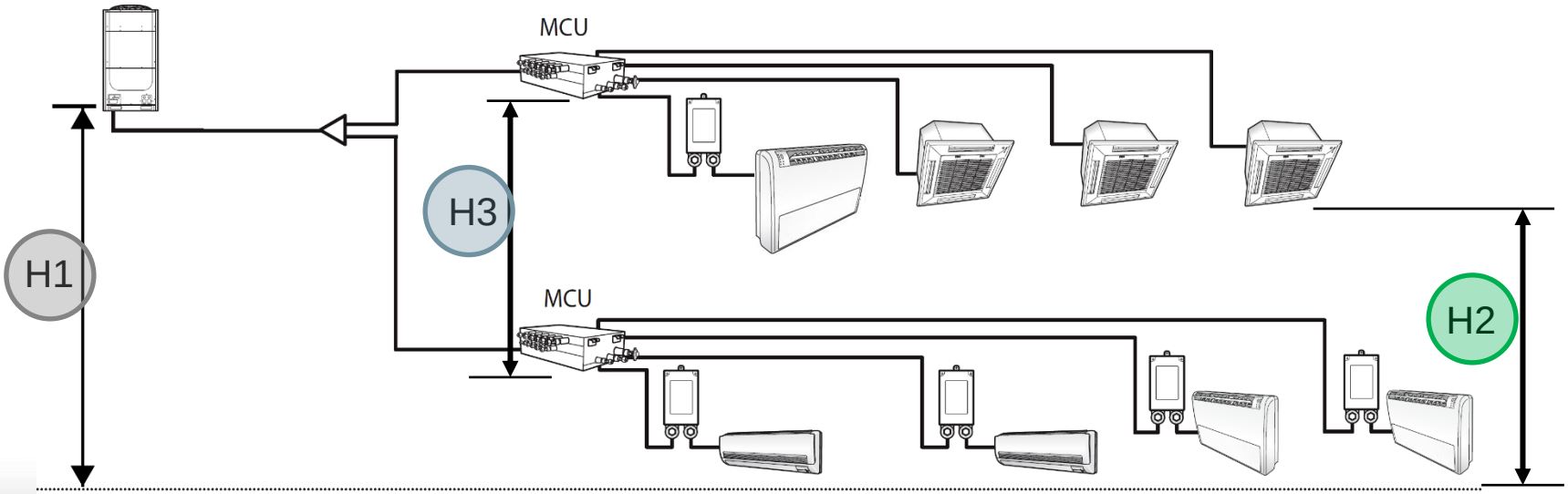
Maximum Piping Lengths – Heat Recovery Vertical Separation

Maximum height difference from outdoor unit to lowest indoor unit (H1):

- When condenser is above indoor units (ex: rooftop): 164’ (standard), 360’ with PDM kit
- When condenser is below indoor units (ex: ground level): 131’

Maximum height difference between indoor units (H2): 49’

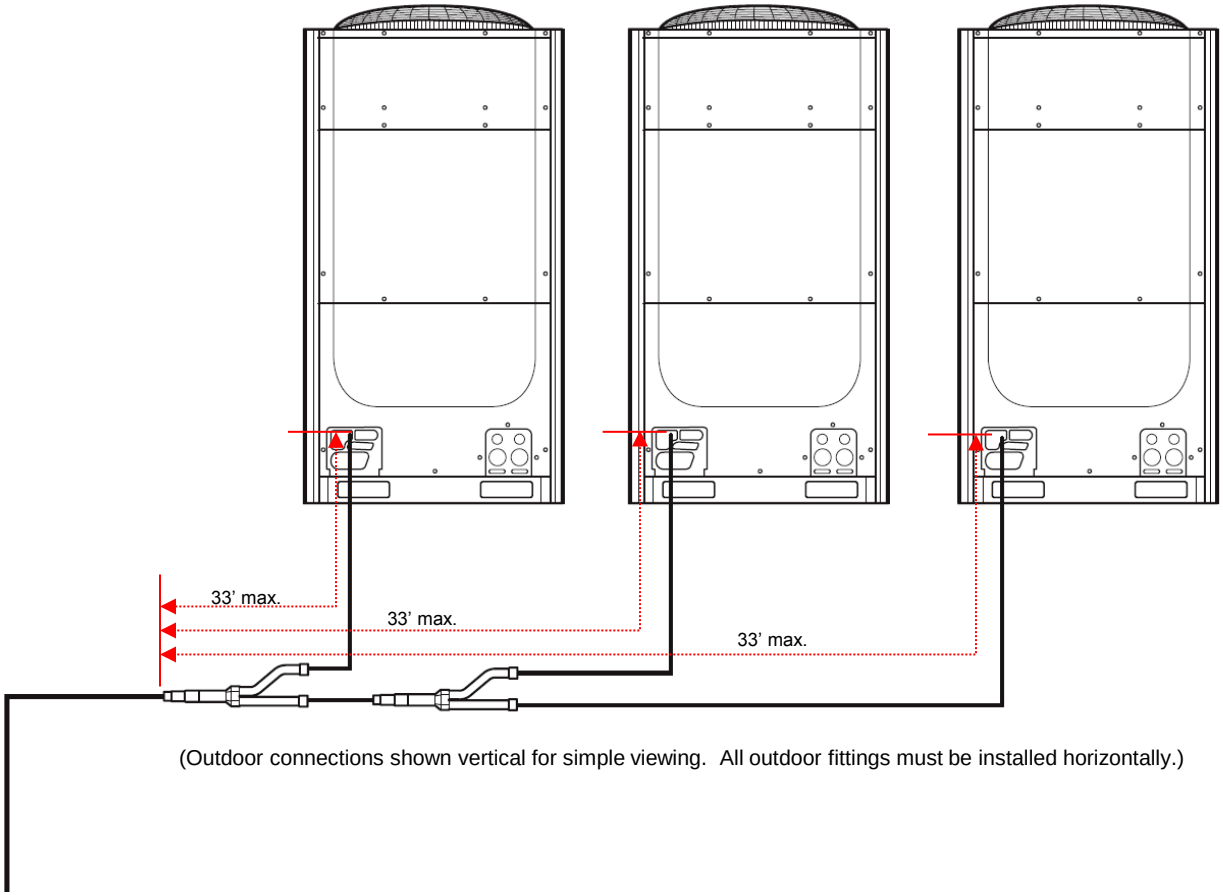
Maximum height difference between MCU’s (H3): 49’



- If vertical separation is ≥ 164’ but ≤ 360, contact Quietside for modified pipe design with PDM kit.
- When vertical separation is >295 a PDM kit is required. Use Samsung’s DVM E-Solution software to select PDM kit

DVM S

Maximum Piping Lengths - Between Outdoor Modules



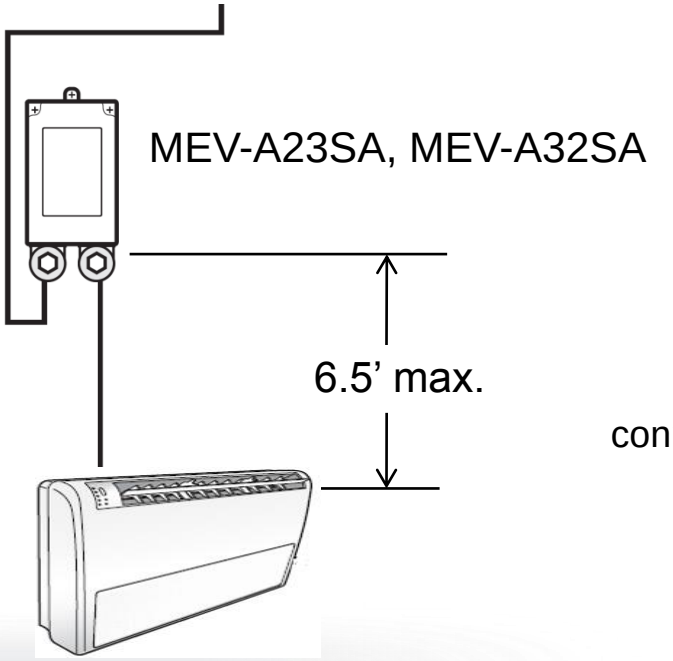
(Outdoor connections shown vertical for simple viewing. All outdoor fittings must be installed horizontally.)

- r, s, t ≤ 33' actual length (43' equivalent) from the first Tee to each outdoor module
- Outdoor units must have **no** vertical separation between modules

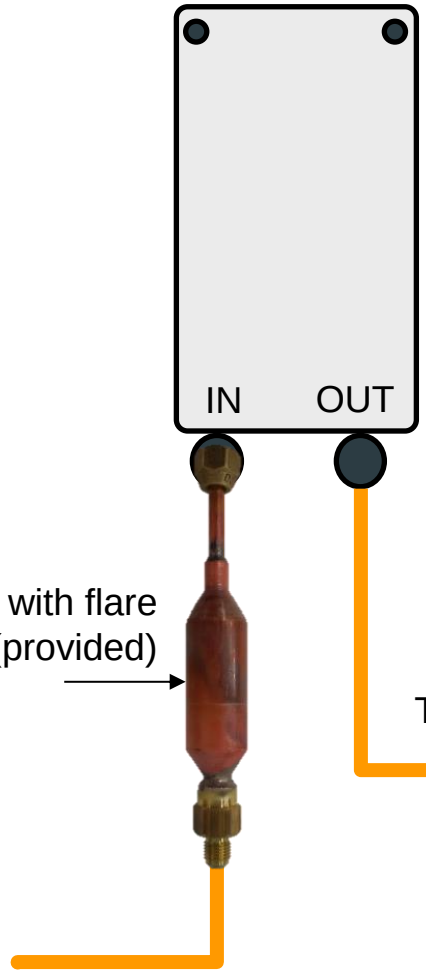
DVM S

Maximum Piping Lengths

- Maximum pipe length between single unit and EEV: ≤6.5’
- Must install vertical as pictured on this page
- Install included strainer on the inlet side
- Never extend interconnect wire



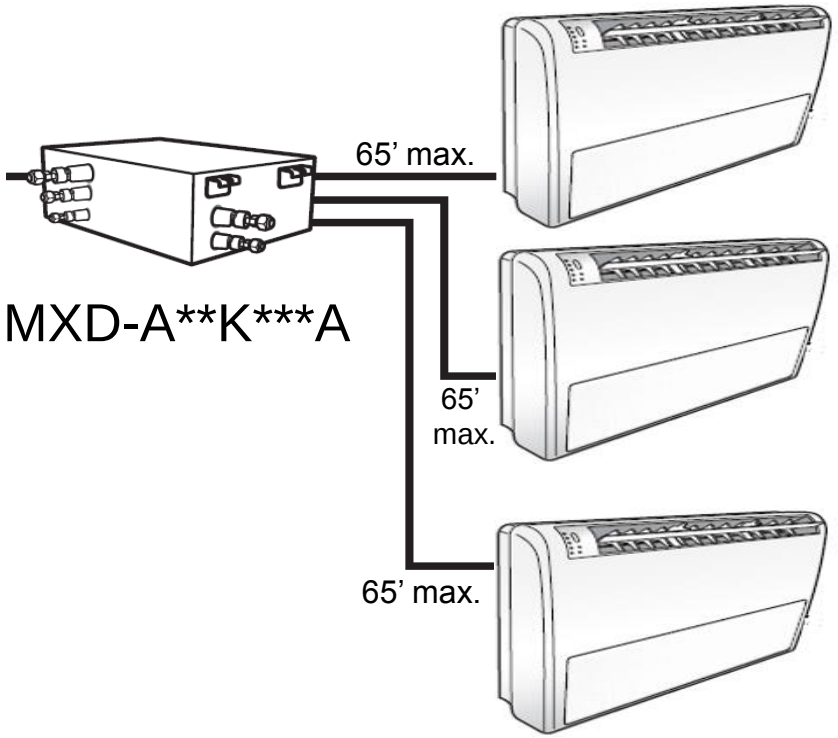
Included strainer



DVM S

Maximum Piping Lengths

- Maximum pipe length between multi unit EEV kit and indoor unit: ≤ 65’ **each**
- MXD EEV kits are for heat pump systems only



DVM S

Piping Equivalent Lengths

- Below are values that Samsung uses for equivalent pipe lengths for an elbow
- Each liquid pipe diameter will have a different equivalent pipe length value

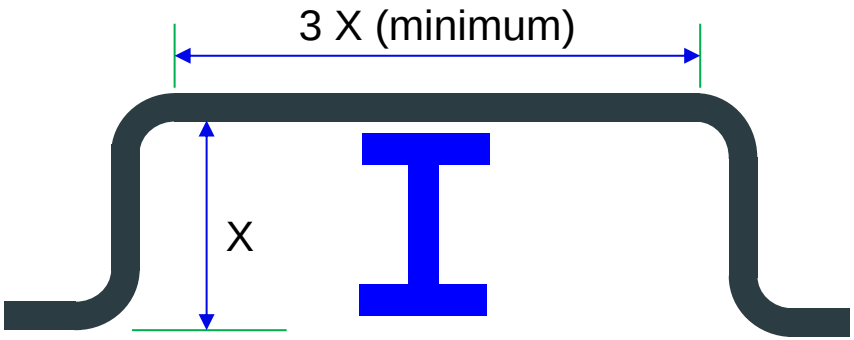
Pipe Size (ø O.D.)	Equivalent length (feet)
3/8”	0.59
1/2”	0.66
5/8”	0.82
3/4”	1.15
7/8”	1.31
1 1/8”	1.64
1 1/4”	1.80
Y-Joint	1.64
Header Joint	3.28

Long radius elbows only

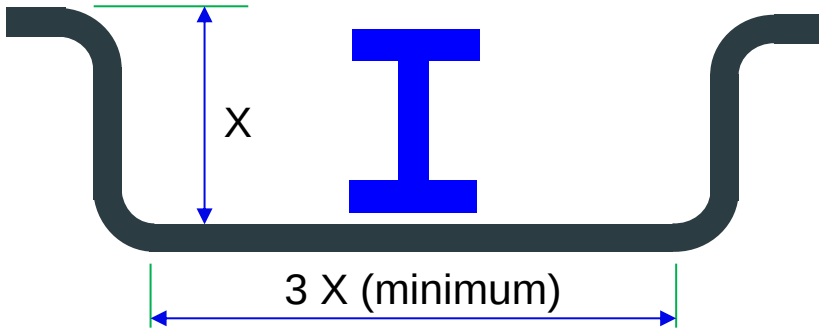
DVM S

Piping Around Obstacles

- When an obstacle, such as an I-beam or concrete T, is in the path of the planned refrigerant pipe run, it is best practice to route the pipe over the obstacle.
- If adequate space is not available to route the insulated pipe over the obstacle, then route the pipe under the obstacle.
- In either case, it is imperative the length of the horizontal section of pipe above or below the obstacle be a minimum of three (3) times the longest vertical rise (or fall) at either end of the segment.



Over obstacle



Under obstacle

Refrigerant Pipe Installation

DVM S

Pipe Installation Tools and Steps

Ensure that quality, proper tools are available during installation

- Manifold Set (dedicated for R410A)
- 1/4” to 5/16” service hose adapter
- Flaring Tool (45º Flare)
- Tubing Cutter
- De-burring Tool
- Micron Gauge
- Torque Wrench Set W/Backup Wrenches
- Vacuum Pump
- Check Valve (For Vacuum Pump)
- Torch Set
- Nitrogen and Regulator
- Nitrogen Flowmeter
- Micro Leads
- Hand Tools
- Refrigerant oil (POE oil)
- Electronic scale

DVM S

Pipe type

- “Soft” copper can be used for pipe sizes up to 5/8”
- Pipe connections at most indoor units does not exceed 5/8”, this allows for flare connections (HSP 6 and 8 ton units have larger suction ports that requires brazing).
- 3/4” and above must be hard-drawn, rigid pipe

Pipe Size (ø O.D.)	Pipe Thickness (inches)	Material
1/4”	0.027	C1220T-O (annealed)
3/8”		
1/2”	0.031	
5/8”	0.039	
3/4”	0.035	C120T-1/2H (drawn temper, hard-drawn)
7/8”		
1 1/8”	0.043	
1 1/4”		
1 3/8”	0.047	
1 1/2”	0.053	
1 3/4”	0.062	
2”	0.079	

DVM S

Refrigerant Piping

- Remove copper burrs after cutting pipe with de-burring tool (especially before flaring of pipe).
- Make sure to point the pipe downward to prevent entry of removed copper.




DVM S

Refrigerant Piping

- Prevent entry of foreign substances by capping and/or taping the ends of refrigerant pipes

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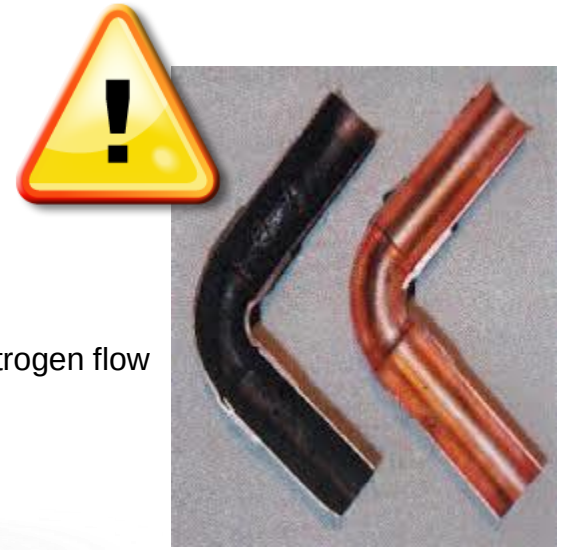
Refrigerant Piping

- To prevent buildup of non-condensable substances in the refrigerant pipes, low flow, dry nitrogen must be used during brazing of copper connections
- This displaces oxygen and prevents oxides from forming
- Failure to use nitrogen while brazing will cause accumulation of oxides at the compressor, various strainers, and expansion valves impacting performance and causing premature failure



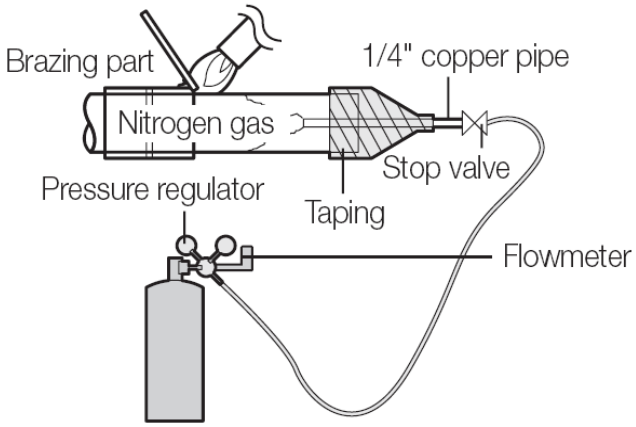
Without nitrogen flow

With nitrogen flow

DVM S

Refrigerant Piping

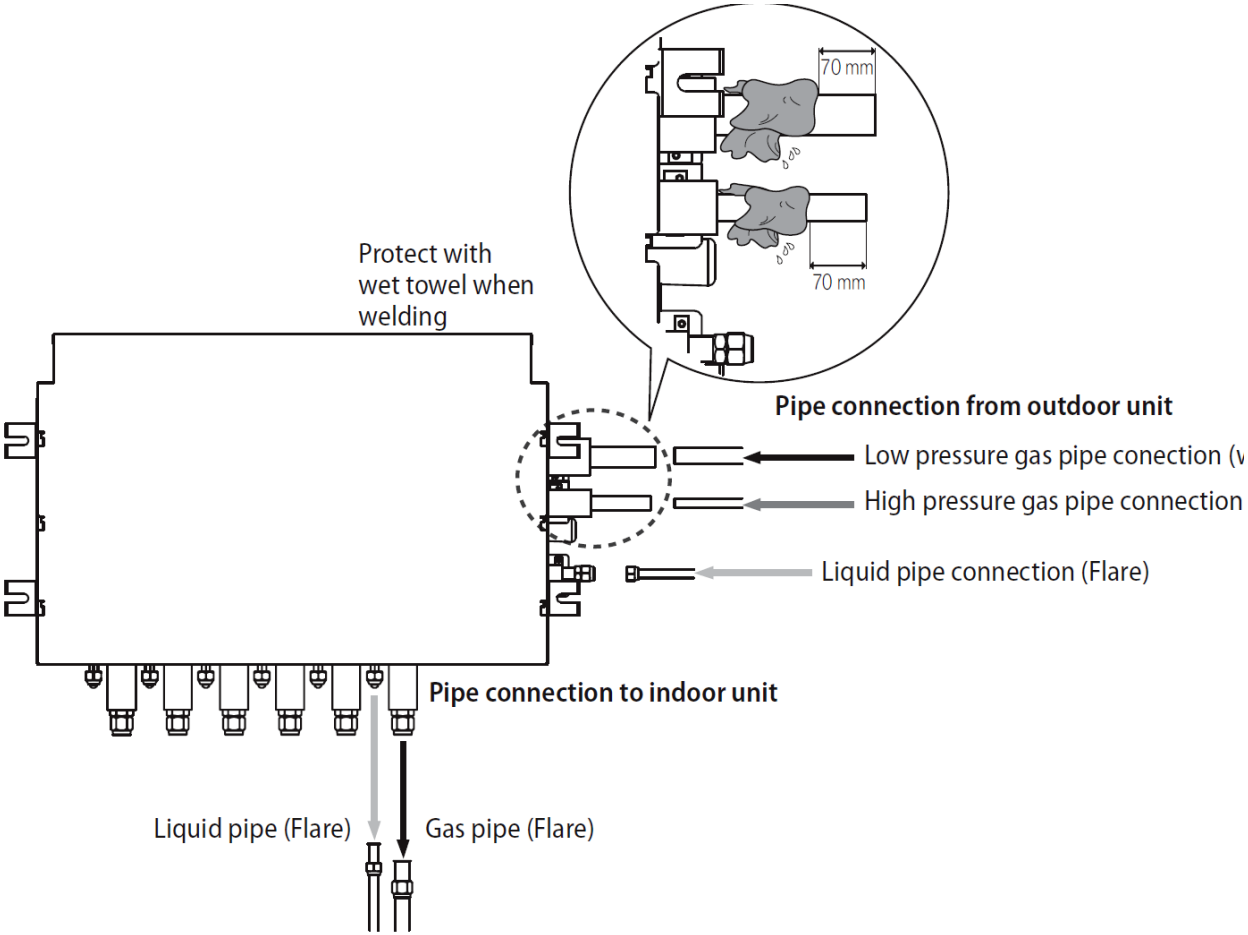
- Connect a nitrogen tank near the point that will be brazed
- Using a flow regulator, maintain 1.76 ft³/hr (≈ 2 – 3 PSI) of dry nitrogen
- If you are having difficulty maintaining this, partially cover the end of the pipe with tape to maintain pressure.
- If flow is too low, this will not effectively prevent oxide formation
- If flow is too high, it will be difficult to make a quality brazed connection
- Maintain flow after brazing is complete until pipe is no longer hot



DVM S

MCU's (HR Only)

- MCU refrigerant connections are flare and braze type
- Take precautions to prevent MCU damage by overheating



DVM S

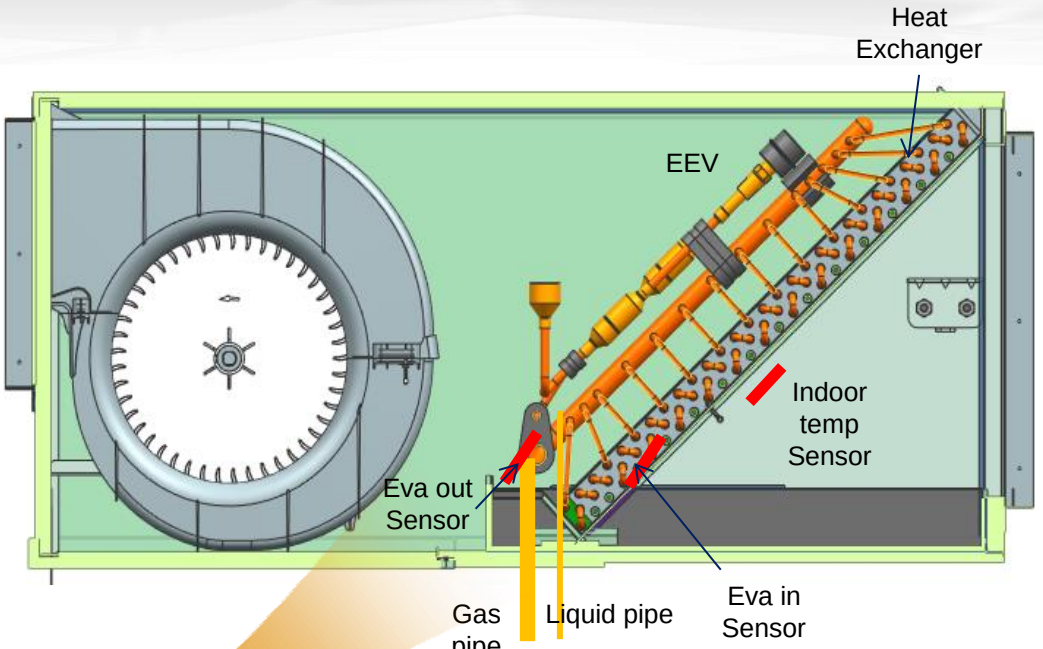
Refrigerant Piping

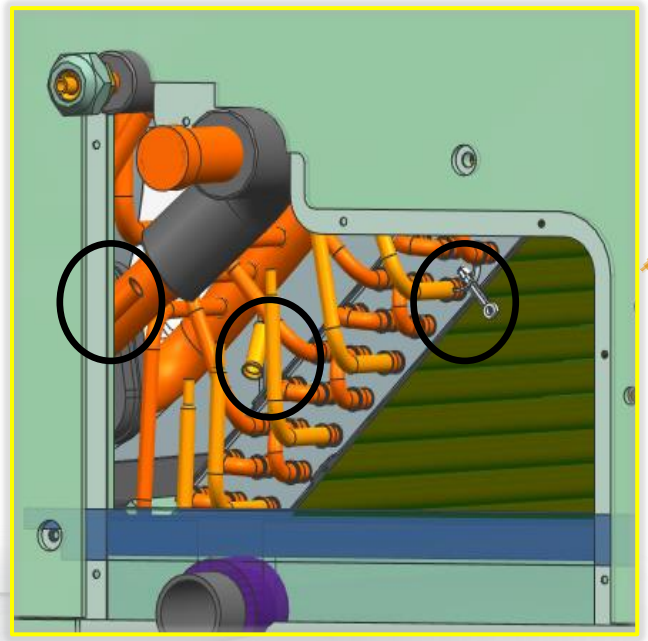
- Larger HSP units (AM072FNHDCH/AA and AM096FNHDCH/AA) have a flare fitting on the liquid line connection
- The suction line must be brazed
- The unit ships with a copper cap that needs to be removed with a torch
- REMOVE THE LIQUID SIDE FITTING BEFORE SWEATING OFF THE SUCTION LINE CAP
- Failure to do this first can cause injury.

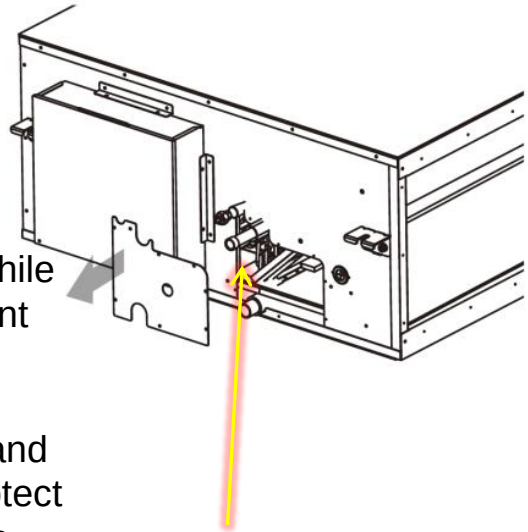
DVM S

Refrigerant Piping

- While brazing the suction line, take care not to overheat the pipe or allow a flame to enter the cabinet
- There are sensors right behind the cabinet door that are easily damaged







- Removal of the EVA out sensor while brazing is recommended to prevent damage
- Use of heat dissipating products and wet cloths is recommended to protect the cabinet and other components

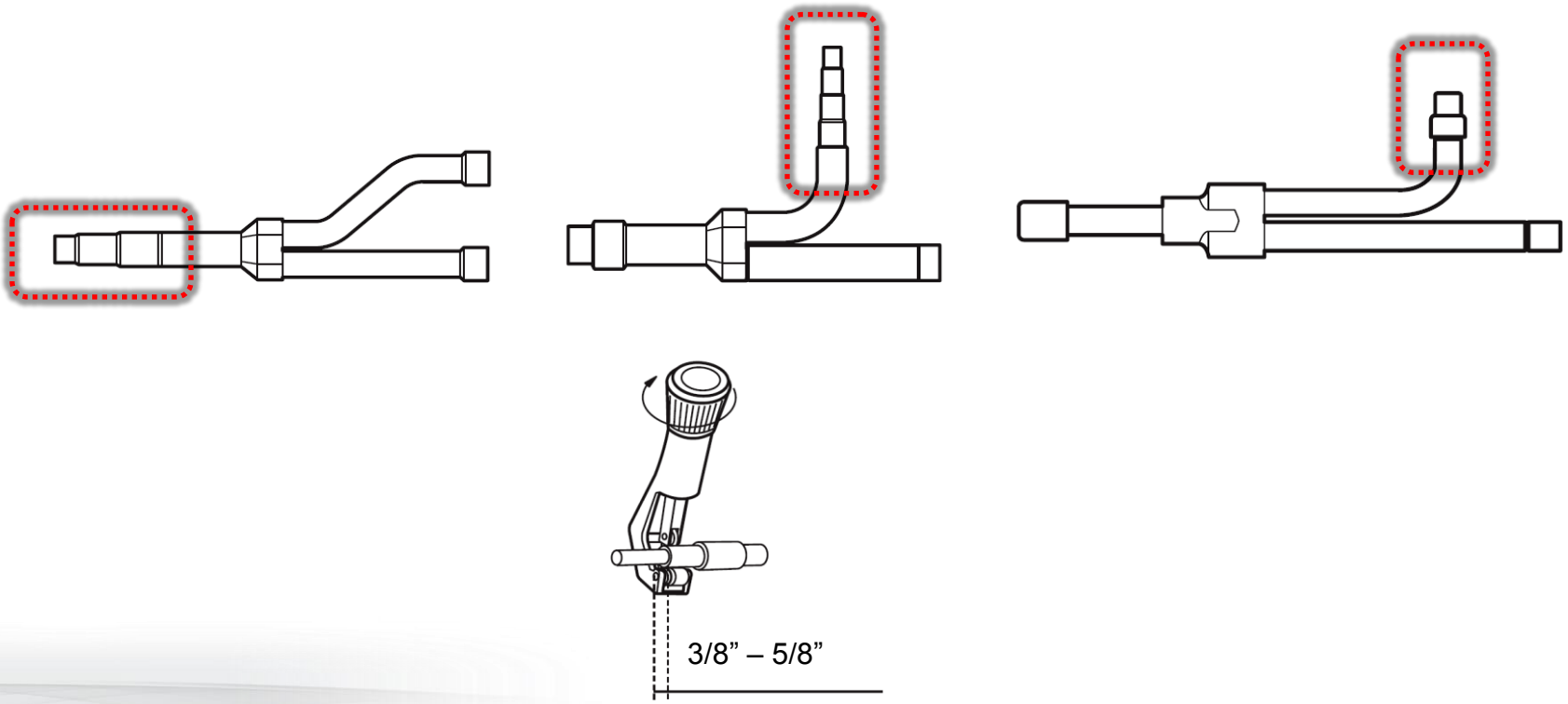
DVM S

Tee and “Y” Installation

DVM S

Outdoor Joint (HP and HR)

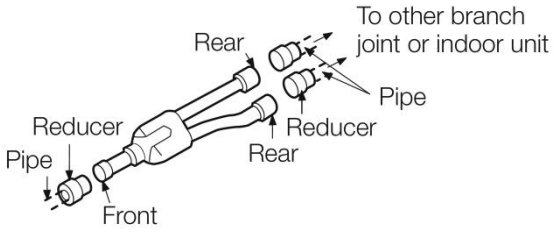
- Some fittings have adjustable ends to facilitate easy field installation of multiple pipe sizes with a single Y-joint



DVM S

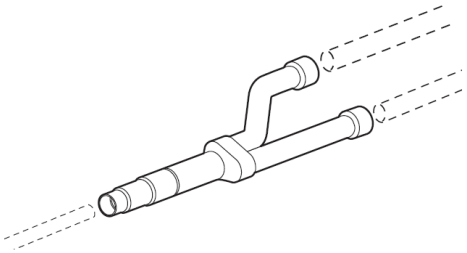
Y Joint Installation

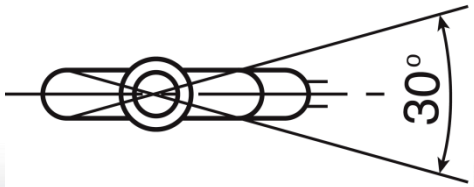
- Samsung Y-Joint fittings will include necessary reducers to connect to various pipe sizes

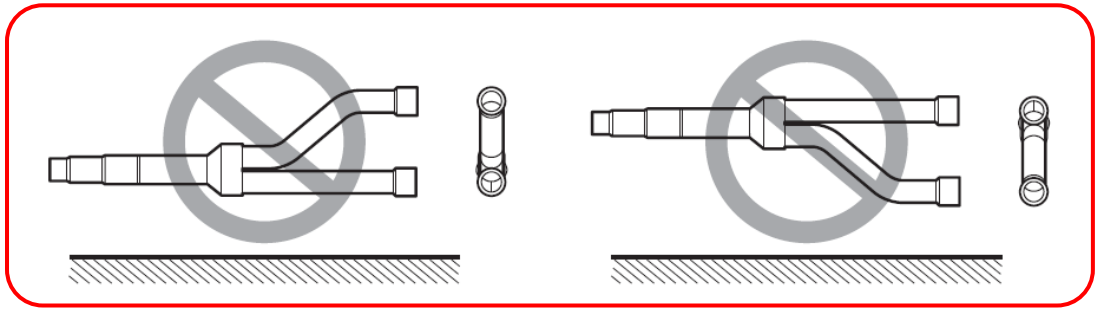


- <u>All Y-joints must be installed horizontally level</u> (within 15º of horizontal plane)

Horizontally installed







Vaporized refrigerant leans to upper direction of Y joint.

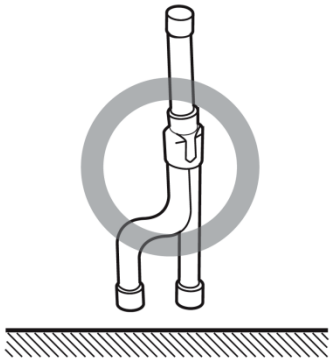
Install within ± 15° of horizontal plane

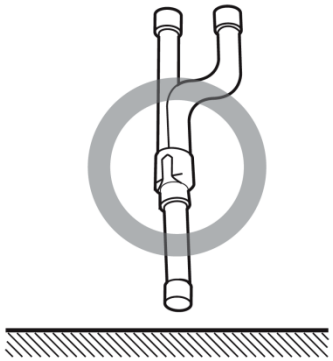
DVM S

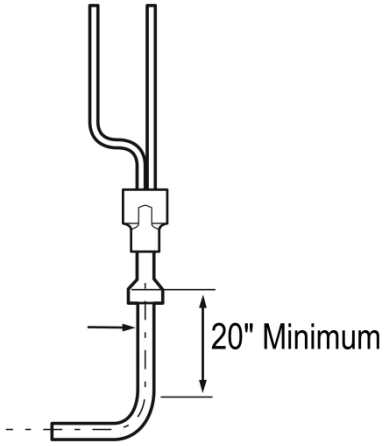
Y Joint Installation

- Samsung Y-Joint fittings can be installed vertically
- Ensure that there is minimum 20” between an elbow and a Y-joint before turning upward or downward
- Y-joints must be installed vertically level or horizontally level, never at upward/downward slope

Vertically installed



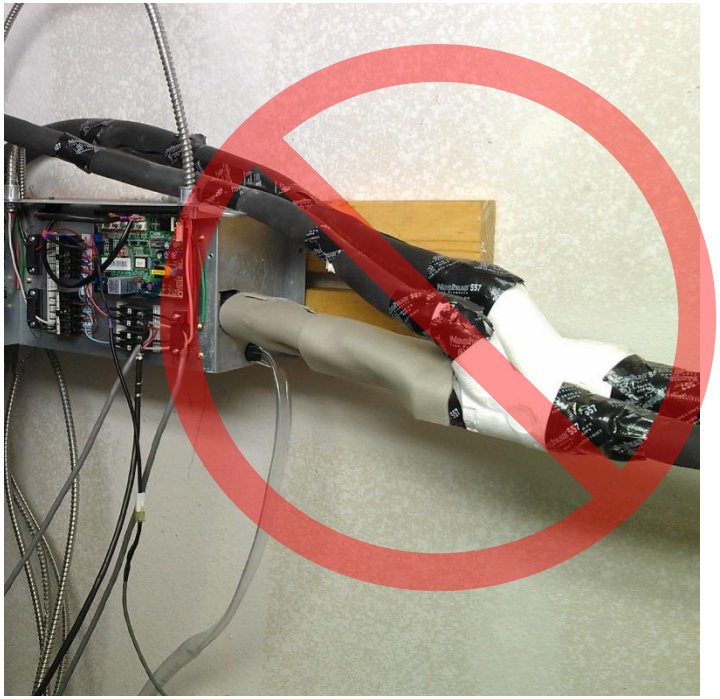




Allow 20” minimum between elbow and Y joint when installing vertically

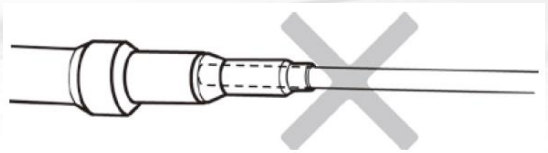
DVM S

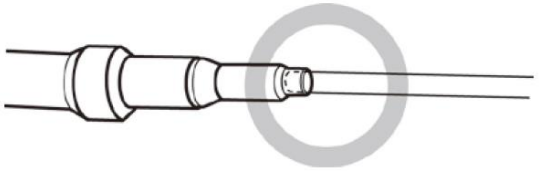
Y Joint Installation



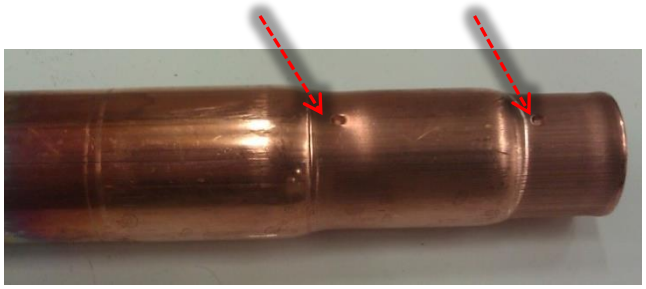
DVM S

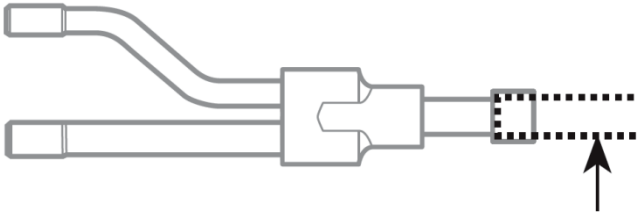
Y Joint Installation



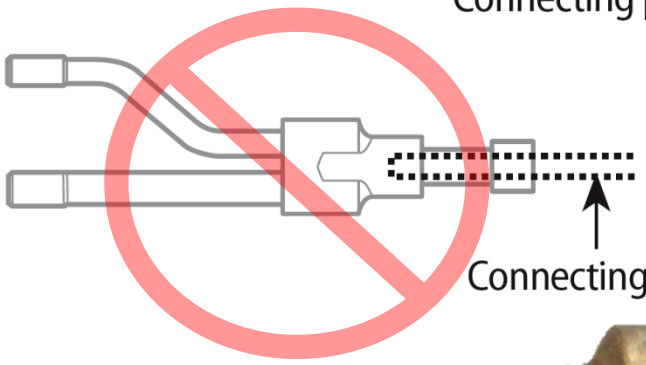


- If the refrigerant fitting does not have a groove to stop the copper pipe from entering too far, measure and mark the pipe at 5/8” from the end





- The pipe should not be inserted past this point



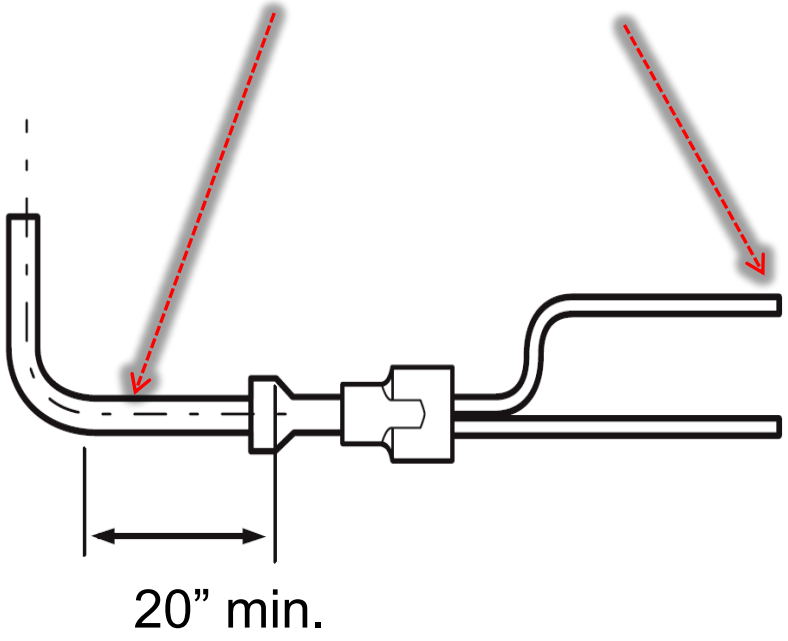
- Care needs to be taken to ensure that the refrigerant pipe does not get pushed into the Y joint too far before brazing

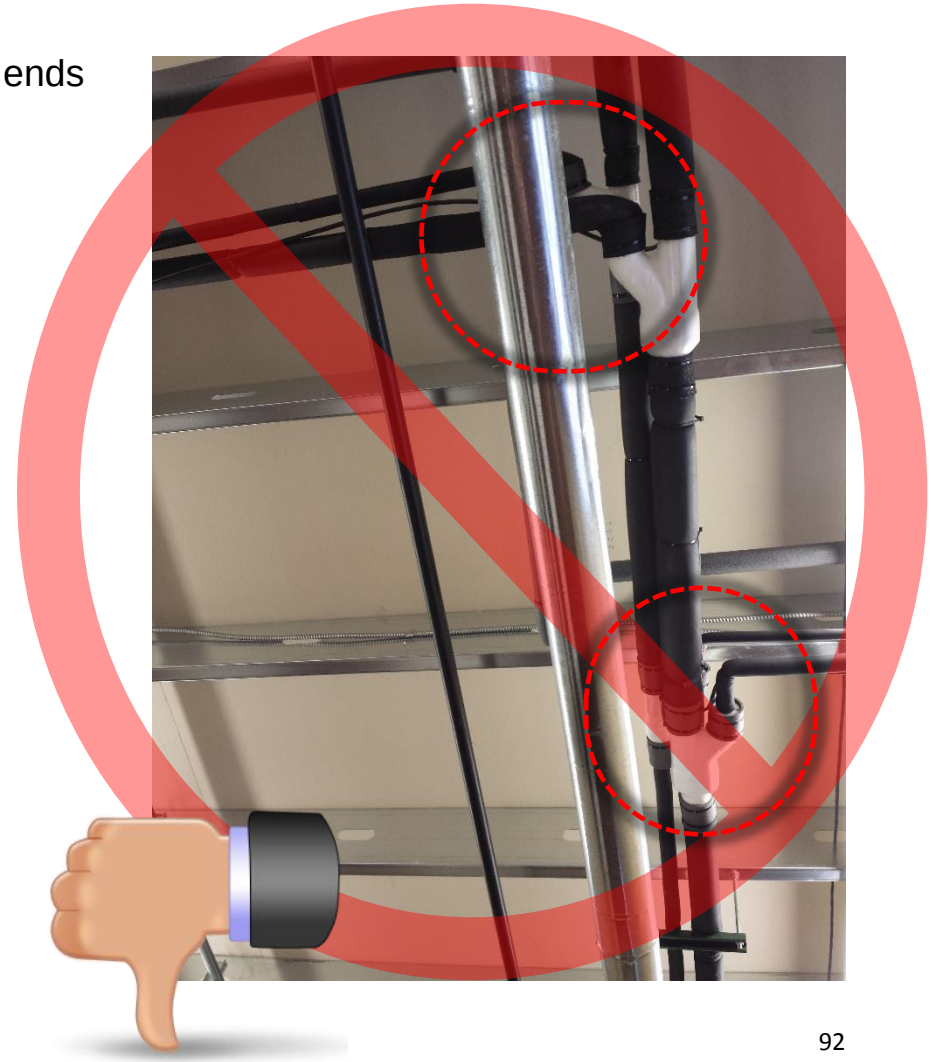
- If inserted too far this can cause turbulence, noise, and potential vibration

DVM S

Y Joint Installation

20” minimum between a Y-joint and an elbow on both ends





DVM S

Header Joint Installation

- Header joint kits will include a liquid fitting, suction fitting, reducers and insulation
- The liquid fitting is open at both ends to allow left or right installation
- Install the included plug on the open end after the incoming refrigerant pipe is connected

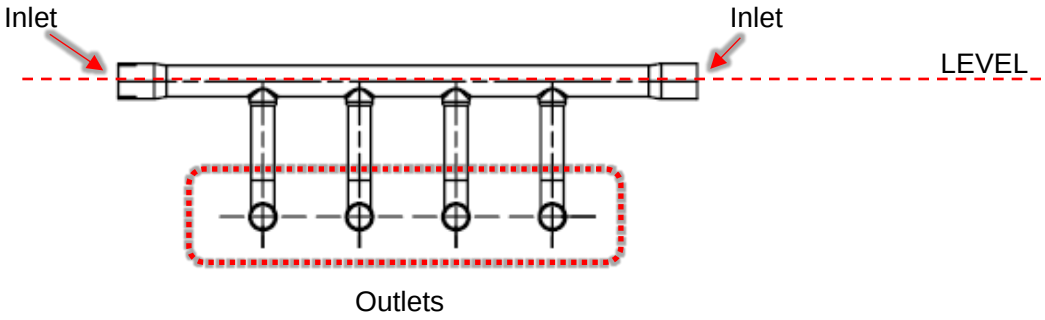
- The outlets (liquid and suction) can only connect to a single indoor unit, never a Y-joint or 2/3 port EEV kit

DVM S

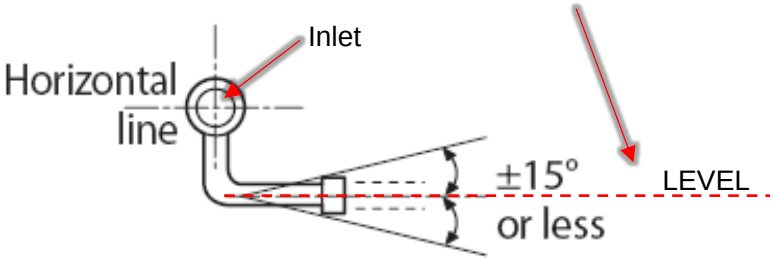
Header Joint Installation

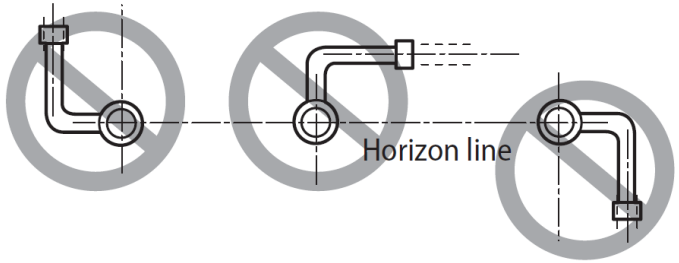
Liquid fitting

- The liquid pipe must be installed horizontally level



- The outlet ports must be on the bottom side of the liquid fitting with the outlets horizontally level (within 15º in either direction)





- <u>NEVER INSTALL VERTICALLY</u>

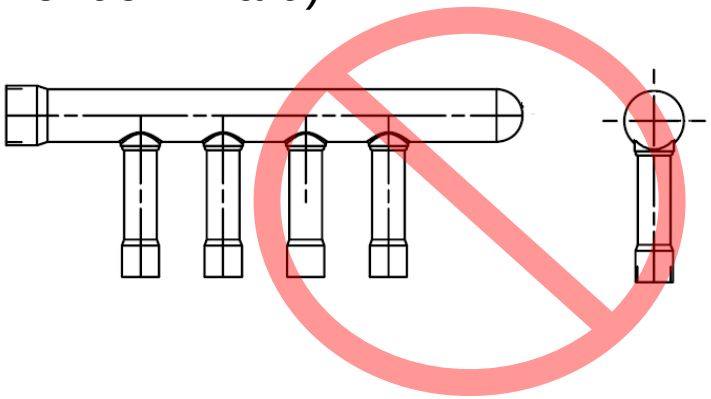
- Cap any unused ports

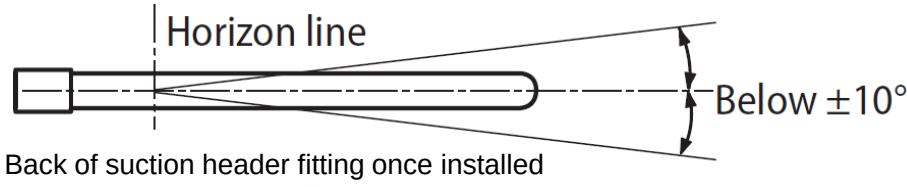
DVM S

Header Joint Installation

Suction gas fitting

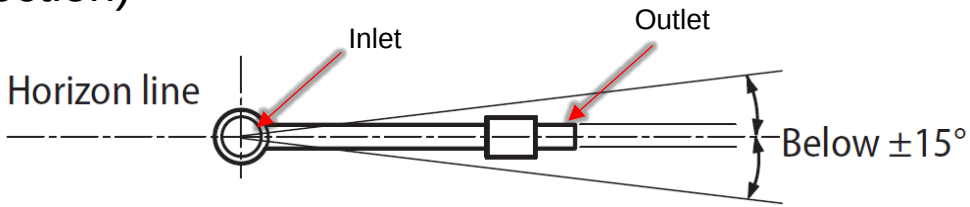
- The suction pipe must be installed horizontally level (within 10º in either direction) with the outlet ports in a horizontal position (do not point upward or downward)





Back of suction header fitting once installed

- Suction header outlet ports must be horizontally level (within 15º in either direction)



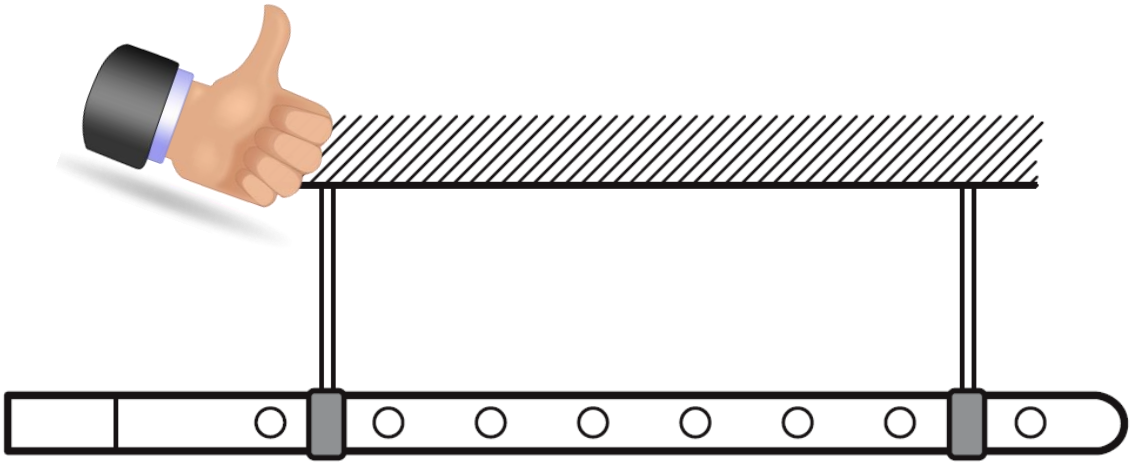
- <u>NEVER INSTALL VERTICALLY</u>

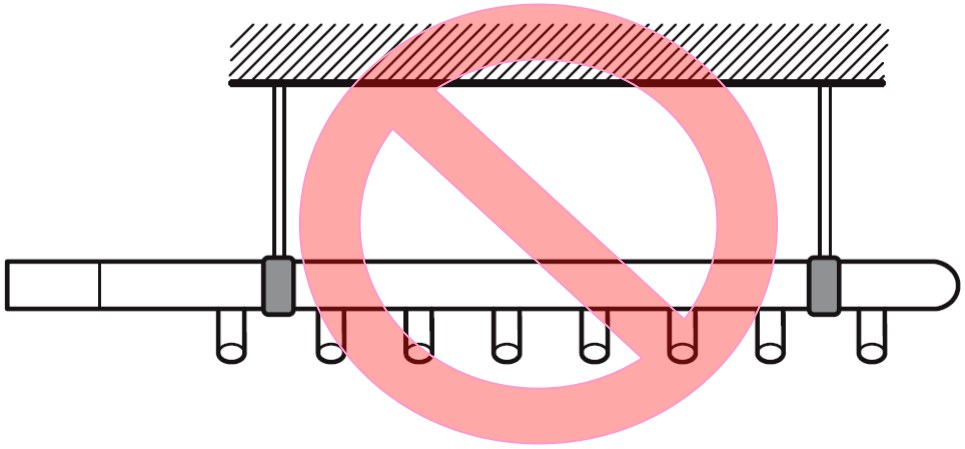
- Cap any unused ports

DVM S

Pipe Support

Support headers after insulating



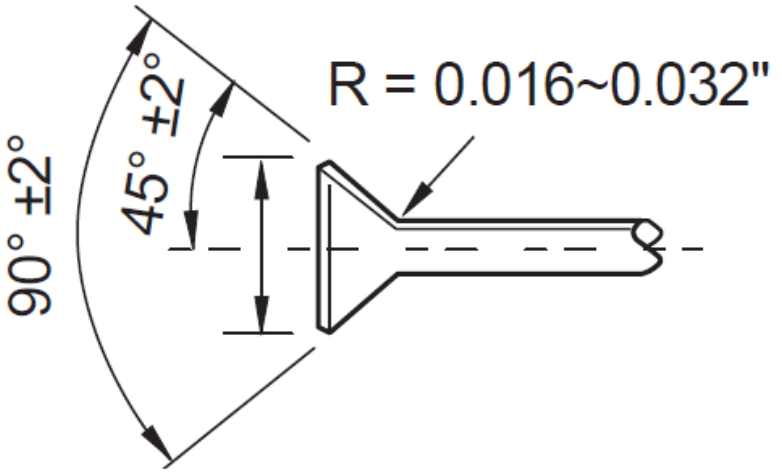


(Suction outlets pointing down)

DVM S

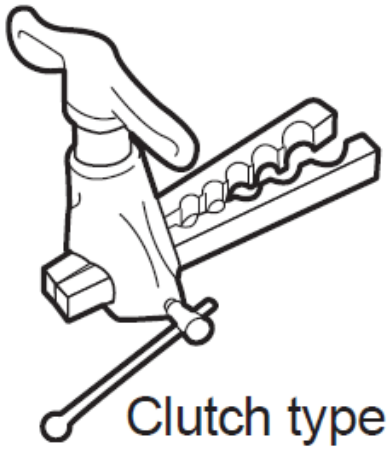
Refrigerant Piping - Flaring

- Proper flare techniques are necessary for a properly installed system
- Make sure the flare nut (provided with the indoor units) is on the copper before a flare is made
- Samsung requires that all flare joints made in the field are done with a tool that creates a 45^0 flare

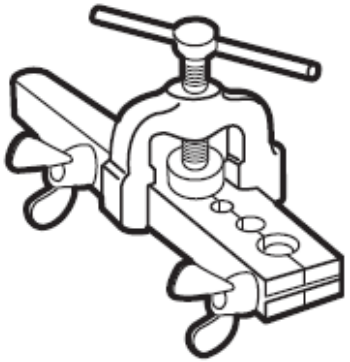


DVM S

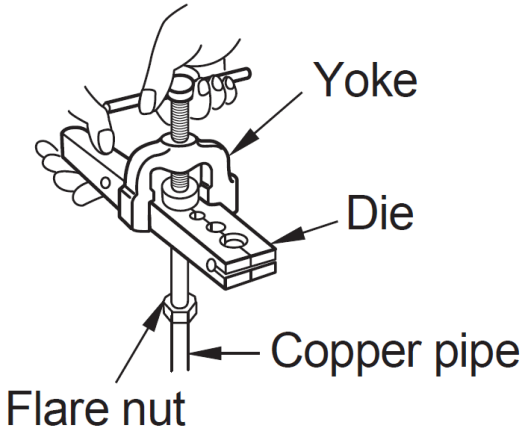
Refrigerant Piping – Types of flare tools



Clutch type



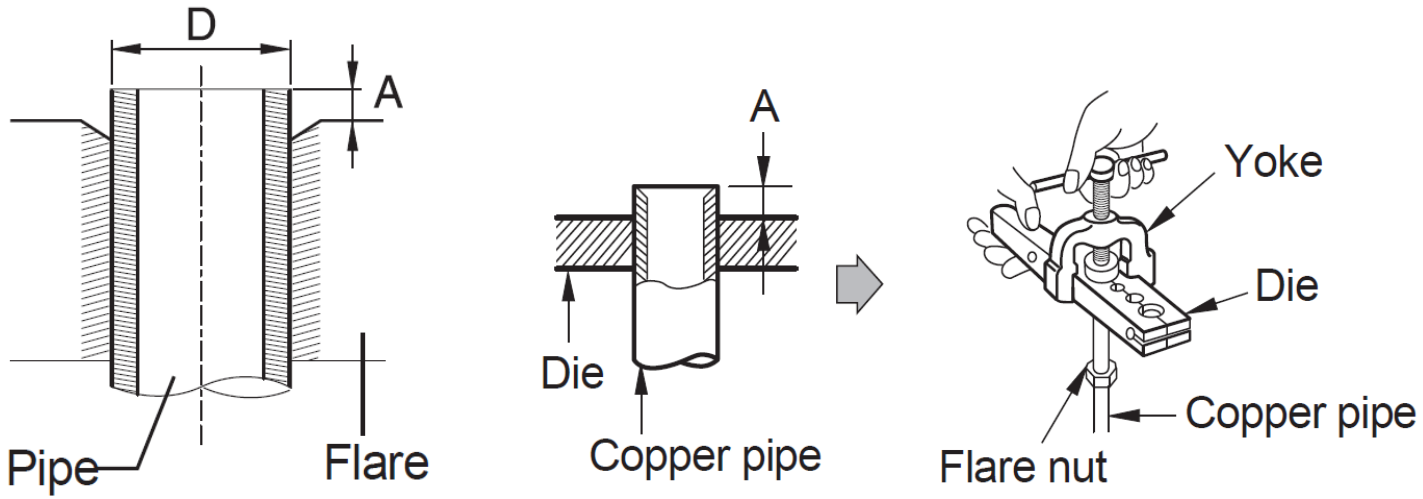
Wing nut type



DVM S

Refrigerant Piping - Flaring

- Make sure the copper pipe depth is within Samsung recommendations noted below
- The “depth” is referring to the distance between the die and the end of the copper tube.



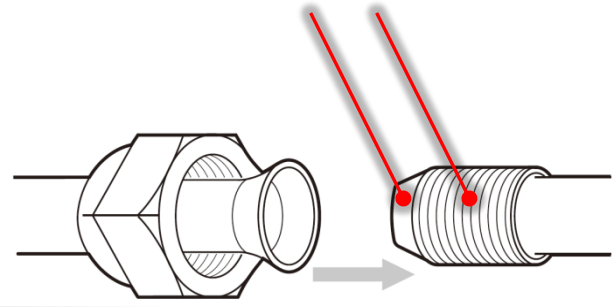
Pipe diameter [D]		Depth of flaring part [A]					
		Using flaring tool for R-410A		Using conventional flaring tool			
				Clutch type		Wing nut type	
mm	inch	mm	inch	mm	inch	mm	inch
6.35	1/4	0~0.5	0~0.02	1.0~1.5	0.04~0.06	1.5~2.0	0.06~0.08
9.52	3/8	0~0.5	0~0.02	1.0~1.5	0.04~0.06	1.5~2.0	0.06~0.08
12.7	1/2	0~0.5	0~0.02	1.0~1.5	0.04~0.06	1.5~2.0	0.06~0.08
15.88	5/8	0~0.5	0~0.02	1.0~1.5	0.04~0.06	1.5~2.0	0.06~0.08

DVM S

Refrigerant Piping - Flaring

- After making a flare, inspect to ensure a proper connection can be made to the indoor unit

- Apply POE refrigerant oil (small amount) to inside of the flare, on the threads, and on the face of the brass male fitting to facilitate proper tightening and seal of the flare nut



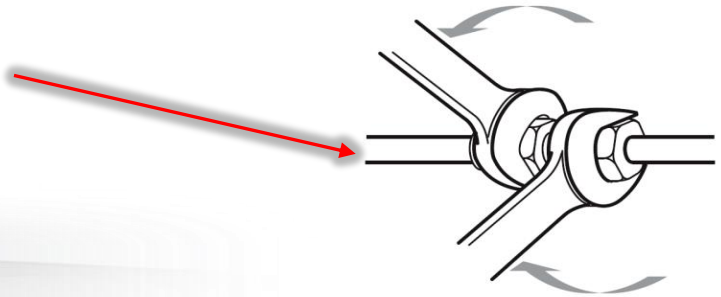
DVM S

Refrigerant Piping - Flaring

- Over tightening is a very common cause of leaks
- Torque the flare nut to the specifications listed in the indoor unit installation manuals

Pipe Diameter (OD)	Torque (ft./lbs.)
1/4”	10.46 – 12.63
3/8”	24.02 – 29.36
1/2”	36.43 – 44.37
5/8”	45.45 – 55.48

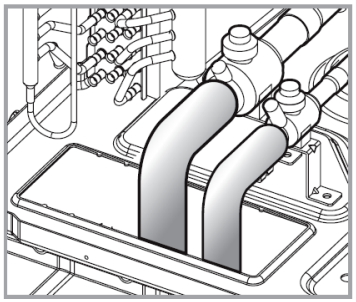
- While tightening, prevent pipe damage by supporting the male side with a wrench pushing in the opposite direction

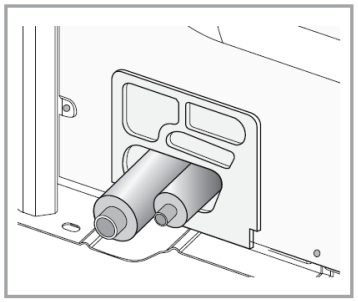


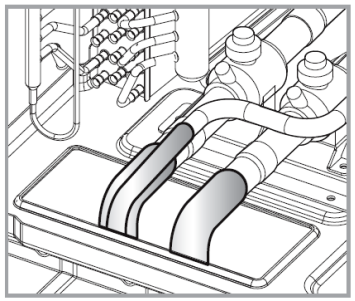
DVM S

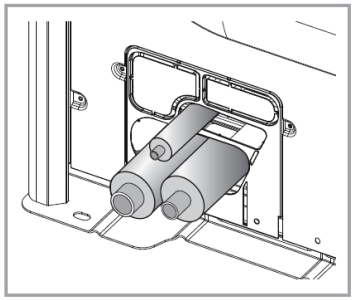
Outdoor Units Piping

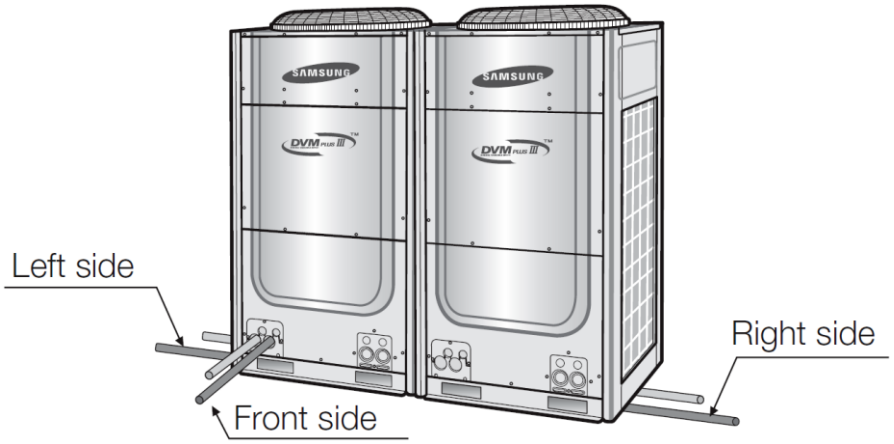
Main refrigerant pipes can enter the outdoor cabinet through the front access door or through the bottom of the unit

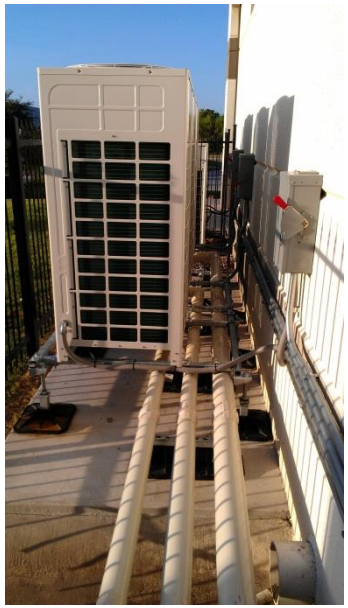






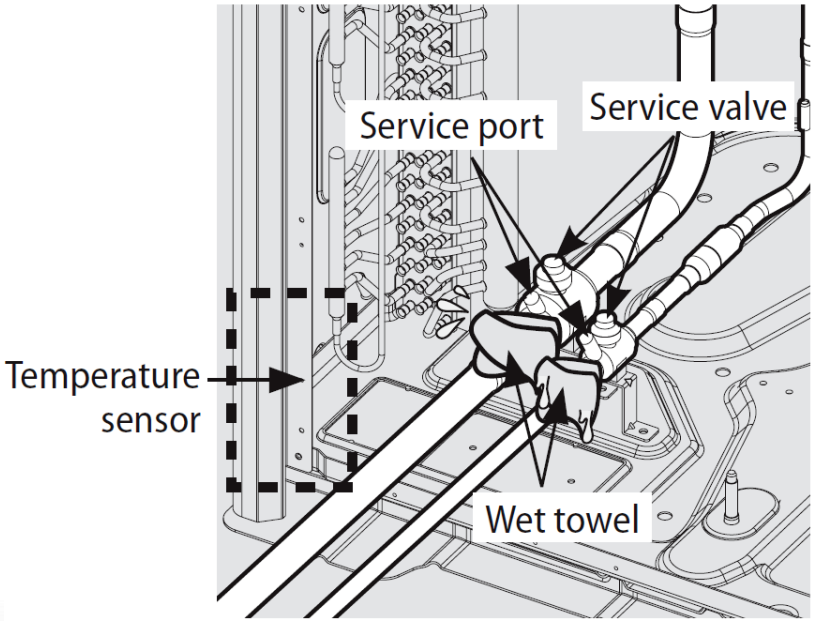




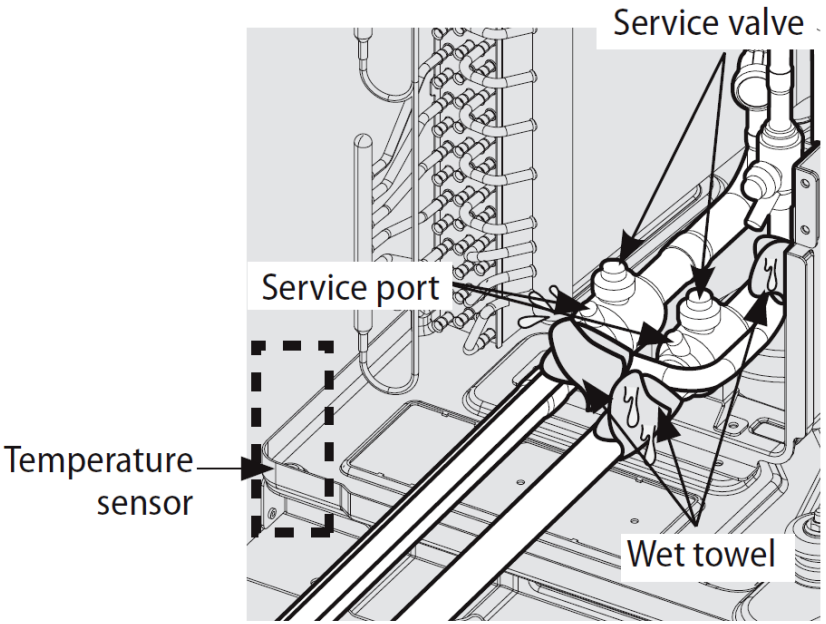


DVM S

- Take necessary precautions to avoid damaging outdoor unit while brazing
- Use wet towels or other heat dissipating products to protect equipment and components
- If temperature sensors are near the brazing areas, remove and replace after the brazed area has cooled.



Heat Pump

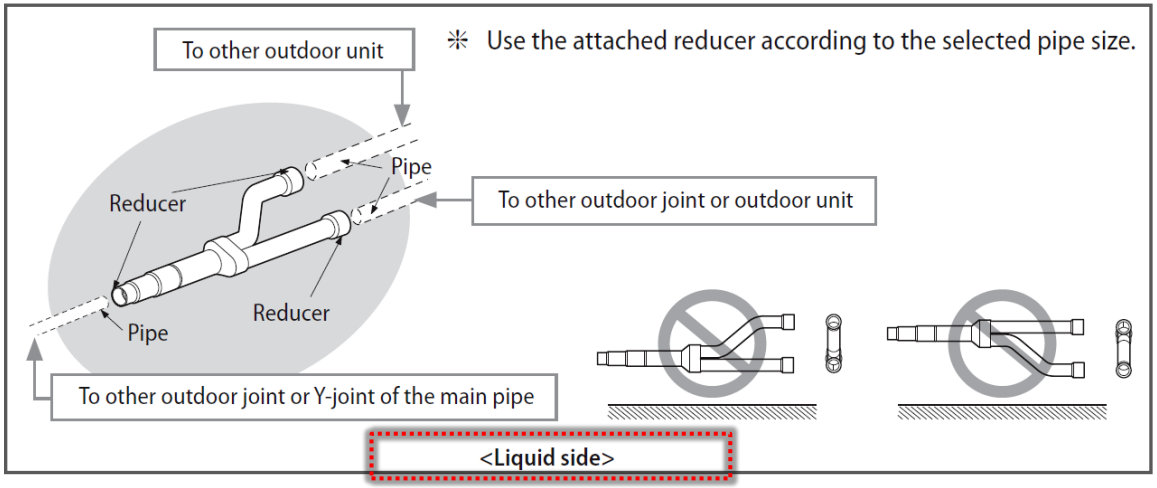


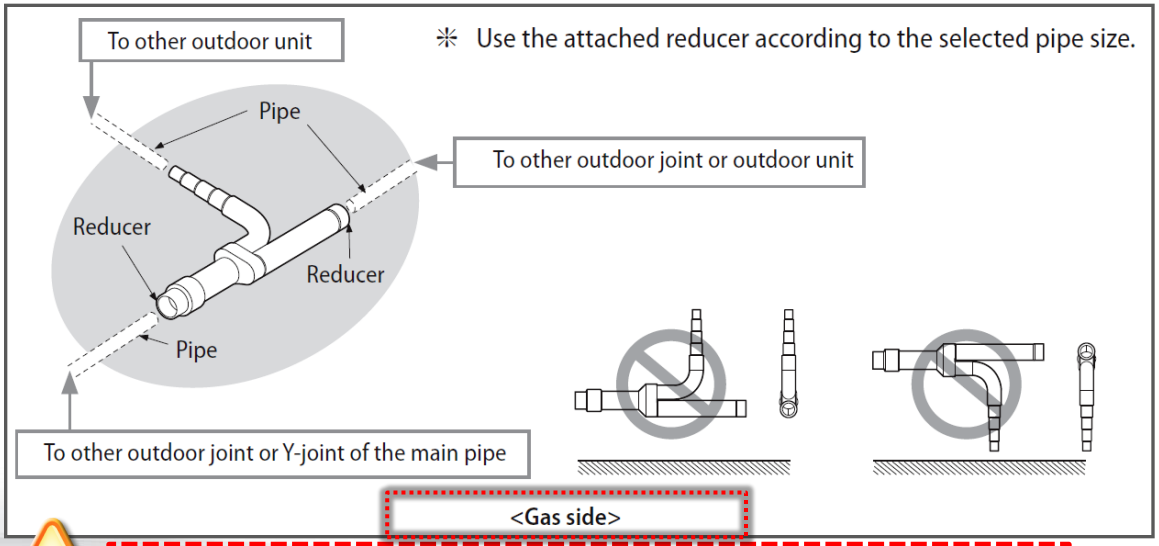
Heat Recovery

DVM S

T Installation (outdoor units only)

Heat Pump and Heat Recovery Systems



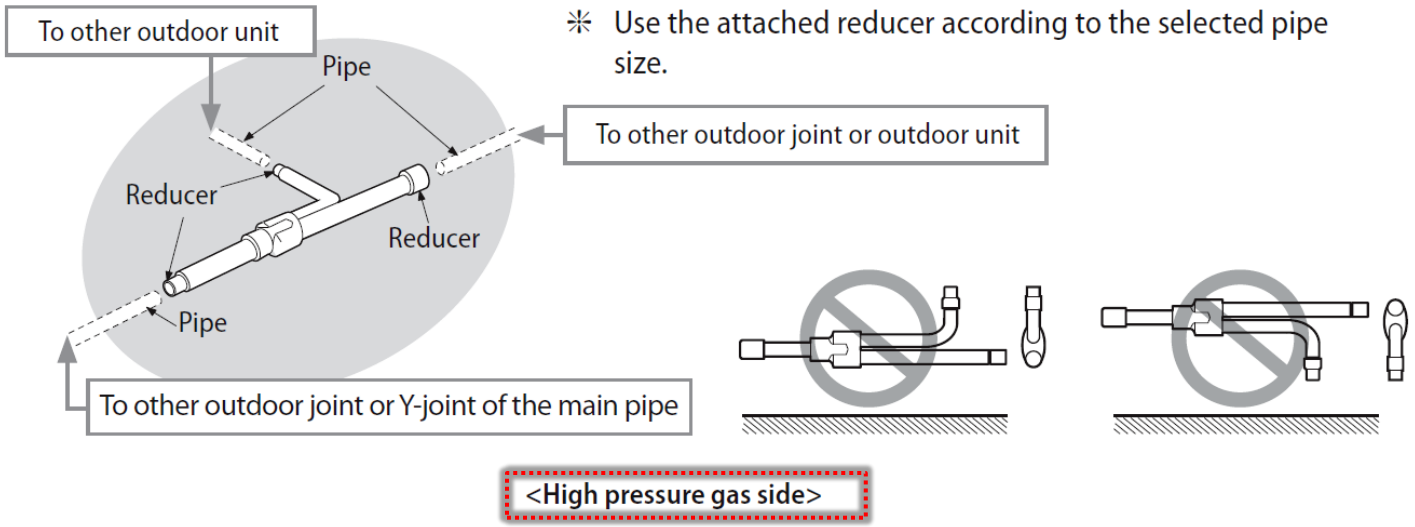


* All fittings must be installed horizontally level

DVM S

T Installation (outdoor units only)

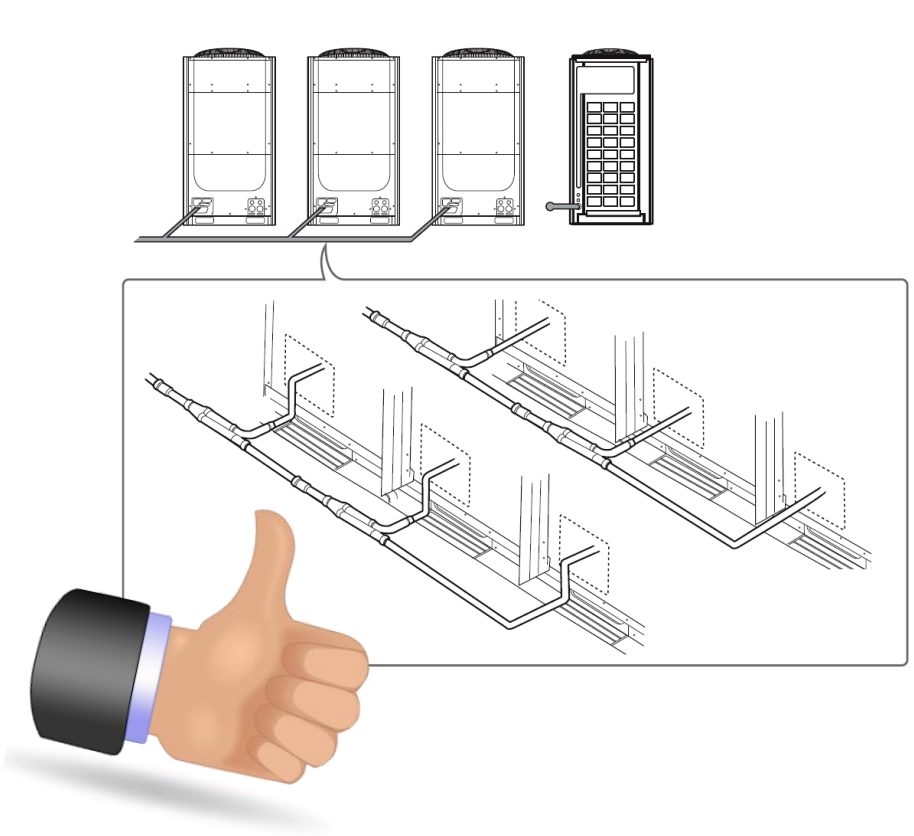
Heat Recovery Systems

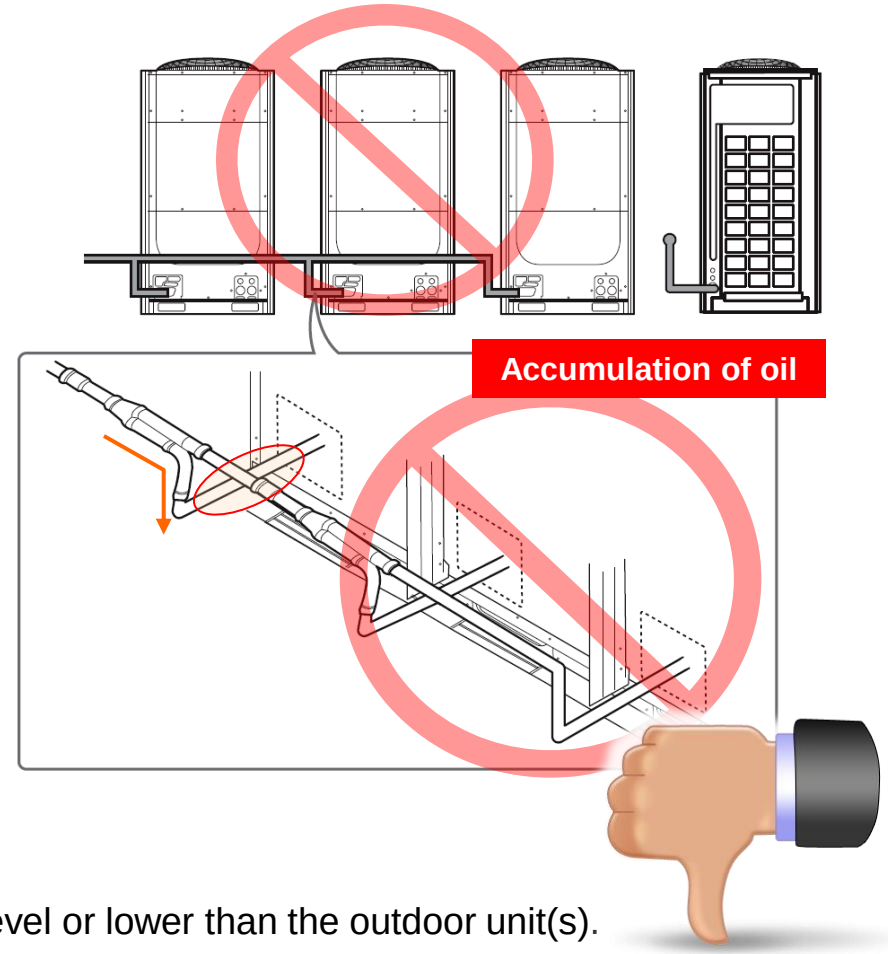


* All fittings must be installed horizontally level

DVM S

Outdoor Units Piping





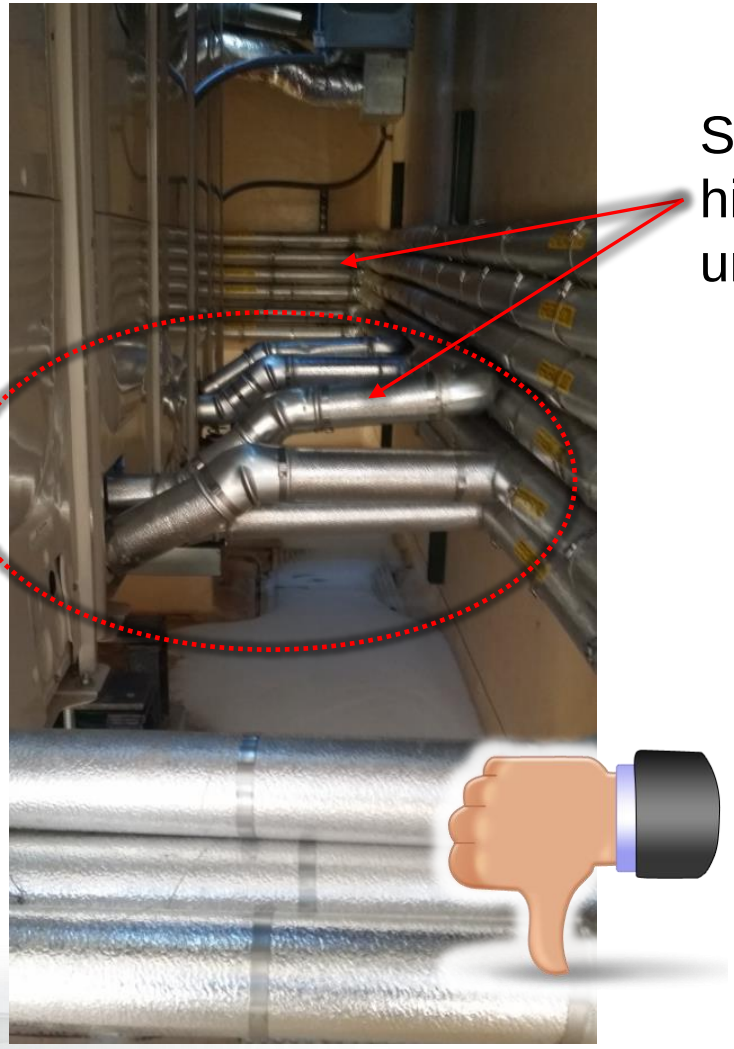
Refrigerant piping should be the same level or lower than the outdoor unit(s).

Examples on following pages

DVM S

Outdoor Units Piping

Refrigerant piping should be the same level or lower than the outdoor unit(s).



Supply pipes are higher than the outdoor unit modules.

Example on following page

DVM S

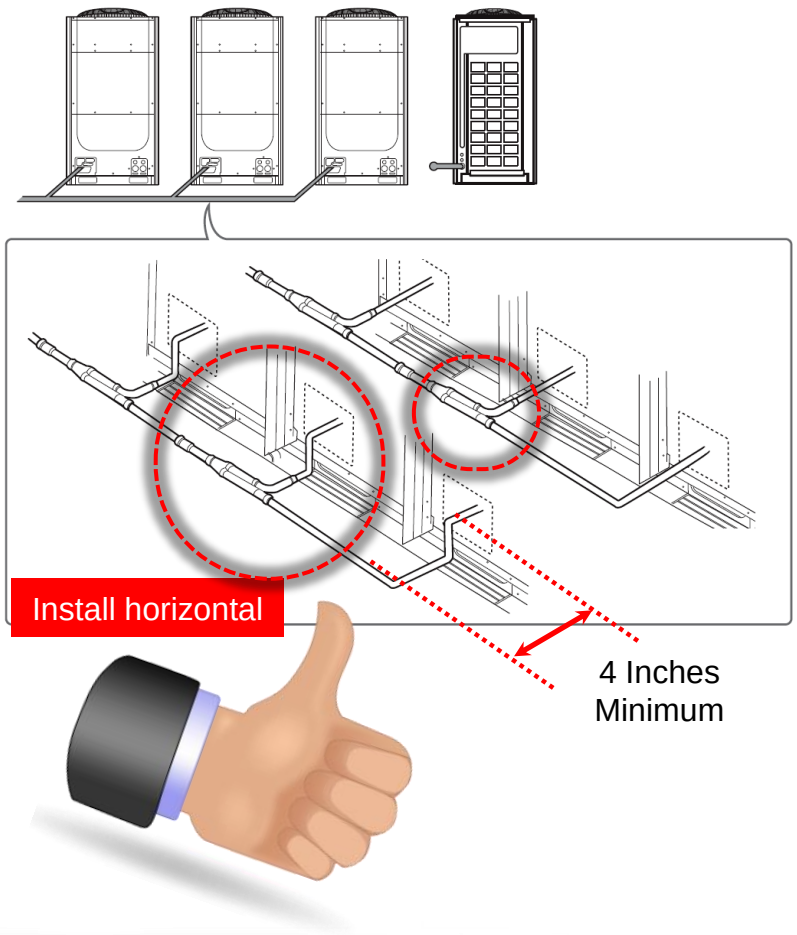
Outdoor Units Piping

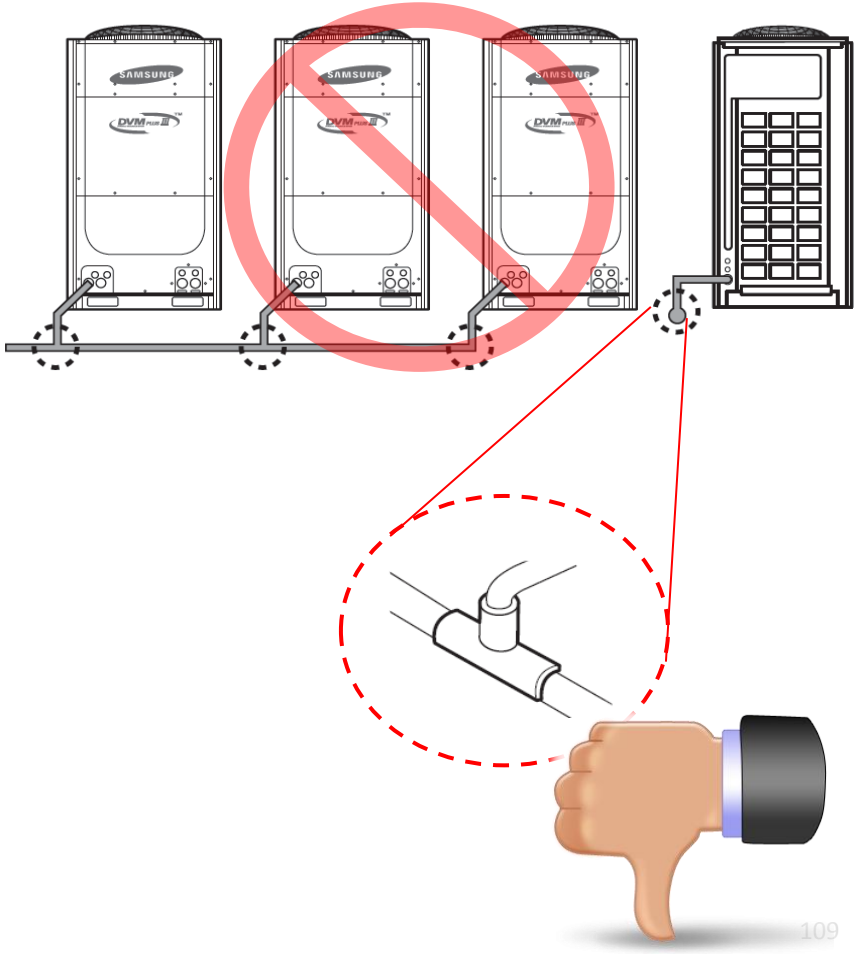
Refrigerant piping should be the same level or lower than the outdoor unit(s).

DVM S

Outdoor Units Piping

Refrigerant piping should be installed in a horizontal direction.

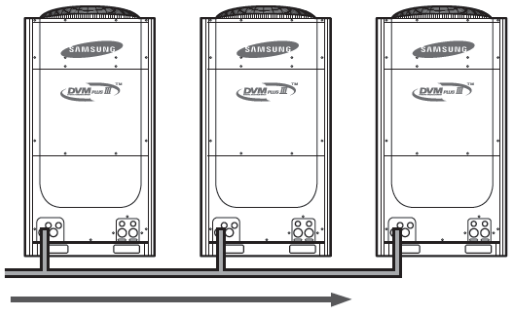


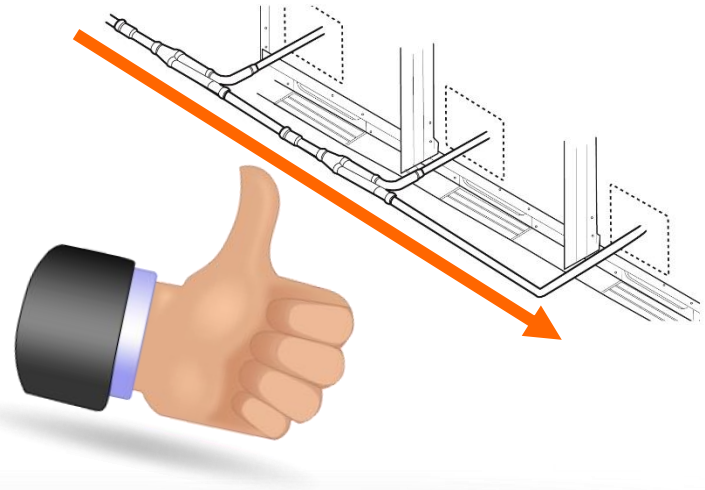


DVM S

Outdoor Units Piping

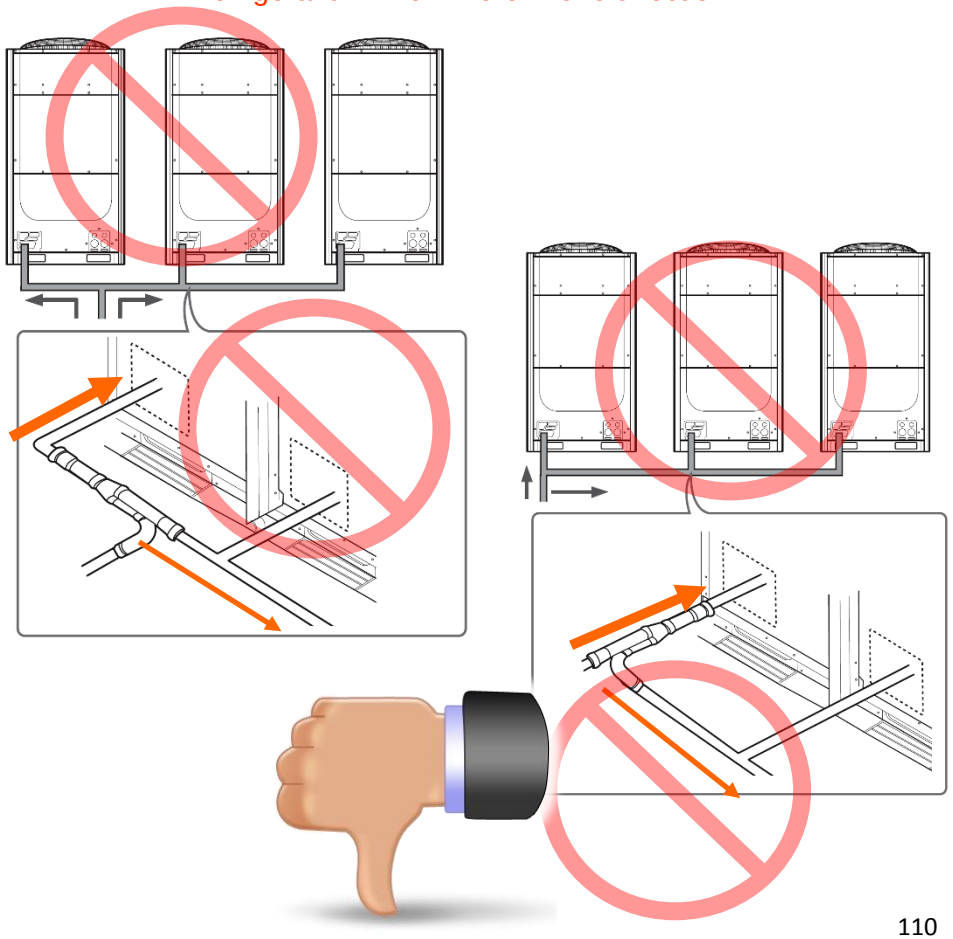
Refrigerant piping should be connected with side direction. As the pipes approach the outdoor units, it needs to run parallel to the front of the modules





Unbalancing of Ref. & oil distribution

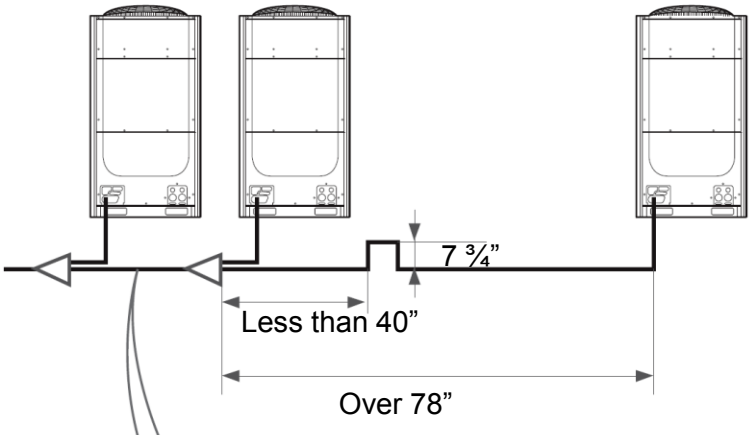
Refrigerant will flow more in one direction

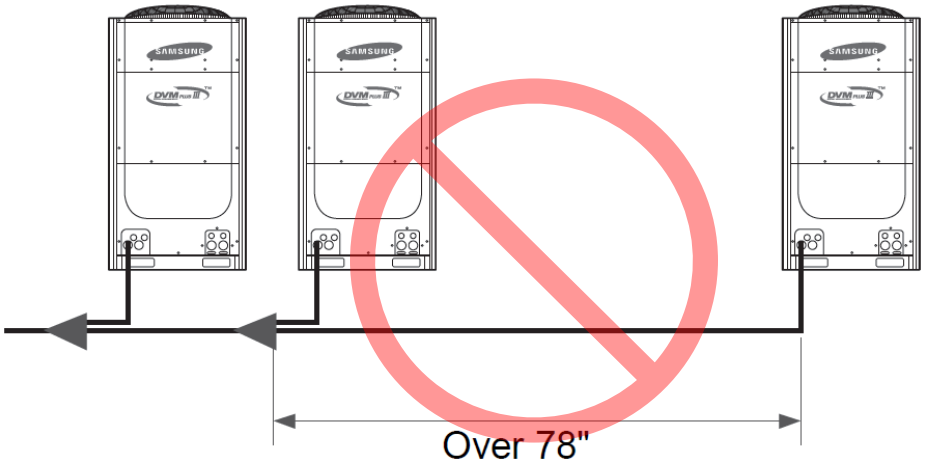


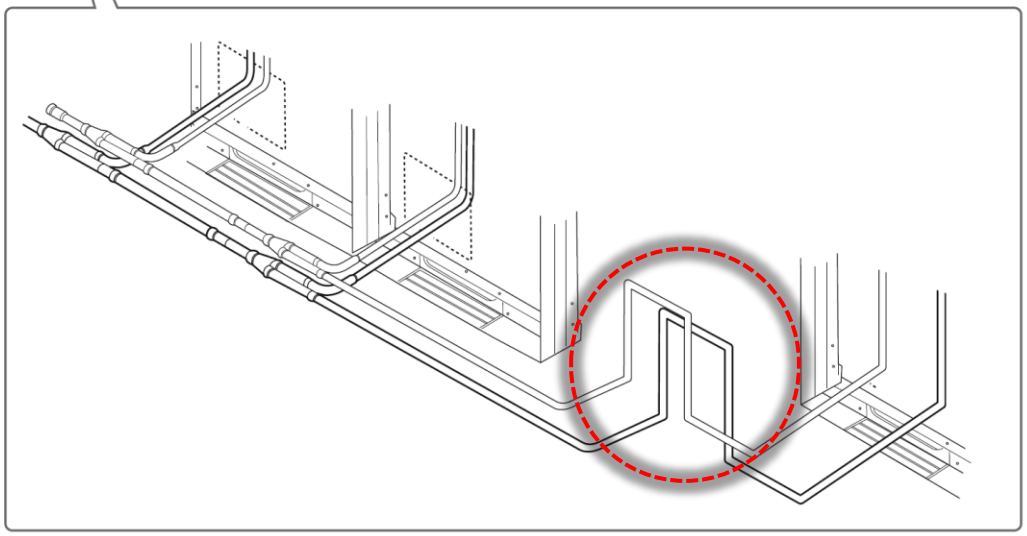
DVM S

Outdoor Units Piping

Install a vertical trap between SUB1 and SUB2 outdoor modules when over 78” from second outdoor Tee

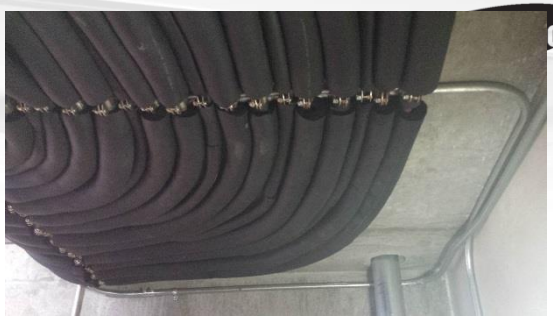


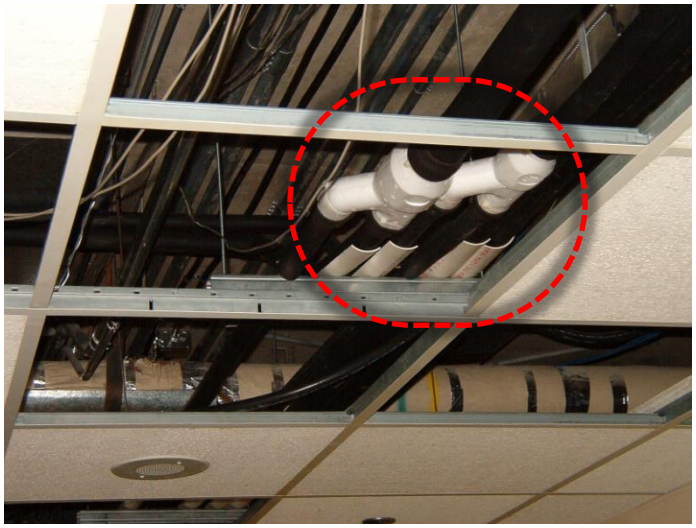




DVM S

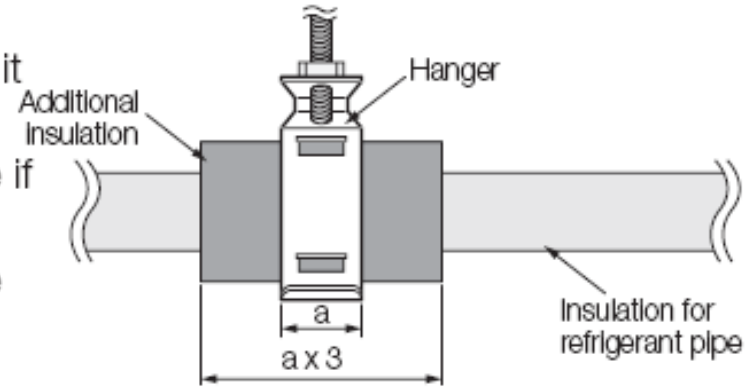
Pipe Support





CAUTION

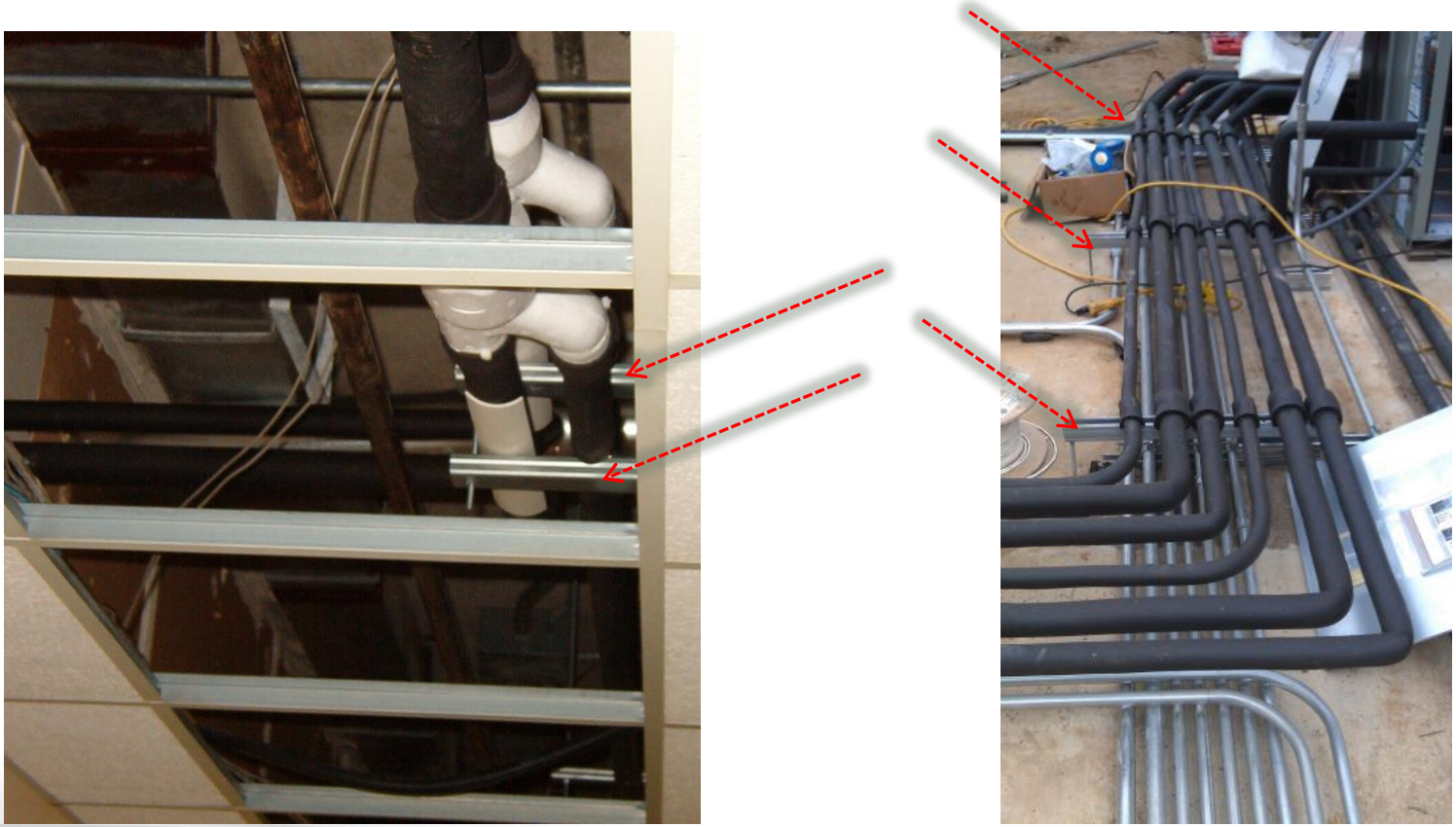
- Install the insulation not to be get wider and use the adhesives on the connection part of it to prevent moisture entering.
- Wind the refrigerant pipe with insulation tape if it is exposed to outside sunlight.
- Install the refrigerant pipe respecting that the insulation does not get thinner on the bent part or hanger of pipe.



DVM S

Pipe Support

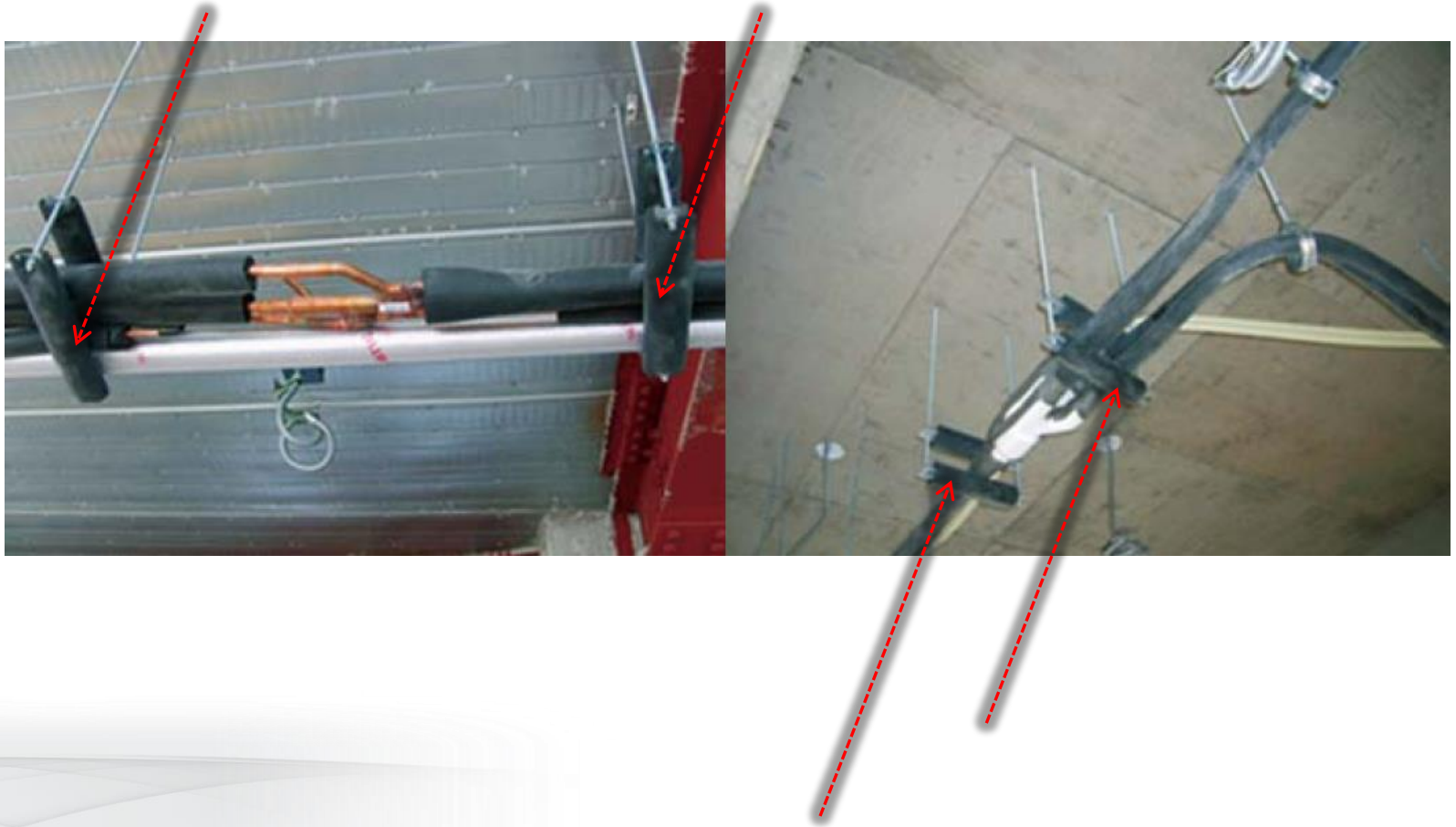
- Ref pipes through 1”, supports must be spaced no more than **48 inches** apart
- If the ref pipe size is larger than 1”, the refrigerant line supports must be spaced no more than **60 inches apart**



DVM S

Pipe Support

- Install a hanger before and after each branch joint to prevent sagging and stress on the brazed joints (within 18” of the inlets and outlets)



DVM S

Copper Expansion and Contraction

- Under normal operating conditions, the vapor pipe temperature of a DVM S system can vary as much as 280° F.
- With this large variance in pipe temperature, the designer must consider pipe expansion and contraction to avoid pipe and fitting fatigue failures.
- If the pipe is mounted in free air space, no natural restriction to movement is present if mounting clamps are properly spaced and installed.
- When the refrigerant pipe is mounted underground in a utility duct stacked among other pipes, natural restriction to linear movement is present.
- In extreme cases, the restrictive force of surface friction between insulating jackets could become so great that natural expansion ceases and the pipe is “fixed” in place.
- In this situation, opposing force caused by change in refrigerant fluid/vapor temperature can lead to pipe/fitting stress failure.

DVM S

Copper Expansion and Contraction

- The refrigerant pipe support system must be engineered to allow free expansion to occur.
- When a segment of pipe is mounted between two fixed points, provisions must be provided to allow pipe expansion to naturally occur.
- The most common method is the inclusion of expansion Loop or U-bends
- Each segment of pipe has a natural fixed point where no movement occurs. This fixed point is located at the center point of the segment assuming the entire pipe is insulated in a similar fashion.

Copper Expansion and Contraction

- The natural fixed point of the pipe segment is typically where the expansion Loop or U-bend should be. Linear pipe expansion can be calculated using the following formula :

$$LE = C \times L \times (Tr - Ta) \times 12$$

LE	=	Anticipated linear tubing expansion (in.)
C	=	Constant (For copper = 9.2 x 10-6 in./in. °F)
L	=	Length of pipe (ft.)
Tr	=	Refrigerant pipe temperature (°F)
Ta	=	Ambient air temperature (°F)
12	=	Inches to feet conversion (12 in./ft.)

- From the anticipated expansion data table on the next slide, find the row corresponding with the actual length of the straight pipe segment.
- Estimate the minimum and maximum temperature of the pipe. In the column showing the minimum pipe temperature, look up the anticipated expansion distance.
- Do the same for the maximum pipe temperature.
- Calculate the difference in the two expansion distance values. The result will be the anticipated change in pipe length.

DVM S

Copper Expansion and Contraction

To find the anticipated expansion value:

1. From the table below, find the row corresponding with the actual feet of the straight pipe segment.
2. Estimate the minimum and maximum temperature of the pipe.
3. In the column showing the minimum pipe temperature, look up the anticipated expansion distance corresponding to the segment length. Do the same for the maximum pipe temperature.
4. Calculate the difference in the two expansion distance values. The result will be the change in pipe length.

Linear Thermal Expansion of Copper Tubing in Inches.

Pipe Length (ft.)	Fluid Temperature °F																			
	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°	125°	130°
10	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.12	0.13	0.14	0.15	0.15
20	0.08	0.08	0.10	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.22	0.23	0.26	0.28	0.29	0.30
30	0.12	0.12	0.15	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.32	0.35	0.39	0.42	0.44	0.45
40	0.16	0.16	0.20	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.43	0.46	0.52	0.56	0.58	0.60
50	0.20	0.20	0.25	0.30	0.33	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.54	0.58	0.65	0.70	0.73	0.75
60	0.24	0.24	0.30	0.36	0.39	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.65	0.69	0.78	0.84	0.87	0.90
70	0.28	0.28	0.35	0.42	0.46	0.49	0.53	0.56	0.60	0.63	0.67	0.70	0.74	0.77	0.76	0.81	0.91	0.98	1.02	1.05
80	0.32	0.32	0.40	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.86	0.92	1.04	1.12	1.16	1.20
90	0.36	0.36	0.45	0.54	0.59	0.63	0.68	0.72	0.77	0.81	0.86	0.90	0.95	0.99	0.97	1.04	1.17	1.26	1.31	1.35
100	0.40	0.40	0.50	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.08	1.15	1.30	1.40	1.45	1.50
120	0.48	0.48	0.60	0.72	0.78	0.84	0.90	0.96	1.02	1.08	1.14	1.20	1.26	1.32	1.30	1.38	1.56	1.68	1.74	1.80
140	0.56	0.56	0.70	0.84	0.91	0.98	1.05	1.12	1.19	1.26	1.33	1.40	1.47	1.54	1.51	1.61	1.82	1.96	2.03	2.10
160	0.64	0.64	0.80	0.96	1.04	1.12	1.20	1.28	1.36	1.44	1.52	1.60	1.68	1.76	1.73	1.84	2.08	2.24	2.32	2.40
180	0.72	0.72	0.90	1.08	1.17	1.26	1.35	1.44	1.53	1.62	1.71	1.80	1.89	1.98	1.94	2.07	2.34	2.52	2.61	2.70
200	0.80	0.80	1.00	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.16	2.30	2.60	2.80	2.90	3.00
220	0.88	0.88	1.10	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20	2.31	2.42	2.38	2.53	2.86	3.08	3.19	3.30
240	0.96	0.96	1.20	1.44	1.56	1.68	1.80	1.92	2.04	2.16	2.28	2.40	2.52	2.64	2.59	2.76	3.12	3.36	3.48	3.60
260	1.04	1.04	1.30	1.56	1.69	1.82	1.95	2.08	2.21	2.34	2.47	2.60	2.73	2.86	2.81	2.99	3.38	3.64	3.77	3.90
280	1.12	1.12	1.40	1.68	1.82	1.96	2.10	2.24	2.38	2.52	2.66	2.80	2.94	3.08	3.02	3.22	3.64	3.92	4.06	4.20
300	1.20	1.20	1.50	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.15	3.30	3.24	3.45	3.90	4.20	4.35	4.50

Pipe length baseline temperature = 0 ° F

The Engineers' Toolbox (www.engineeringtoolbox.com) - Expansion of Carbon, Copper and Stainless Steel Pipe

DVM S

Copper Expansion and Contraction – General Example

- A DVM S system is installed and the design shows that there is a 120 feet straight segment of tubing between a Y-branch and an indoor unit.

- In heating, this pipe transports hot gas vapor to the indoor units at 120° F. In cooling, the same tube is a suction line returning refrigerant vapor to the outdoor unit at 40° F.

- Look up the copper tubing expansion at each temperature and calculate the difference.

Vapor Line

Transporting Hot Vapor: 120 ft. pipe at 120° F = 1.68 in.
Transporting Suction Vapor: 120 ft. pipe at 40° F = 0.48 in.
Anticipated Change in Length: 1.68 in. – 0.48 in. = **1.20 in.**

Liquid Line

- The liquid temperature remains relatively the same temperature; only the direction of flow will reverse. Therefore, no significant change in length of the liquid line is anticipated.
- When creating an expansion joint, the joint height should be a minimum of two times the joint width.
- Use soft copper with long radius bends on longer runs or long radius elbows for shorter pipe segments.
- Using the anticipated linear expansion (LE) distance calculated, look up the Expansion Loop or U-bend minimum design dimensions. If other types of expansion joints are chosen, design per ASTM B-88 Standards.

DVM S

Copper Expansion and Contraction – General Example

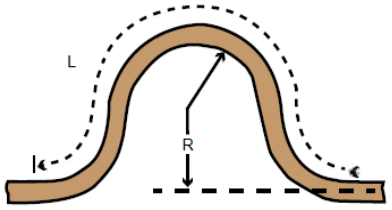
For the example on the previous page, if

- anticipated change in length = **1.20 in,** and
- the vapor pipe is 1 1/4”,
- **an expansion loop or U-bend would be needed with a 20” radius.**

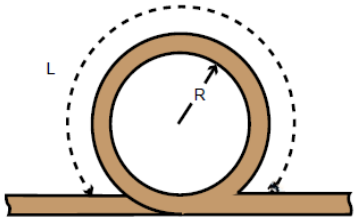
Anticipated Linear Expansion (LE) (in)		Nominal Tube Size (OD) inches						
		1/4	3/8	1/2	3/4	1	1-1/4	1-1/2
1/2	R[1]	6	7	8	9	11	12	13
	L[2]	38	44	50	59	67	74	80
1	R[1]	9	10	11	13	15	17	18
	L[2]	54	63	70	83	94	104	113
1-1/2	R[1]	11	12	14	16	18	20	22
	L[2]	66	77	86	101	115	127	138
2	R[1]	12	14	16	19	21	23	25
	L[2]	77	89	99	117	133	147	160
2-1/2	R[1]	14	16	18	21	24	26	29
	L[2]	86	99	111	131	149	165	179
3	R[1]	15	17	19	23	26	29	31
	L[2]	94	109	122	143	163	180	196
3-1/2	R[1]	16	19	21	25	28	31	34
	L[2]	102	117	131	155	176	195	212
4	R[1]	17	20	22	26	30	33	36
	L[2]	109	126	140	166	188	208	226

[1]*R = Centerline Length of Pipe.*
[2]*L = Centerline Minimum Radius (inches).*

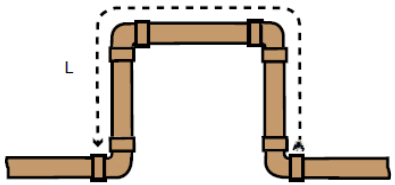
Coiled Expansion Loops and Offsets



Large Tubing U-bend (>3/4 in.)



Loop



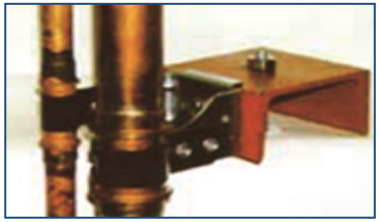
Small Tubing U-bend (<3/4 in.)

R1 = Centerline Length of Pipe.
L2 = Centerline Minimum Radius (inches).

DVM S

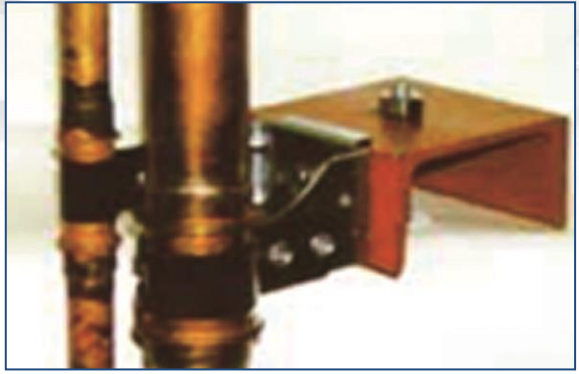
Vertical Pipe Support

- When installing refrigerant pipes vertically, support the pipes according to the table below.

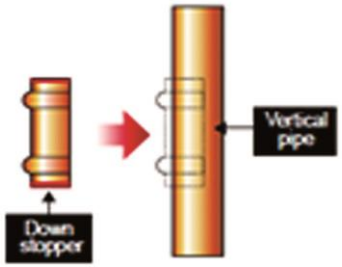
	Height	Fixing interval	Example
1	Less than 50’	• Support pipes every 16’ minimum • Protect pipe from clamp with tape or rubber	
2	Higher than 50’	• Support pipes every 16’ minimum • Install a down stopper every 3 floors or every 50’.	

DVM S

Vertical Pipe Support

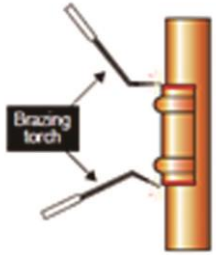


1.



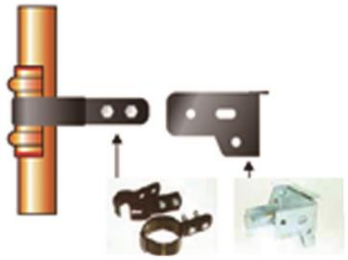
Attaching the down stopper to the vertical pipe

2.



Braze the down stopper to the pipe while flowing low pressure nitrogen through the pipe

3.



Secure the support to the structure and to the pipe

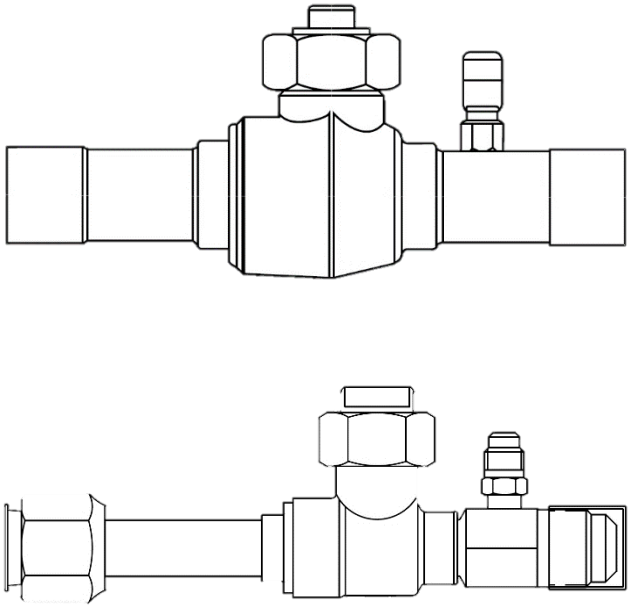
4.

Insulate the pipe and support appropriately

Isolation Valves

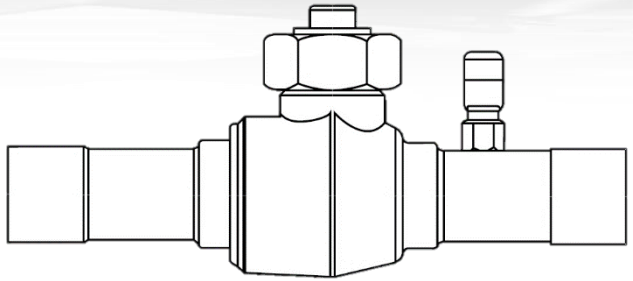
Isolation Valves

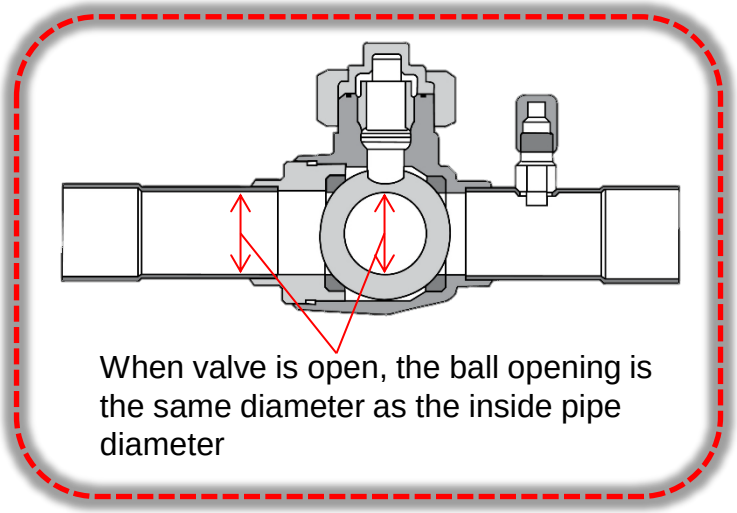
- Isolation valves are not required but recommended
- Installation of refrigerant isolation valves will make any future service or replacement much easier
- Installation may also allow for system operation during any unit replacement or service

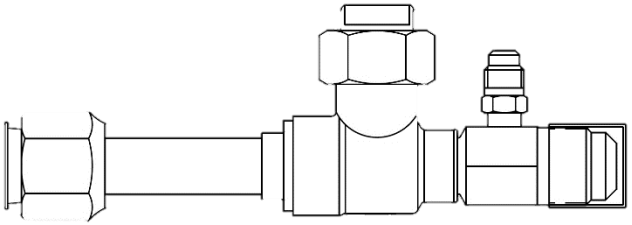


Isolation Valves

- Full-port valves are mandatory if isolation valves are installed
- Valves with a service port access are recommended for pressure check and vacuum drying operations





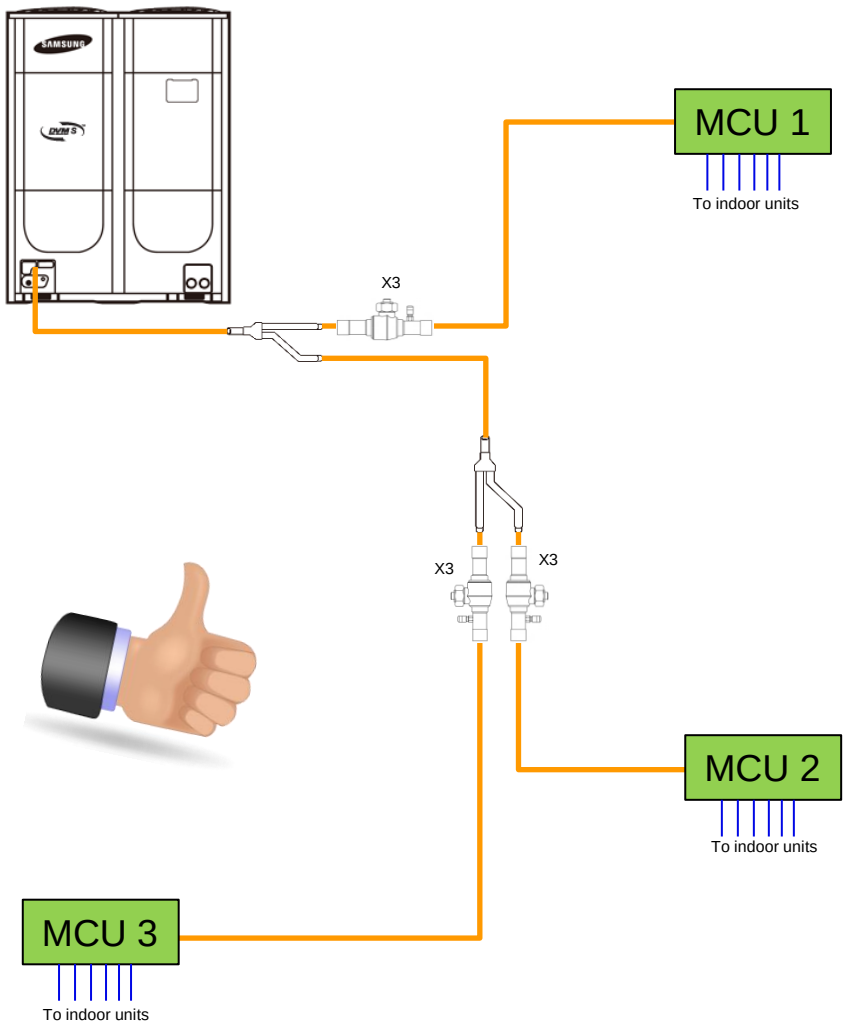


Isolation Valves

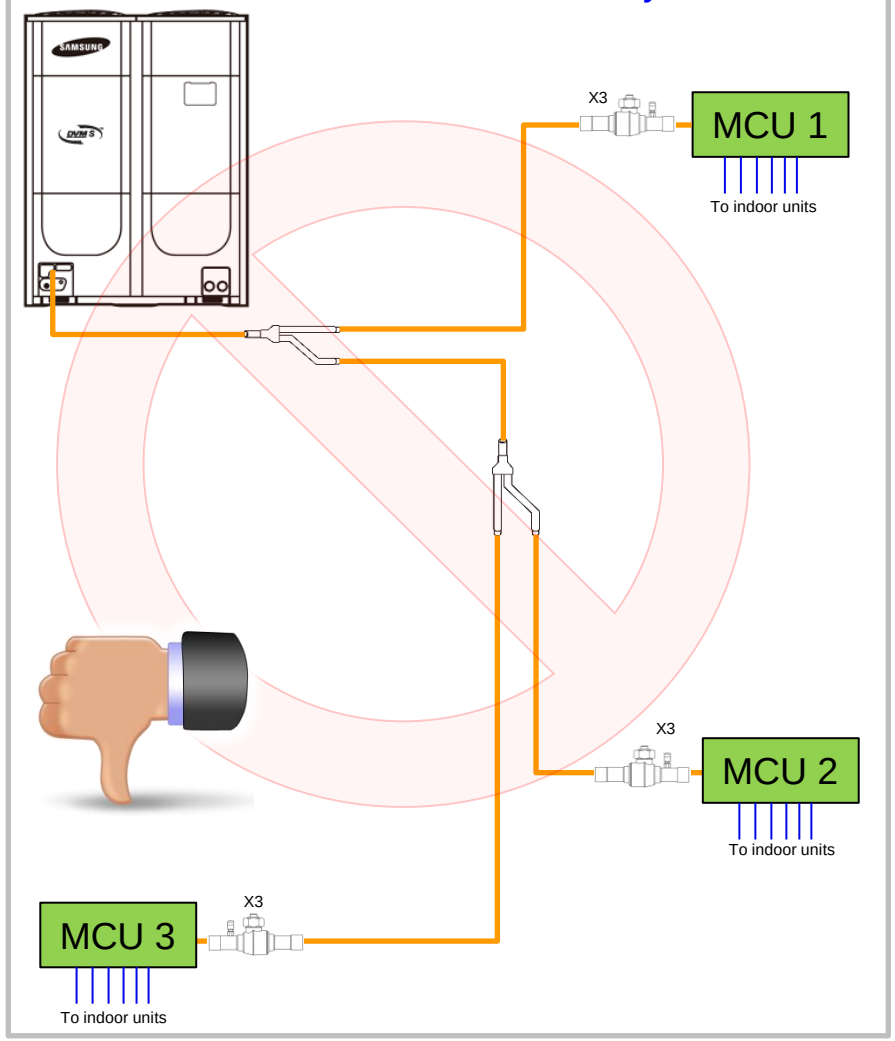
Heat Recovery Systems

When installing isolation valves before MCU's to isolate an MCU and connected indoor units, install the valves right after the connected Y-joint (explanation on following pages).

Isolation valves installed immediately after Y-joint



Isolation valves installed immediately before MCU

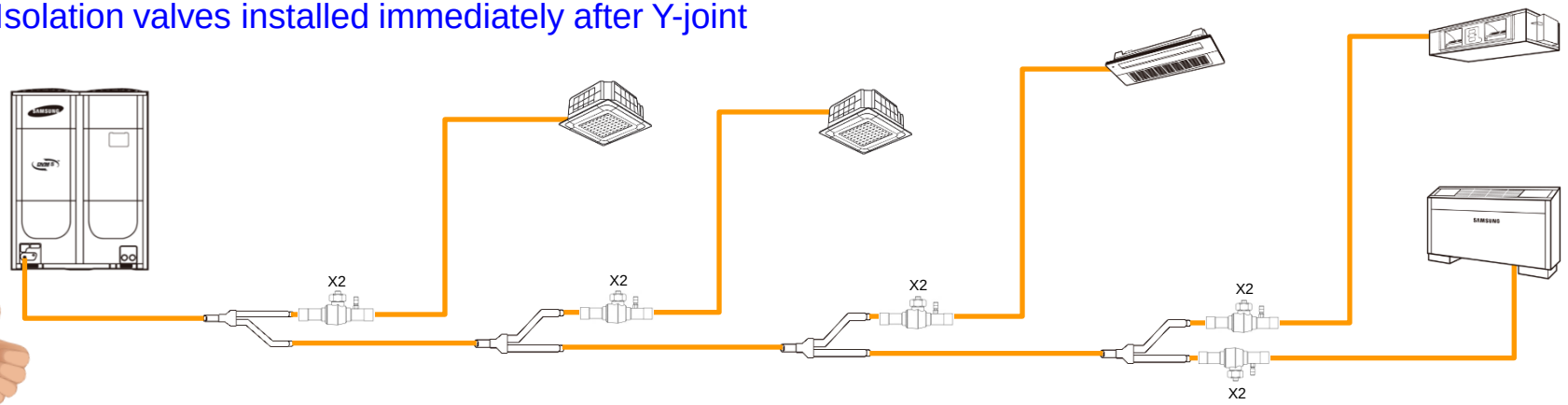


Isolation Valves

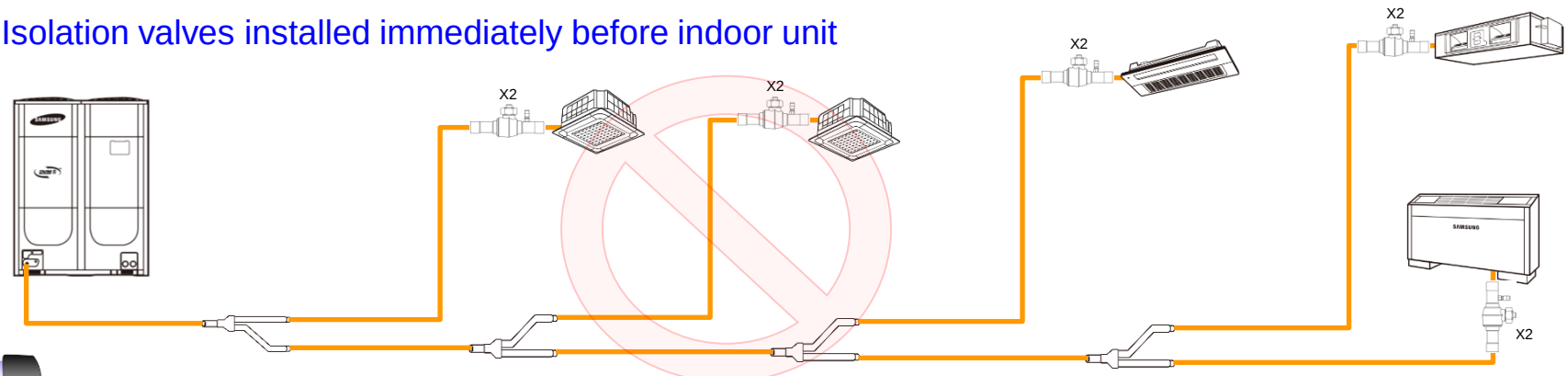
Heat Pump Systems

When installing isolation valves on heat pump systems, install the valves immediately after the Y-Joint (explanation on following pages).

Isolation valves installed immediately after Y-joint



Isolation valves installed immediately before indoor unit



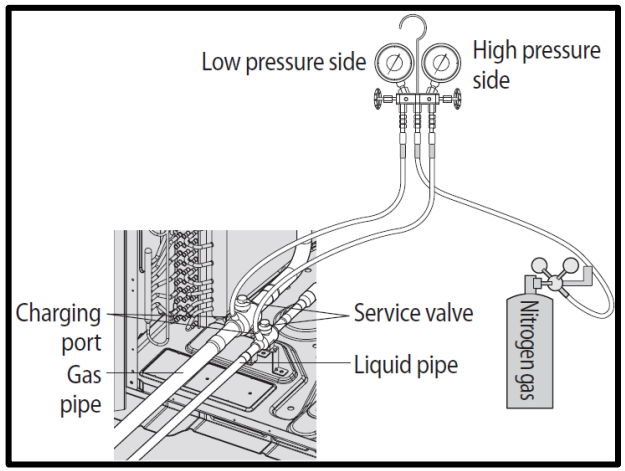
Pressure Test, and Pipe Insulation

DVM S

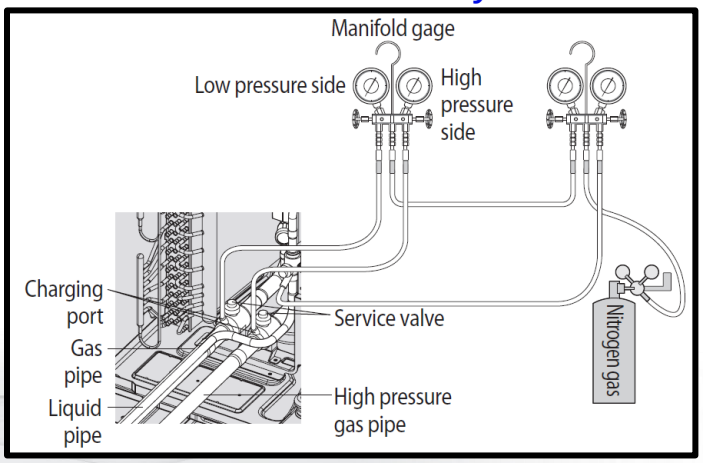
Leak Test - Manifold Connection

All refrigerant pipes must be connected to your manifold during leak testing and vacuum process (liquid, suction, and high pressure gas)

Heat Pump



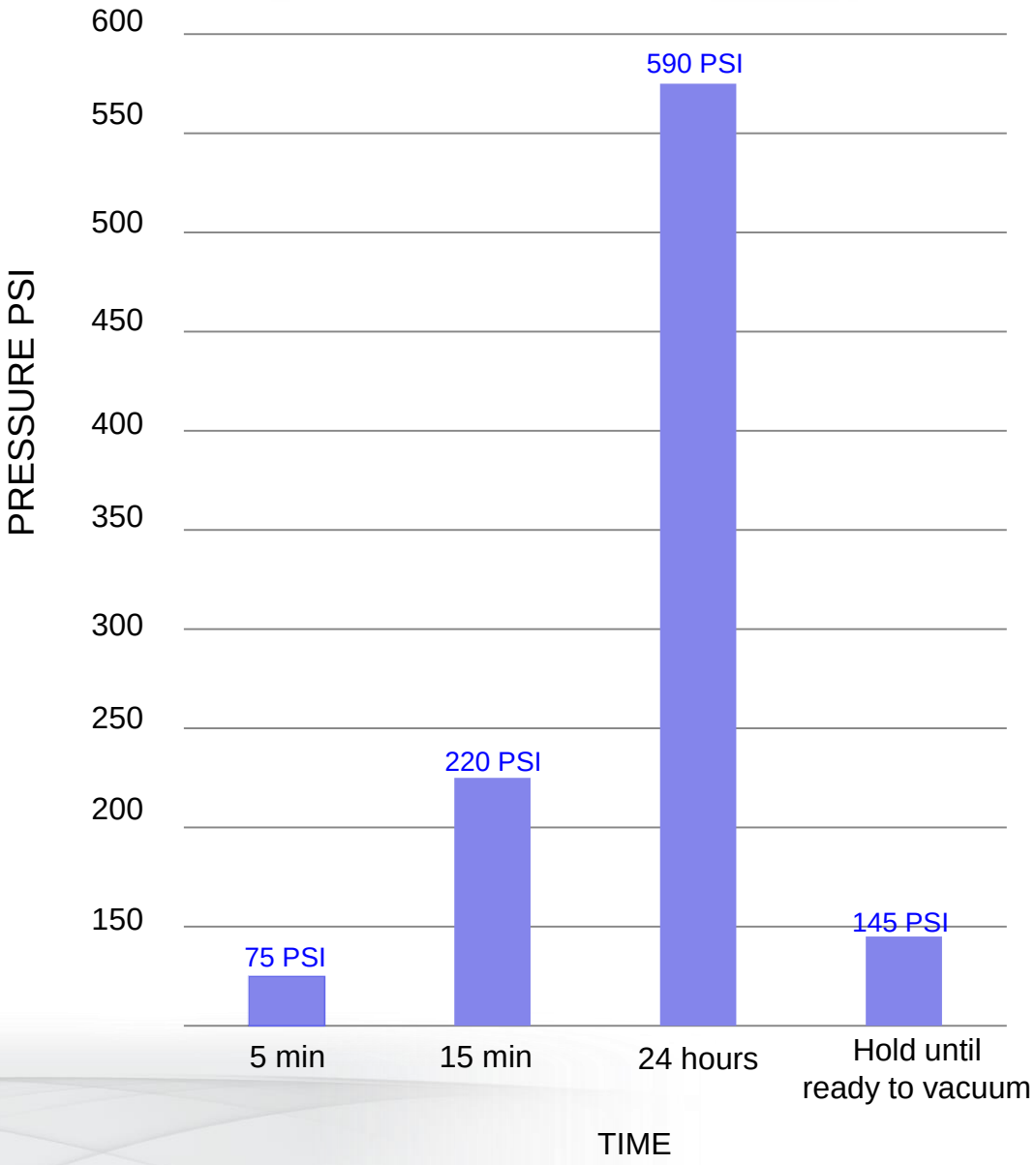
Heat Recovery

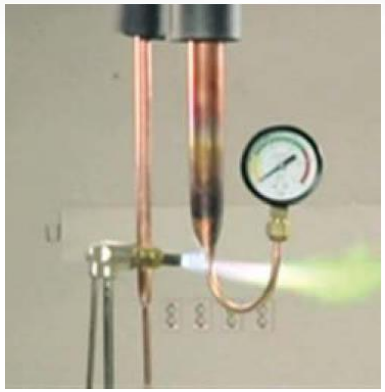


Example: Pressure checking before outdoor unit is installed during and after pipe/IDU installation.

DVM S

Leak Test





1. Pressure system to 75 psi for 5 minutes
2. Pressure system to 220 psi for 5 more minutes
3. Pressure system to 590 psi for 24 hours
4. Bring back down to 145 psi and leave until ready to begin vacuum process

(temperature difference calculation on next page)

DVM S

Leak Test – Ambient temperature changes

- Make a note of ambient temperatures after pressurizing system up to 590 PSI
- After 24 hours if ambient temperatures change, this can effect the pressure within the refrigerant system
- For every 1° F, a pressure change of 0.805 psi can be expected.

= Pressure when adding nitrogen + ((Current temperature-Initial temperature) X 0.805)

EXAMPLE:
If……
It was 85º F when you initially charged with dry nitrogen, and you got the pressure up to 583 psi,
and when you returned after 24 hours the ambient temperature is 82º F, the pressure that should be present is:

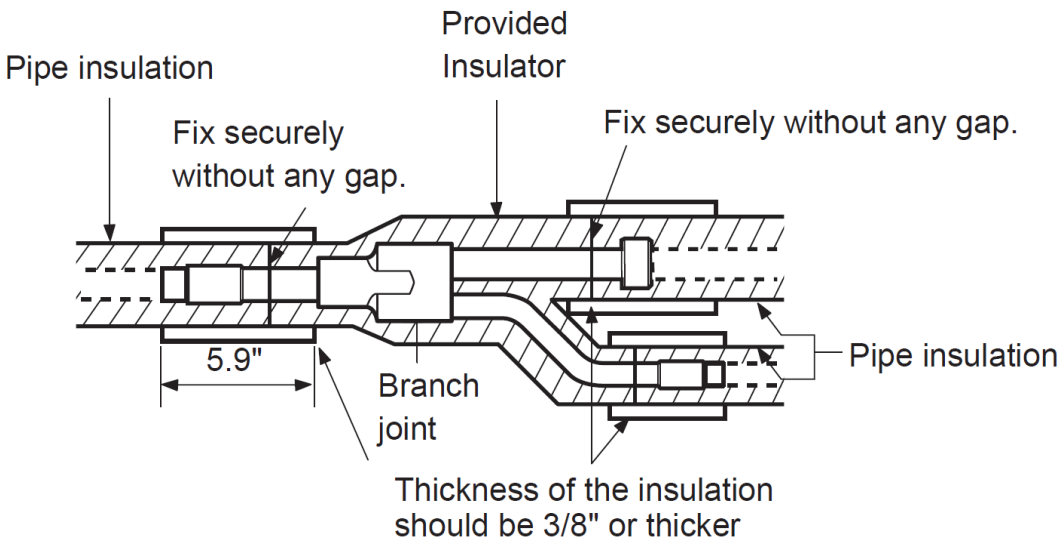
= 583 psi + ((82-85) X 0.805)
= 583 psi + (-3 X .0805)
= 580.58 psi

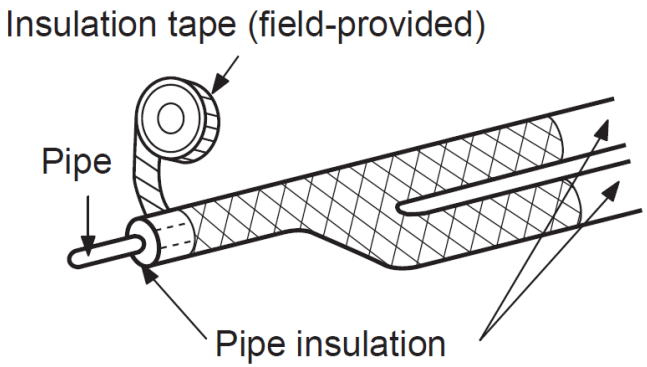
DVM S

Joint Insulation

- To prevent condensation formation, seal all seams of Y-joint and header insulation

- Seal pipe insulation to header and Y-joint insulation



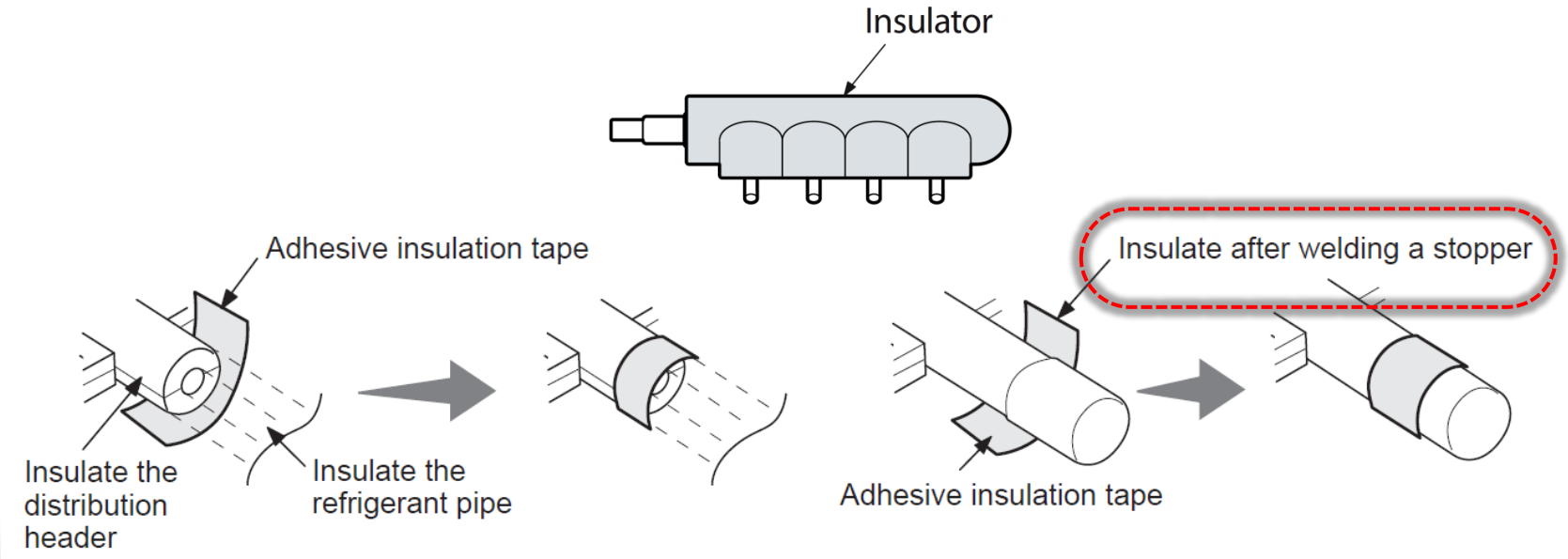


Wrap with adhesive insulation tape after insulating the pipe.

DVM S

Joint Insulation

- Install provided header joint insulation
- If any ports were not used, insulate to prevent condensation
- Seal all seams of provided insulation
- Seal seams of header insulation to pipe insulation

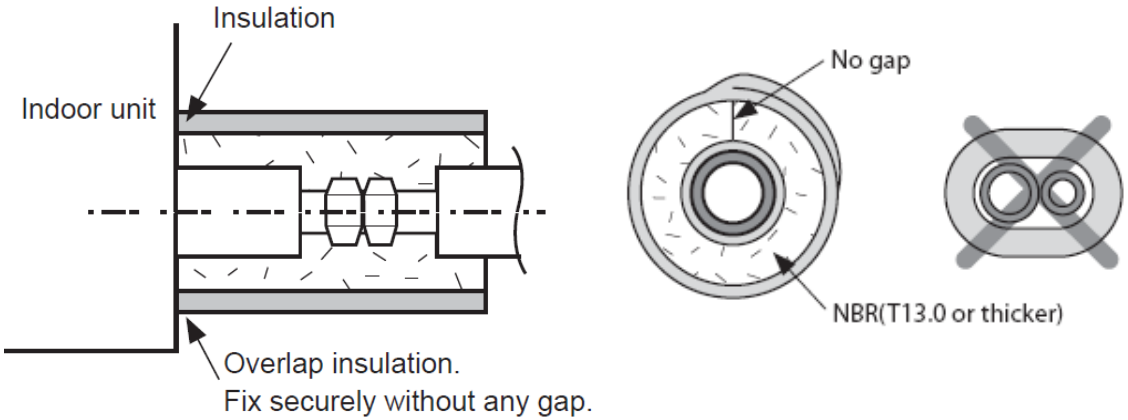


DVM S

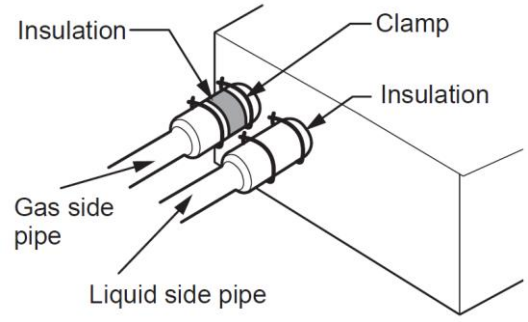
Indoor Unit Connection Insulation

- Wrap the thick pipe insulation that came with the indoor unit around the liquid and suction pipes (individually wrapped) with the seam on the top of the pipes first

- Then wrap the adhesive-back insulation around the thick insulation



- Attach provided wire ties around the insulation as pictured below.



- No copper or brass should be exposed

System Evacuation and Additional Refrigerant

DVM S

System Evacuation

What is a Triple Evacuation?

- Is it timed?
- Is it a process?

Boiling Point of Water at Various Vacuum Levels

Temp. F	Temp. C	Microns	Inches of HG Vacuum	Pressure PSIA
212	100	759,968	0.00	14.696
205	96.11	535,000	4.92	12.279
194	90	525,526	9.23	10.162
176	80	355,092	15.94	6.866
158	70	233,680	20.72	4.519
140	60	149,352	24.04	2.888
122	50	92,456	26.28	1.788
104	40	55,118	27.75	1.066
86	30	31,750	28.67	0.614
80	26.67	25,400	28.92	0.491
76	24.44	22,860	29.02	0.442
72	22.22	20,320	29.12	0.393
69	20.56	17,780	29.22	0.344
64	17.78	15,240	29.32	0.295
59	15	12,700	29.42	0.246
53	11.67	10,160	29.52	0.196
45	7.22	7,620	29.62	0.147
32	0	4,572	29.74	0.088
21	-6.11	2,540	29.82	0.049
6	-14.44	1,270	29.87	0.0245
-24	-31.11	254	29.91	0.0049
-35	-37.22	127	29.9150	0.00245
-60	-51.11	25.40	29.9190	0.00049
-70	-56.67	12.70	29.9195	0.00024
-90	-67.78	2.54	29.9199	0.00005
--		0.00	29.9200	0.000000

DVM S

System Evacuation

1. Connect a vacuum pump with new oil
2. Connect an accurate micron gauge to monitor vacuum status
3. Evacuate down to 5000 microns
4. Pressurize with dry nitrogen to 3 psi
5. Hold pressure for 10 minutes

DVM S

System Evacuation

6. Release nitrogen
7. Evacuate down to 2000 microns
8. Pressurize with dry nitrogen to 3 psi
9. Hold pressure 15 minutes
10. Evacuate to 300 microns and hold for 60 minutes.

- Vacuum process may require multiple vacuum breaks with dry nitrogen
- Vacuum pump operation duration must be over 2.5 hours.
- When the ambient temperature is below 32^0 F, extra care must be takes to ensure that the pipe system remains moisture free during and after installation.

If the above mentioned micron levels cannot be achieved check hose integrity, seal integrity and change your vacuum pump oil.

DVM S

Additional Refrigerant

- At this point the system is ready for the additional refrigerant
- Use a quality digital scale to accurately weigh in the calculated amount of refrigerant
- Additional refrigerant amounts are based on linear feet of liquid line piping for each diameter, EEV kits, etc.
- Samsung's DVM Pro software is a helpful tool to quickly calculate this value

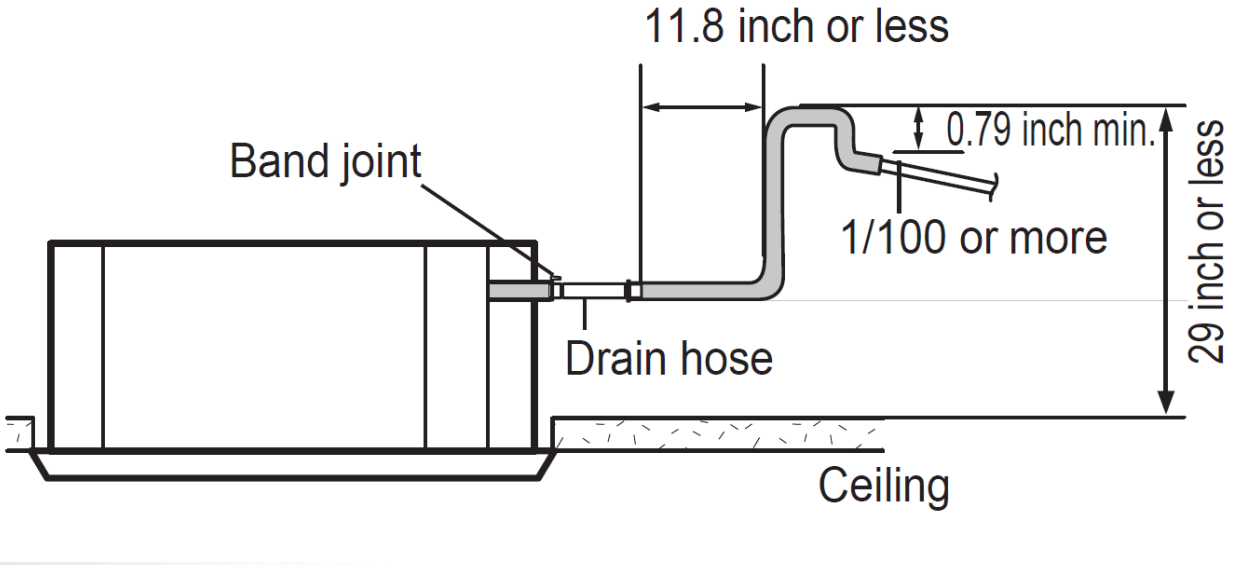
- Add additional refrigerant before releasing the factory charge from the condensing unit

Condensate Drain Piping

DVM S

Drain Pipe Installation – Single Cassette and Samsung Duct Units With Internal Pump

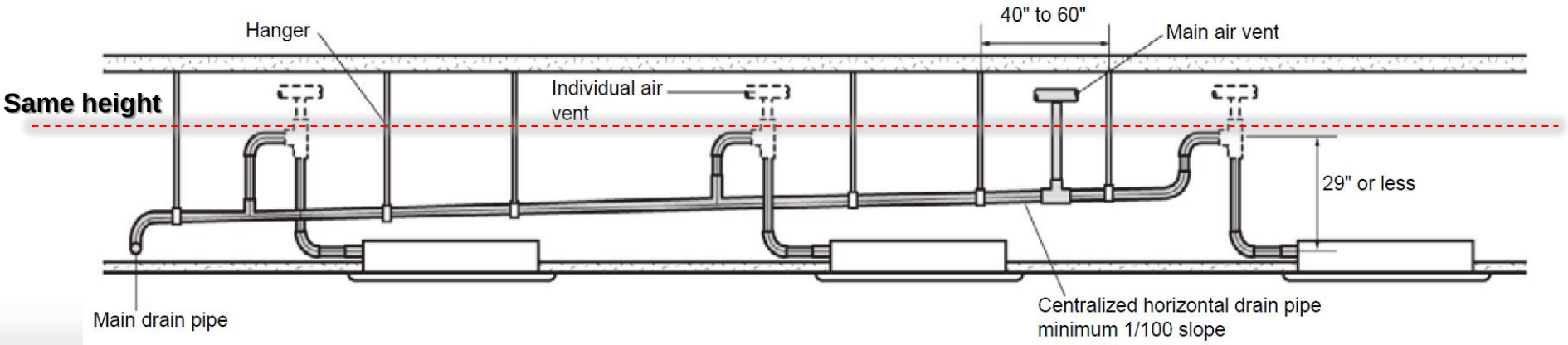
- Current cassette models have a maximum pump head of 29” from the bottom of the unit
- All drain pipes must be insulated throughout the building
- A vent can be installed at the top dead point to facilitate proper drainage if needed
- Hangers must be installed every 40” to 60” minimum to prevent accidental traps
- At the top of the trap a tee or elbow is necessary to prevent debris from falling into the drain pipe



DVM S

Drain Pipe Installation – Single Cassette and Samsung Duct Units With Internal Pump

- The individual drain lines must tap into the main drain line from the top, not the side or bottom (example on next page)
- There must be a main drain pipe vent every 32’ to 50’
- Individual drain vents may be necessary to prevent water leakage
- Make sure the main drain line is sized properly to handle the volume of condensate from multiple units.

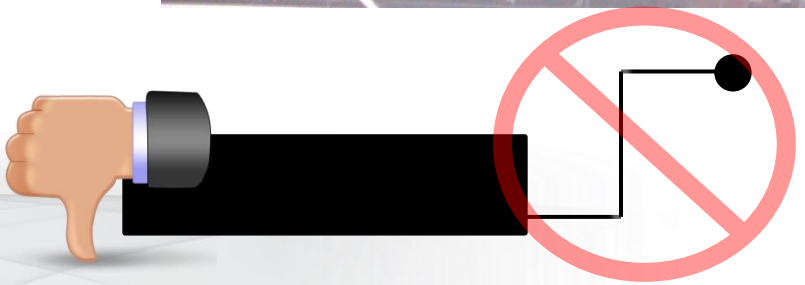


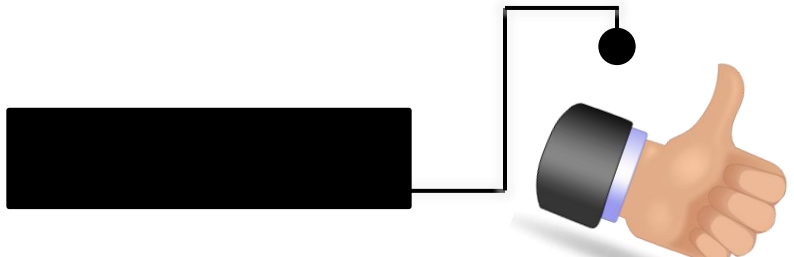
DVM S

Drain Pipe Installation – Tapping Into Top Of Common Drain

- Failure to tap into the main drain pipe from the top will cause: check valve failure, poor or no drainage, and/or water leaks

- Premature pump failure can also occur



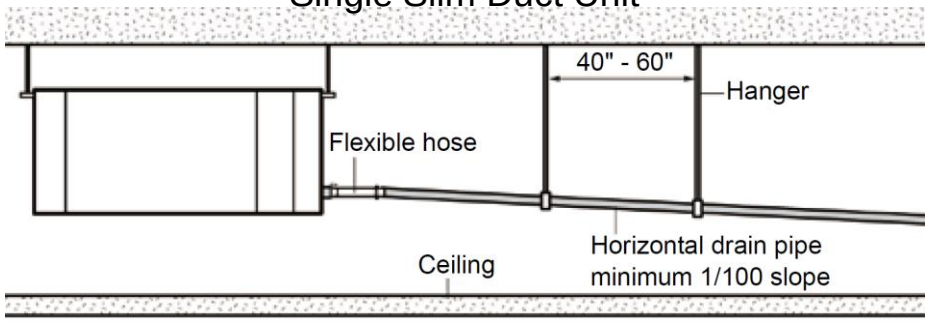


DVM S

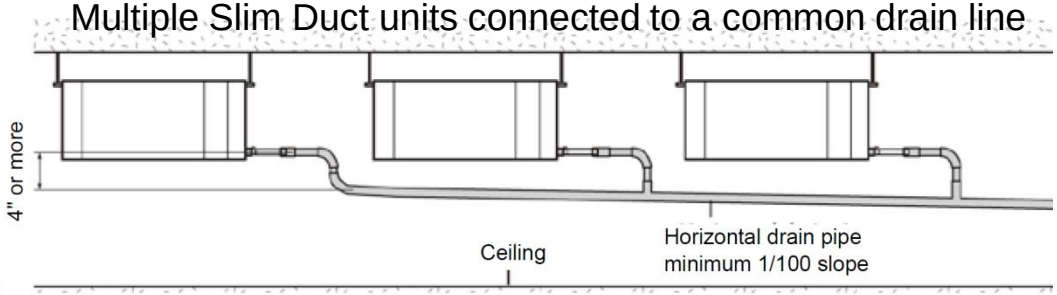
Drain Pipe Installation – Slim Duct (AM0**FNLDCH/AA)

- Slim Duct model unit drain pans are on the positive side of the blower
- Single units do not need a trap to prevent leaks, but needs a trap or vent at some point to prevent gasses from entering (verify local and state codes)
- Never connect multiple units together that are not the same height to prevent leakage in the event of a main drain pipe blockage

Single Slim Duct Unit



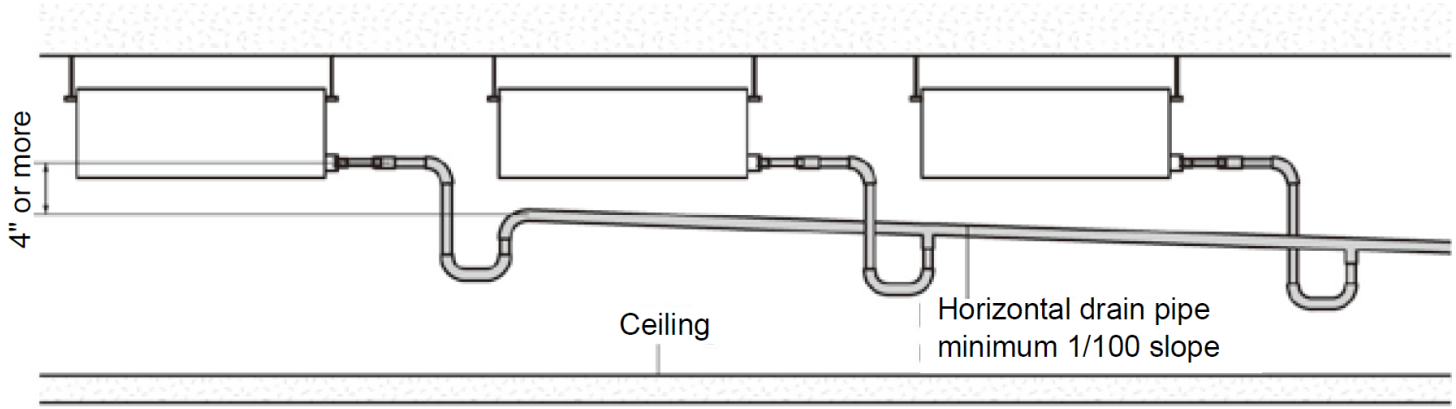
Multiple Slim Duct units connected to a common drain line

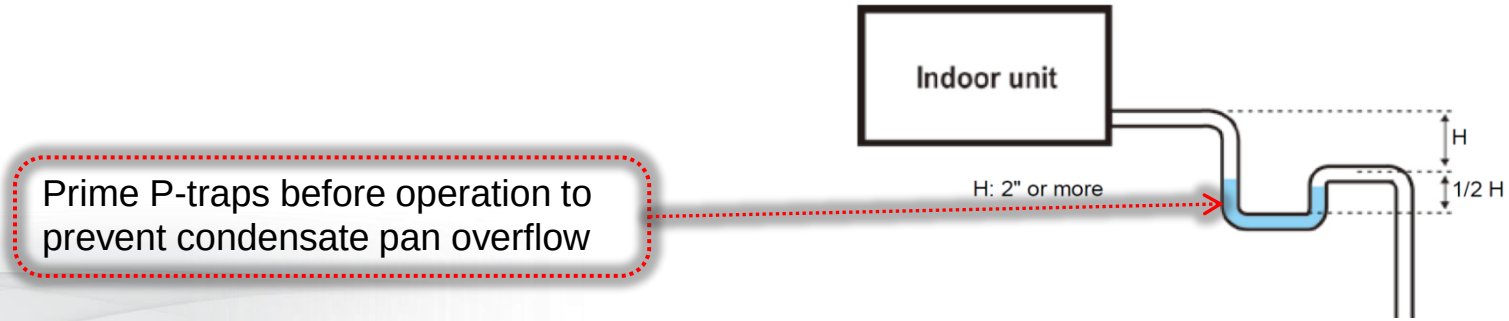


DVM S

Drain Pipe Installation – MSP and HSP Ducted

- MSP and HSP units require a P-trap to allow proper drainage from the unit
- Make sure the main drain pipe can handle the volume of condensation from multiple units
- Only connect units to a single main drain pipe that are suspended the same height

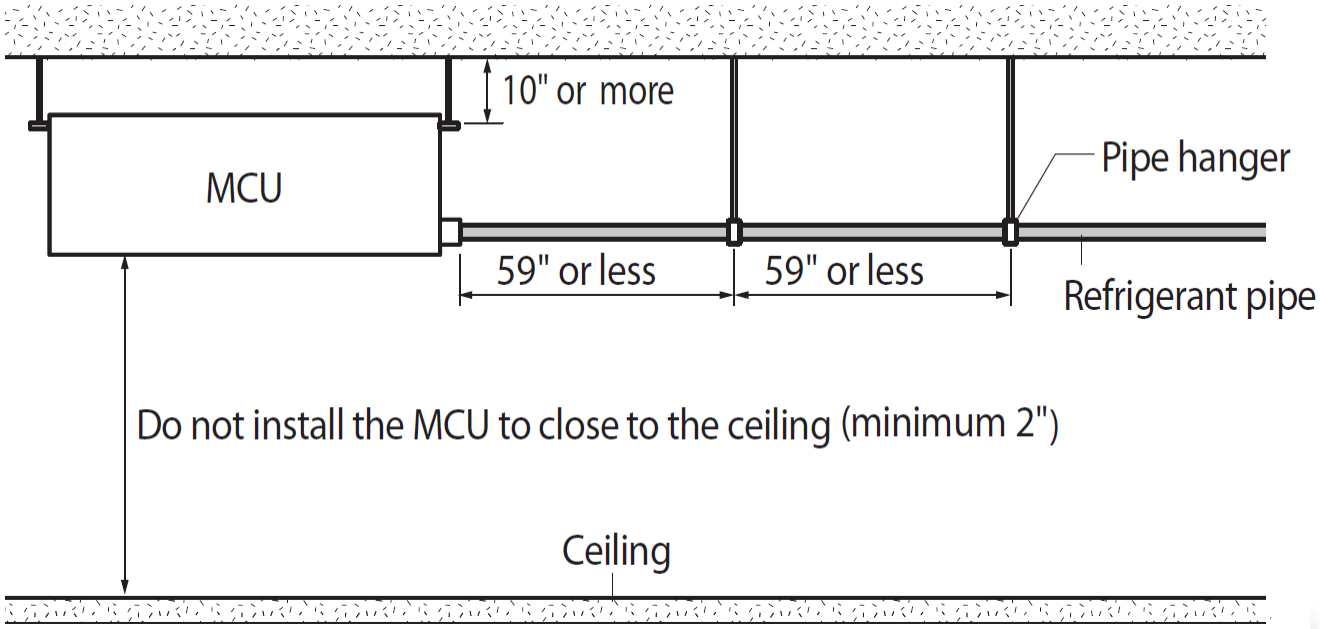




Prime P-traps before operation to prevent condensate pan overflow

DVM S

MCU drain connection



- If proper drain pitch is not possible, consider using a common condensate pump or a smaller single unit condensate pump.

Wall Unit Condensate Pump Installation

DVM S

Condensate pumps – wall mounted, ceiling, and floor standing units

- Cassette units have condensate pumps built in
- Ducted units have Samsung condensate pumps available or built in
- Aspen and Blue Diamond pumps are available through Quietside/Samsung for wall mounted units, MCU's, floor standing units, and ceiling units.

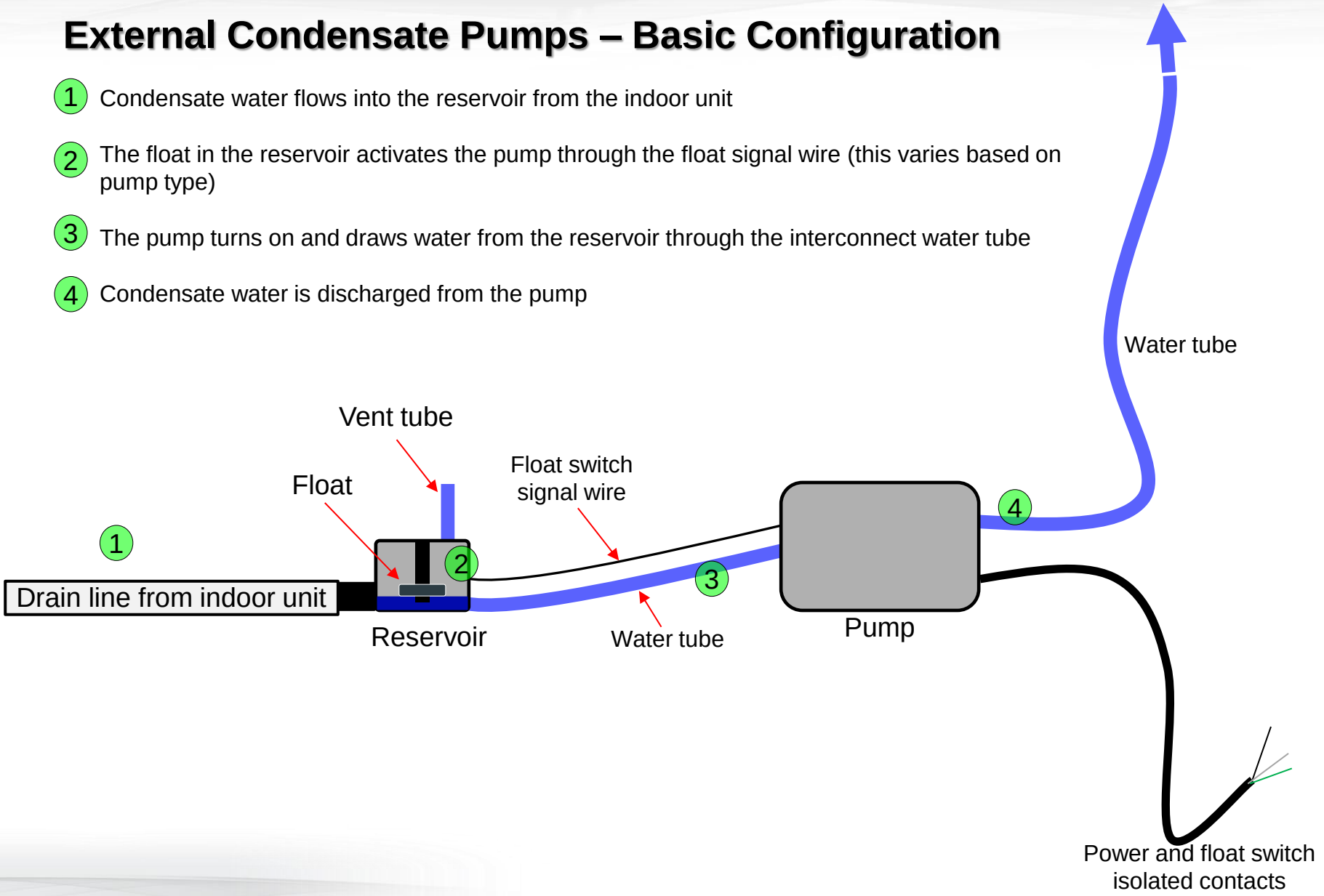
Aspen
ASP-MO-UNIV 110-250

Blue Diamond
BD-BLUE230

DVM S

External Condensate Pumps – Basic Configuration

1. Condensate water flows into the reservoir from the indoor unit
2. The float in the reservoir activates the pump through the float signal wire (this varies based on pump type)
3. The pump turns on and draws water from the reservoir through the interconnect water tube
4. Condensate water is discharged from the pump



DVM S

Condensate pumps – wall mounted units

There are 2 methods for disabling a Samsung wall-mounted unit with condensate pump signal

- Method 1: Temperature sensor connection
- Method 2: External contact, 0 volts, signal connection (external contact control)

DVM S

Condensate pumps – wall mounted units – Method 1

METHOD 1 – Temperature sensor interruption

- Use the N.C. (normally closed, purple) and Common (grey) wires from the pump to turn off system in the event of pump failure or drain blockage

- Do not use this relay to “break” the high voltage to the indoor unit or wired controller connections

Aspen
ASP-MO-UNIV 110-250
Relay wire connection
NC: Purple
Common: Grey

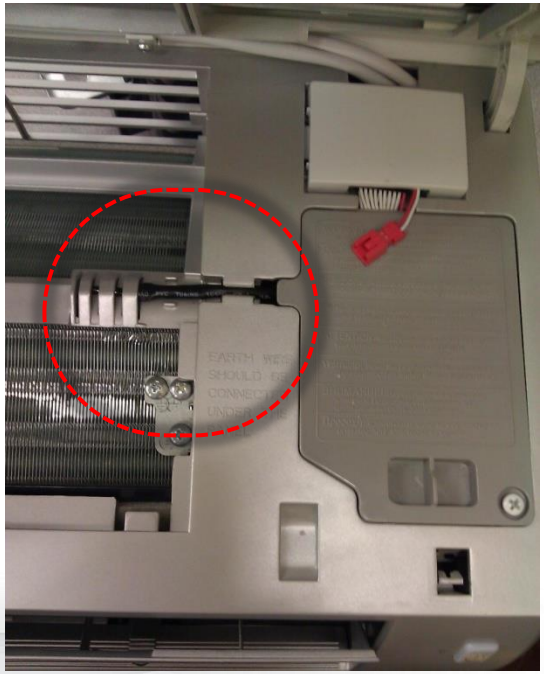
Blue Diamond
BD-BLUE230
Relay wire connection
NC: Yellow
Common: Black
(located in grey cable)

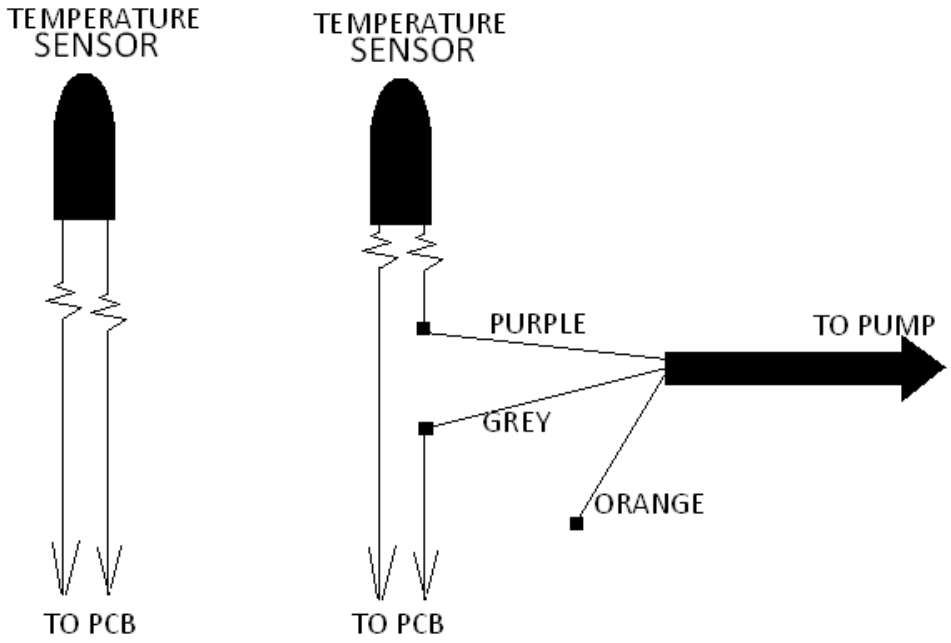
DVM S

Condensate pumps – wall mounted units – Method 1

- Connect this relay to one of the conductors coming from the indoor temperature sensor located on the front of the evaporator coil and break

- When there is a failure, loss of temperature sensing will disable the unit



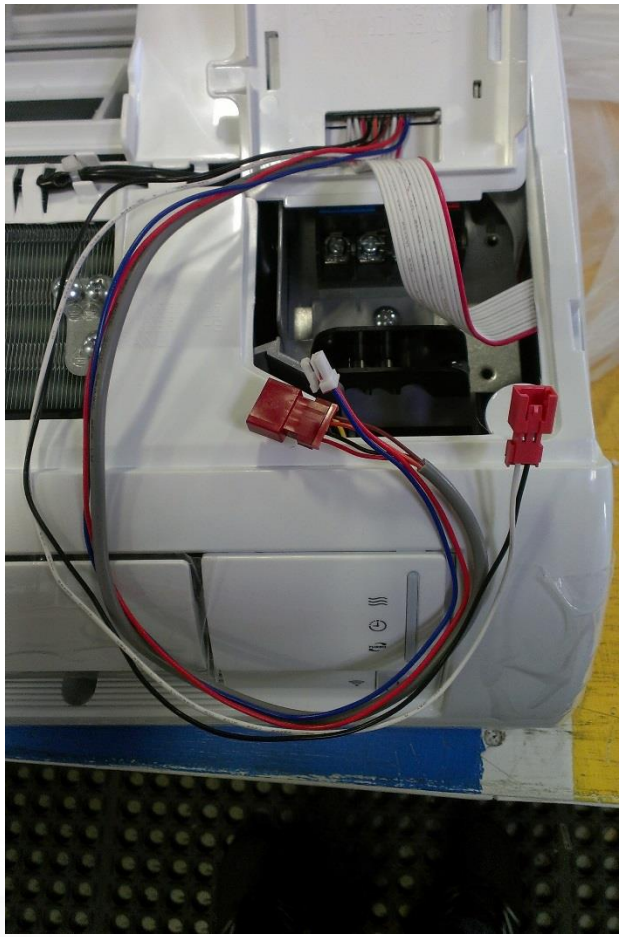


DVM S

Condensate pumps – wall mounted units – Method 2

METHOD 2 – External contact signal

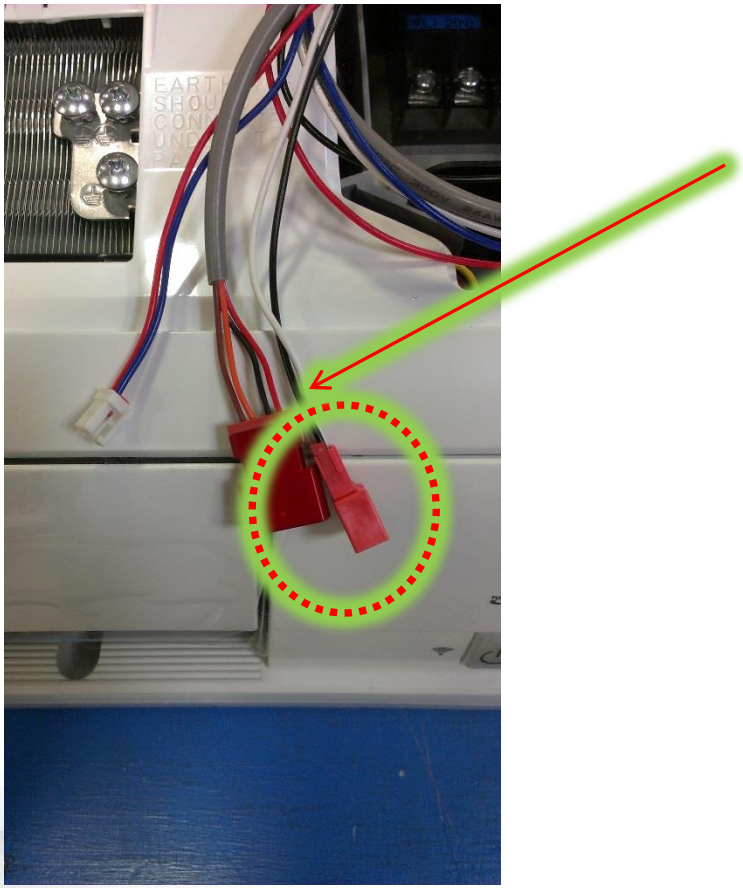
- Locate the external contact control connection wires inside the Neo Forte chassis PCB cover



DVM S

Condensate pumps – wall mounted units – Method 2

- Connect the condensate pump's normally closed and common wires to the external contact control connection wires inside the Neo Forte chassis wire cover



- Black/white wire
- Cut off red connector and connect to pump relay N.C. and Common
- Ensure that all connections are properly insulated and secured inside the unit chassis

Duct Unit Secondary Pan

Float Switch Connection

Duct Unit Float Switch

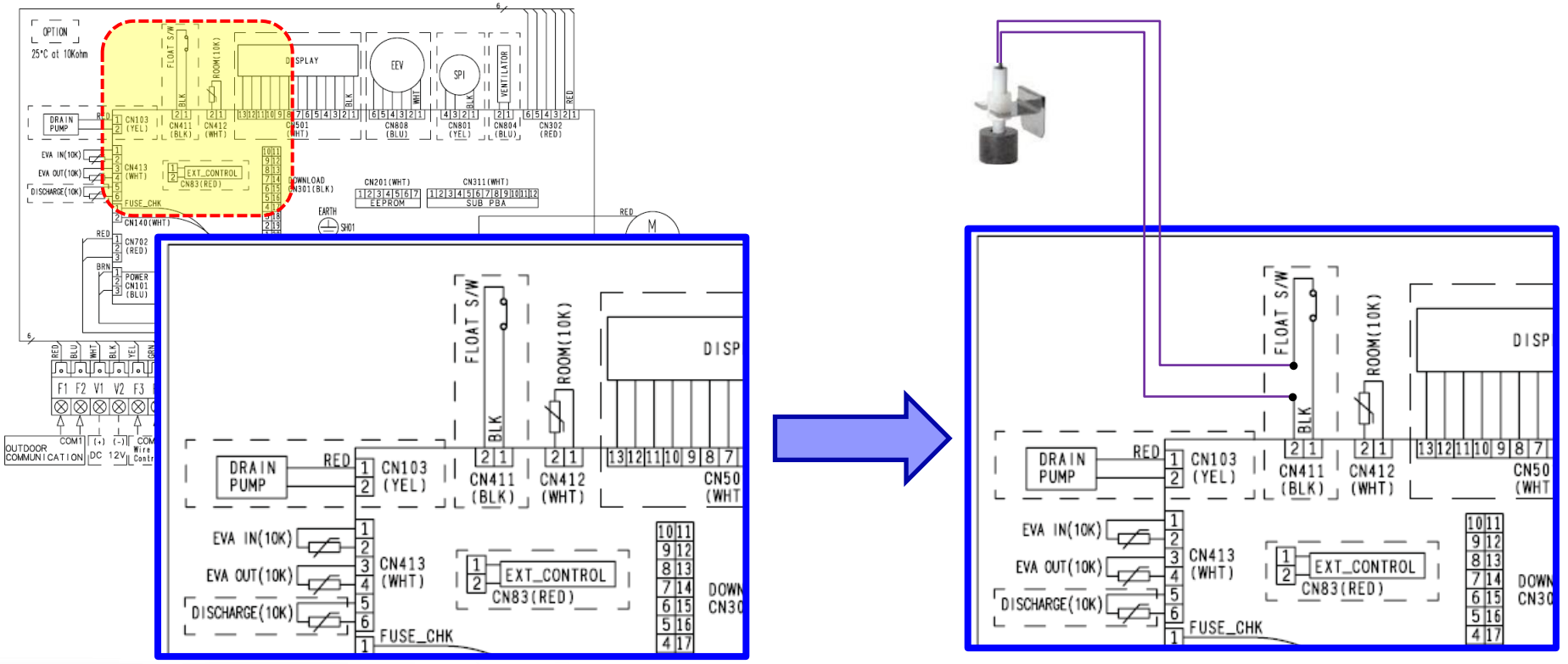
Secondary Pan Float Switch Connection

- Enable Depending on the installation location, a secondary, external pan may need to be installed under a ducted unit.
- The following are options for connecting a field-provided float switch to a ducted unit for emergency float detection

Duct Unit Float Switch

Secondary Pan Float Switch Connection – Example 1

- If the duct unit has an internal Samsung condensate pump, connect the secondary pan switch in series with the built-in float on the condensate pump (black 2 pin plug, CN411)

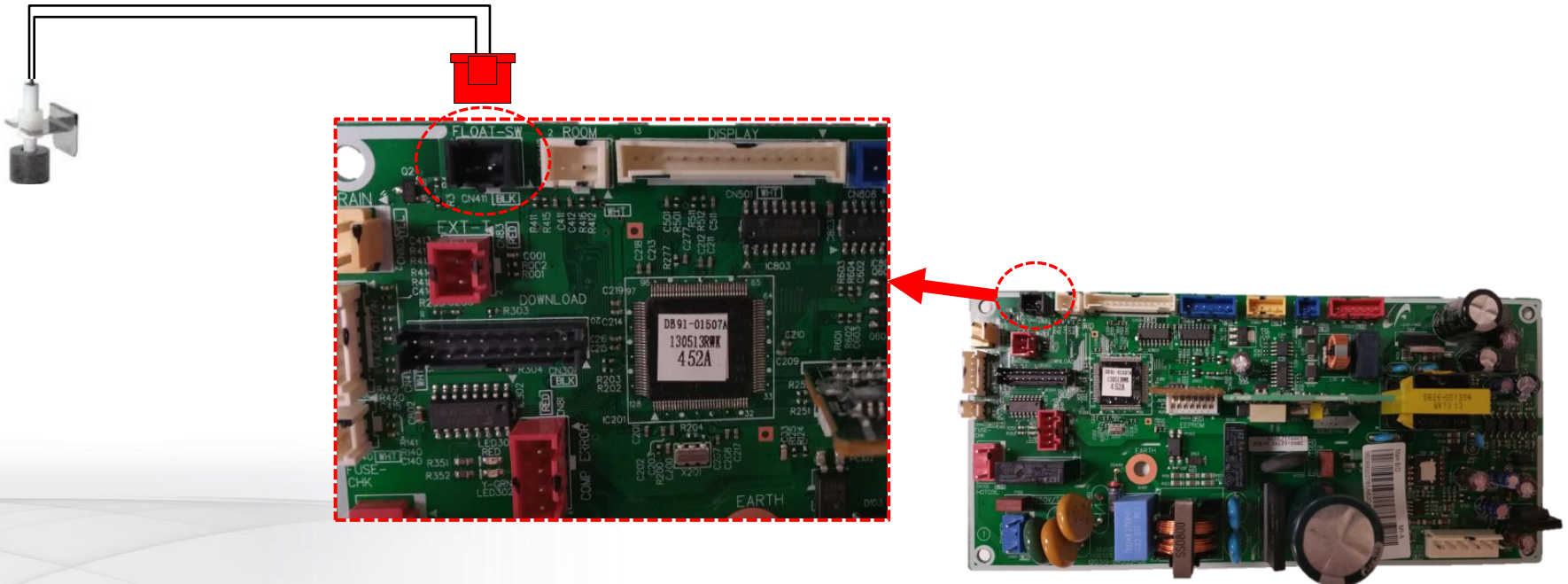


Duct Unit Float Switch

Secondary Pan Float Switch Connection – Example 2

- If the duct unit does not have an internal Samsung condensate pump, connect the secondary pan switch to the “FLOAT-SW” plug on the ducted unit PCB.
- This will require part number DB39-01263A (pigtail with plugs)
- Use the DB39-01263A to connect the field-provided, 0 volt, normally closed switch to the PCB.
- **<u>During indoor unit programming, tell the duct unit that there is a condensate pump installed.</u>**

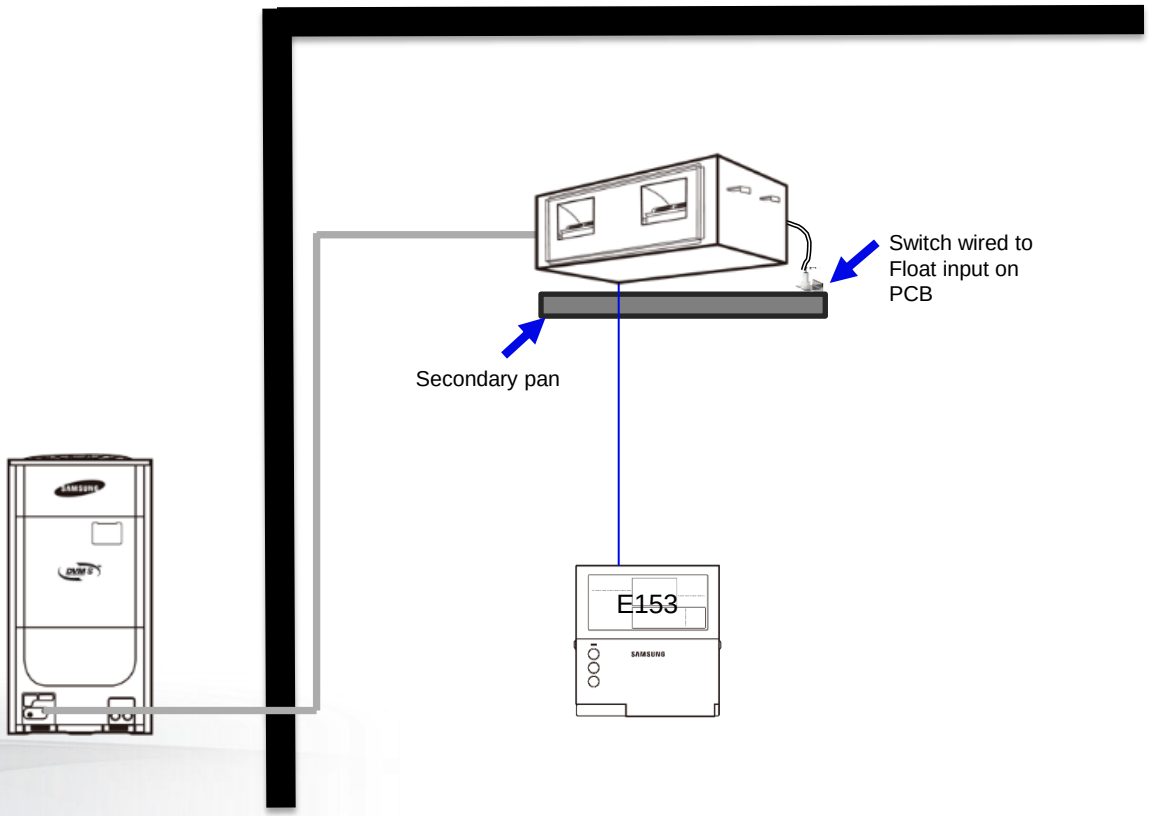
DB39-01263A “CN83 Pigtail”



Duct Unit Float Switch

Secondary Pan Float Switch Connection

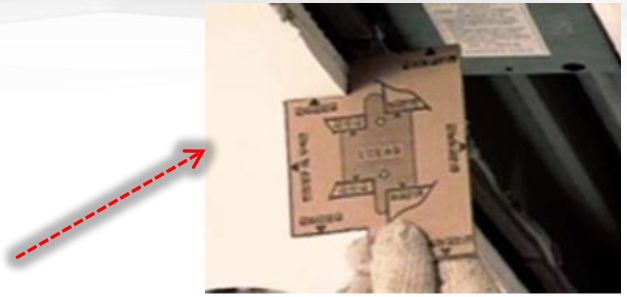
- When the contact is opened and not closed shortly thereafter, E153 will display on the wired controller and any central controllers



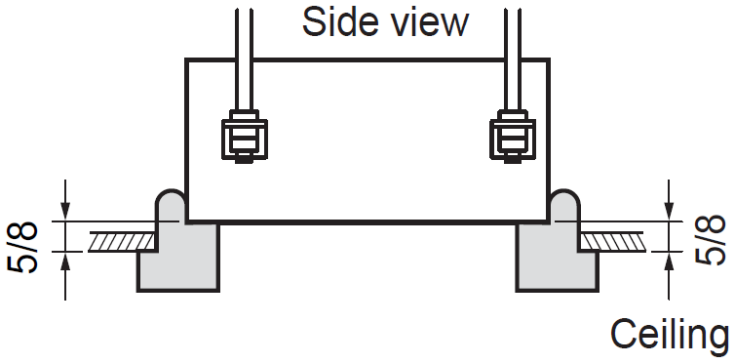
Cassette Panel Installation

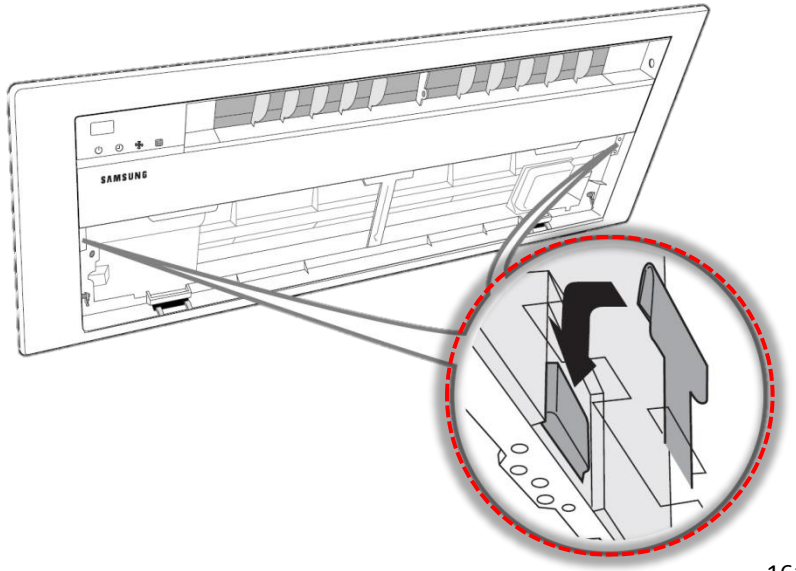
DVM S

1-Way Cassette Panel Installation



- Adjust the height of the indoor unit in relation to the ceiling with the included guide
- Situate the panel in the proper direction before lifting up to unit
- Lift the panel up to the unit guiding the panel hooks into the openings on the 1-way cassette chassis
- Guide the louver and display wires into the PCB box making sure not to pinch or damage them
- Push upward until the hooks catch in the provided openings

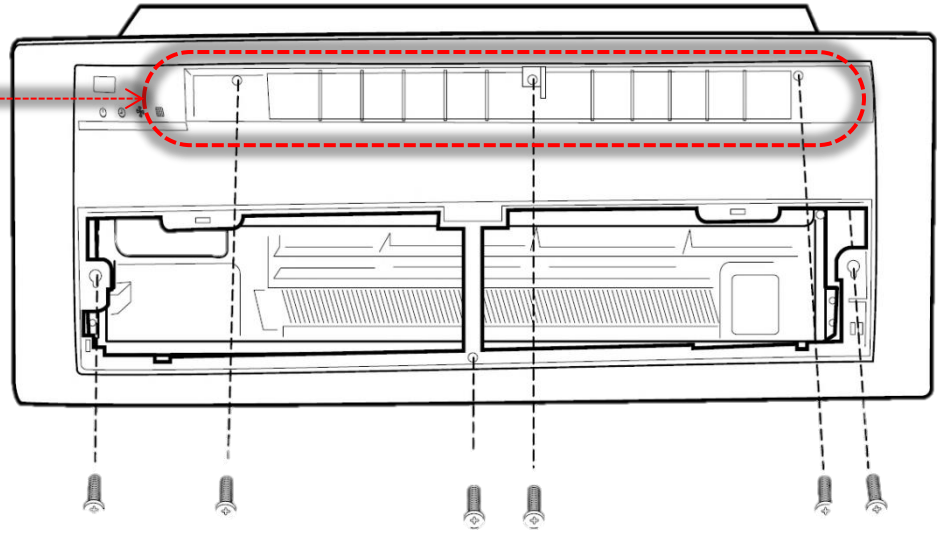


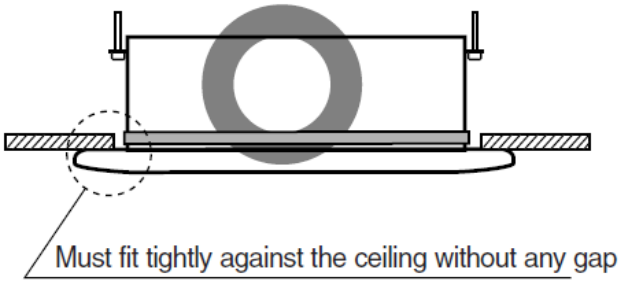


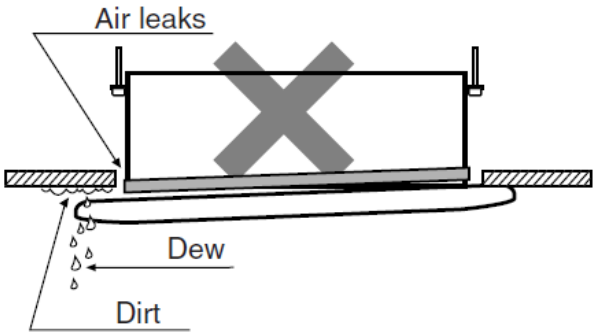
DVM S

1-Way Cassette Panel Installation

- With the provided hardware, screw the panel to the unit
- Take care not to over tighten to prevent damaging the panel
- Make sure the panel is snug to the ceiling all the way around to prevent moisture issues and air leakage
- Install white screw covers (3) by supply air outlet louver

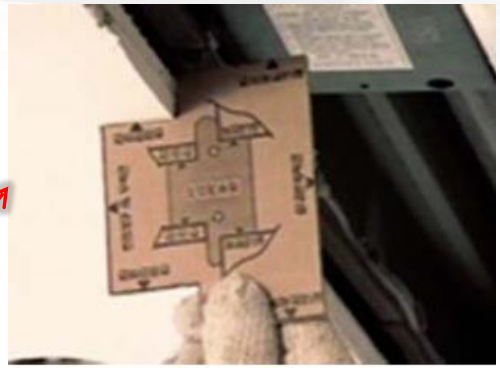




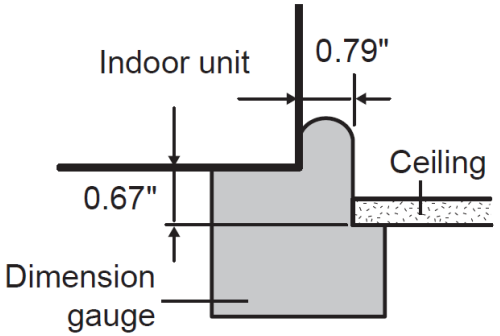


DVM S

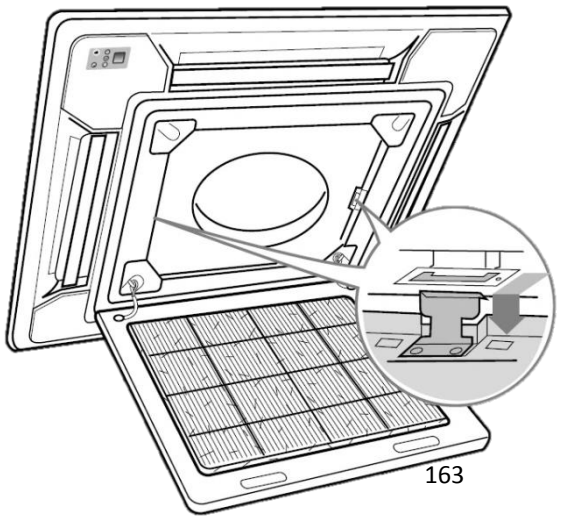
4-Way/Mini 4-way Cassette Panel Installation



- Adjust the height of the indoor unit in relation to the ceiling with the included guide



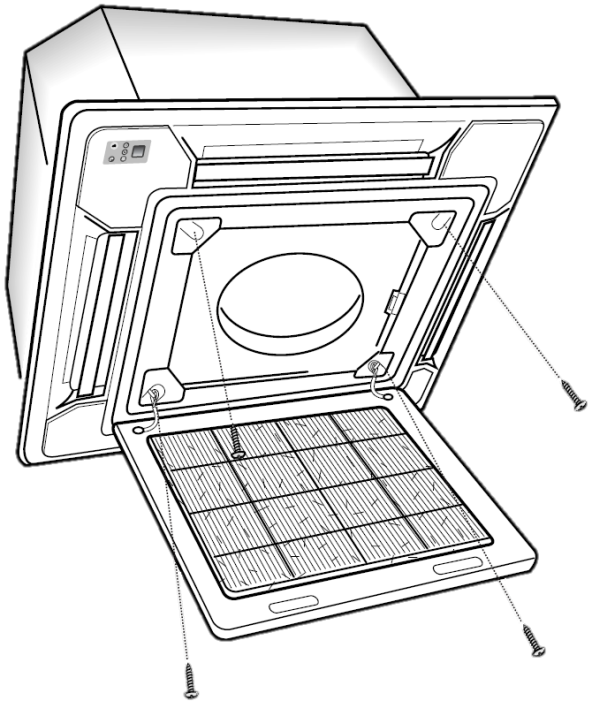
- Situate the panel in the proper direction before lifting it up to unit. There are only 2 directions the panel can attach to the unit because of the 2 panel hooks.
- The side of the panel with the louver and display wires needs to mount on the same side as the indoor unit's PCB
- Lift the panel up to the unit guiding the panel hooks into the openings on the 4-way cassette chassis
- Guide the louver and display wires into the PCB box making sure not to pinch or damage them
- Push upward until the hooks catch in the provided openings



DVM S

4-Way/Mini 4-way Cassette Panel Installation

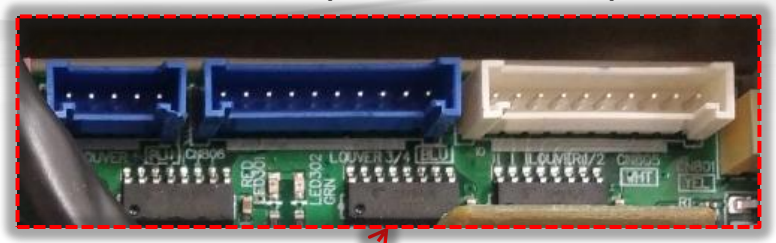
- With the provided hardware, screw the panel to the unit
- Take care not to over tighten to prevent damaging the panel
- Make sure the panel is snug to the ceiling all the way around to prevent moisture issues and air leakage
- Plug in the louver and display connectors to the PCB as described earlier



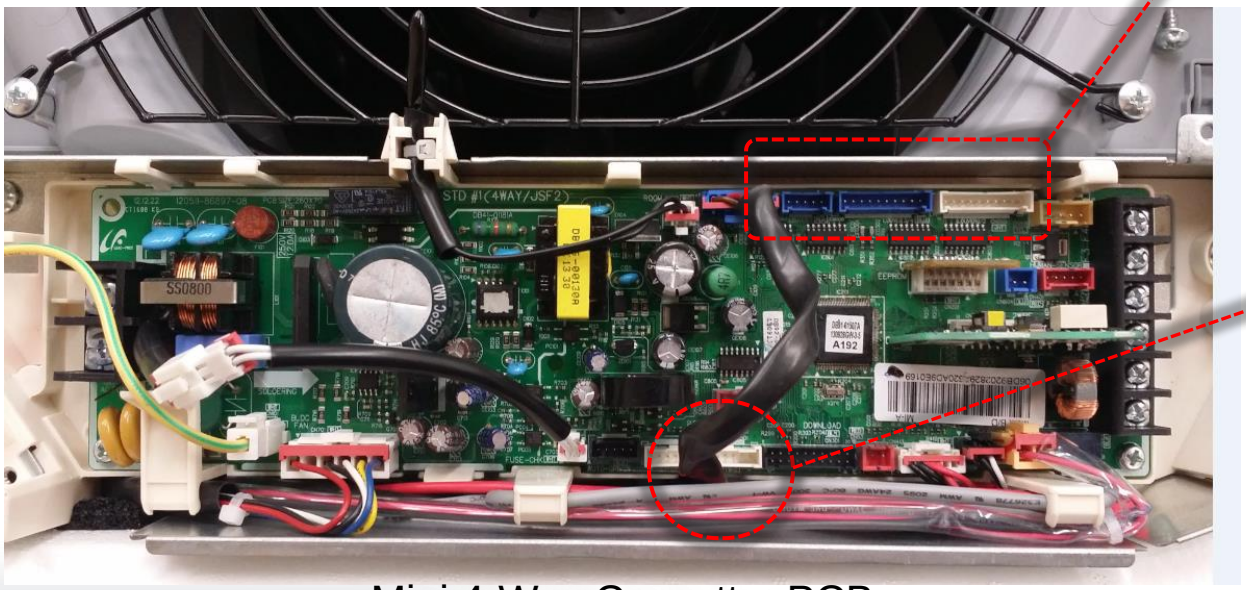
DVM S

Cassette Panel Installation

Louver (CN805/CN806)



- Attach the louver and display connectors to the PCB
- Take care to plug into the correct terminals
- “LOUVER” and “DISPLAY” are printed on the PCB above or below the proper locations



Mini 4-Way Cassette PCB

Display (CN501)

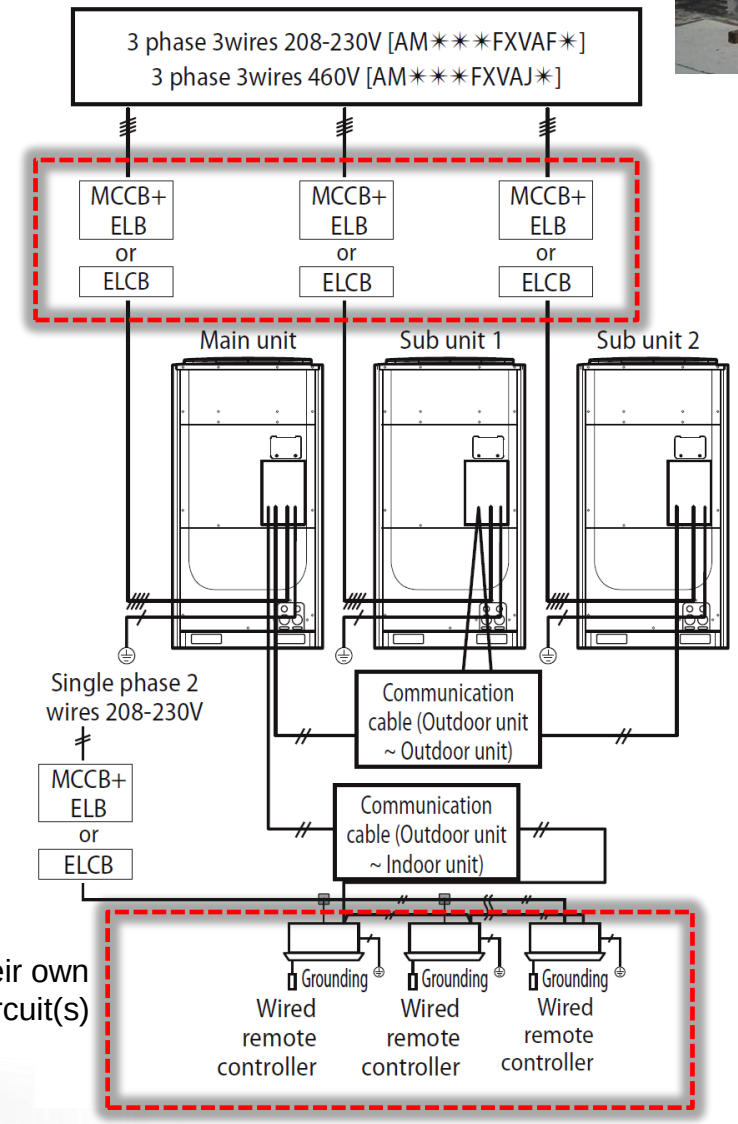
High Voltage Wiring

Only a licensed electrician should connect power to Samsung DVM S systems

DVM S

Main Power Wiring

Each outdoor unit needs its own breaker and disconnect (NEC)

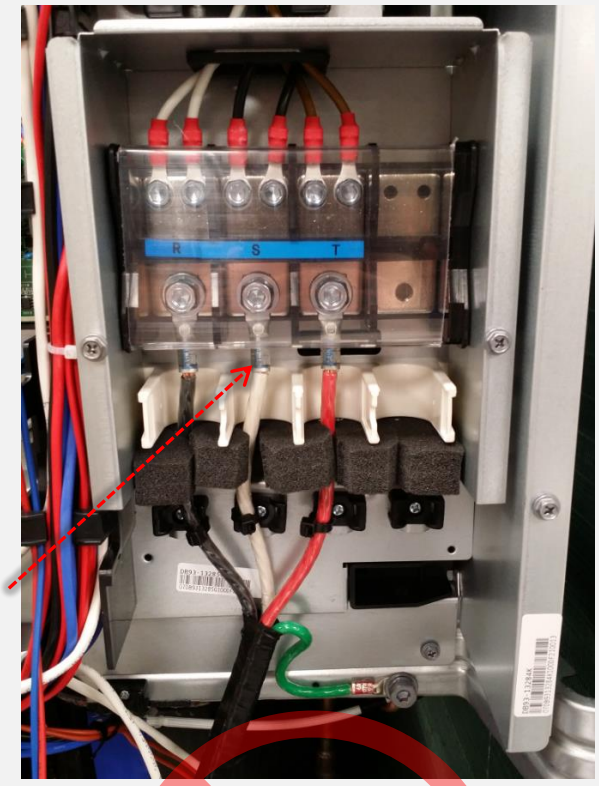


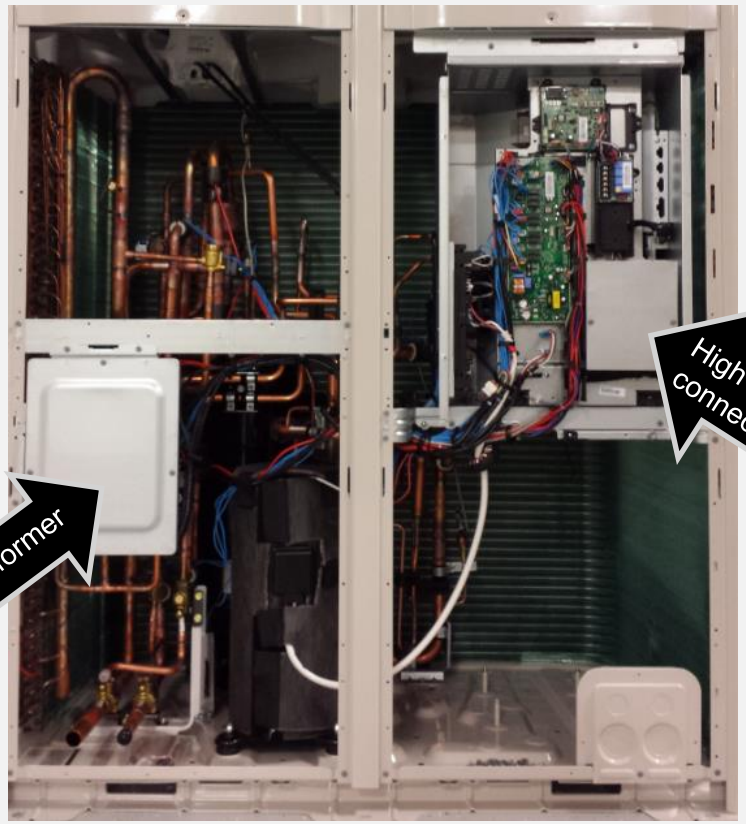
Indoor units require their own 208/230V 1Ph circuit(s)

DVM S

Main Power Wiring Precautions

Use “ring” connectors for all supply voltage wire connections



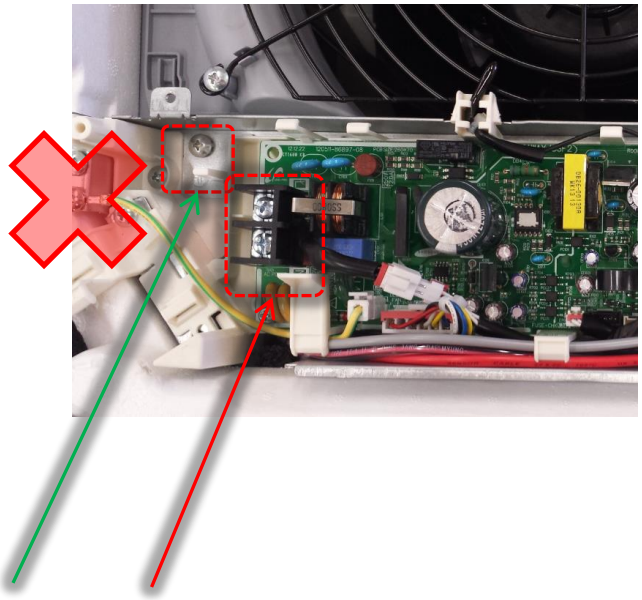


- 460V units have a transformer for 230V internal components (valves, controls, etc.)
- Connect high voltage in the control box, not at the transformer.

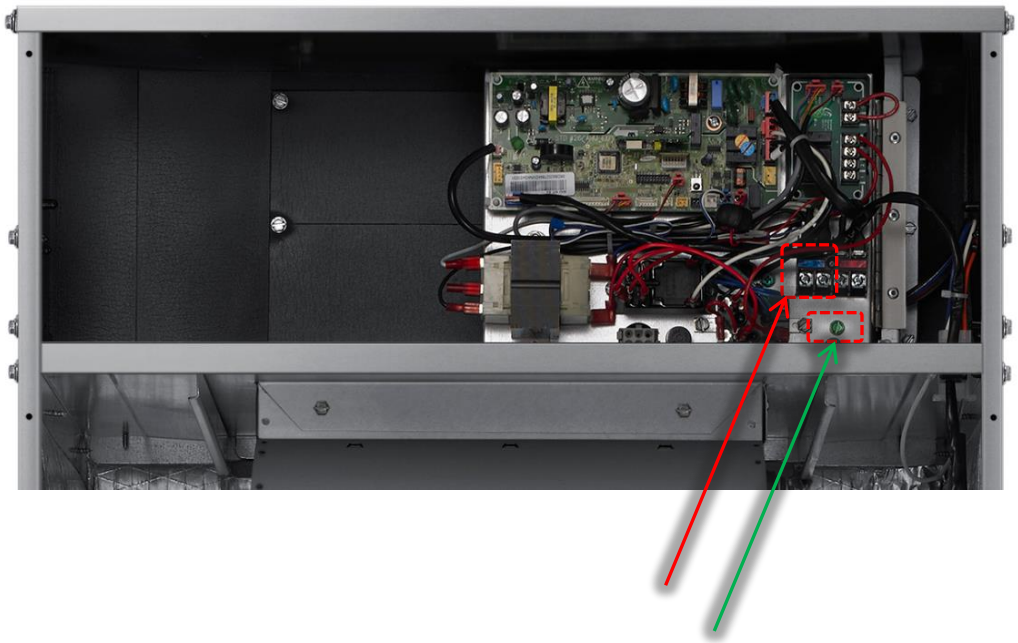
DVM Indoor Units

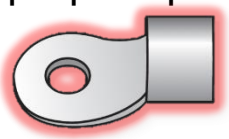
Main Power Wiring – Indoor Unit

Mini 4-Way Cassette



AM0**JNZDCH/AA Multi-position AHU

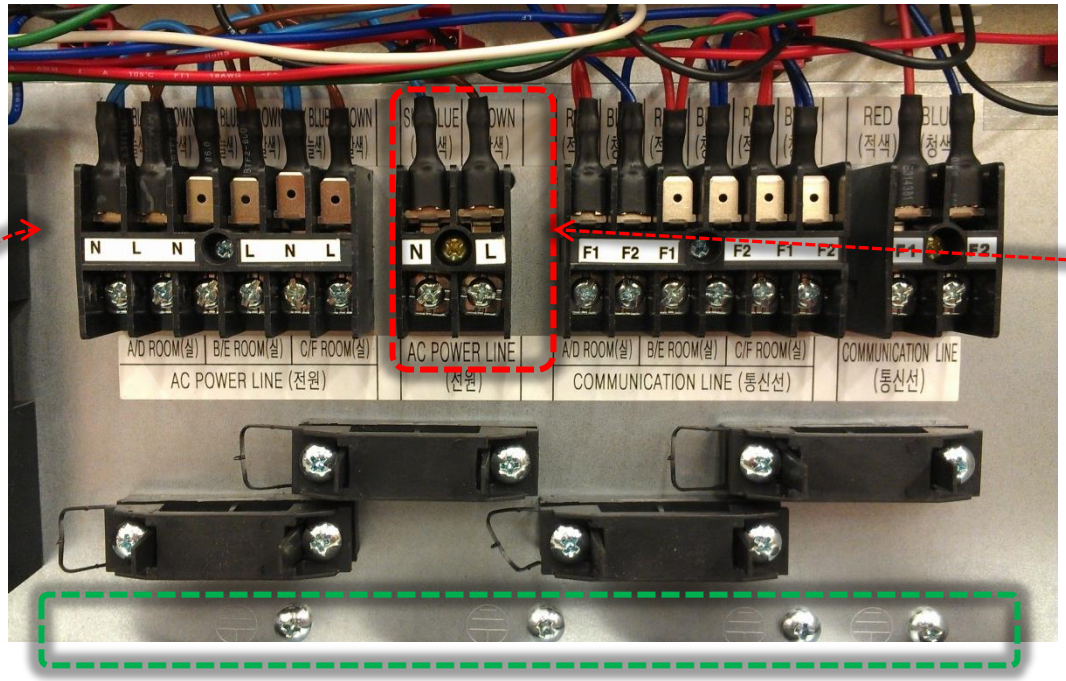


- Connect the 1Ø/208-230V circuit(s) to the 1(L) and 2(N) terminals in each indoor unit
- Ensure the unit is properly grounded well for proper operation and safety
- Use ring connectors to connect high voltage 
- Do not connect the main ground at the same point where the indoor unit is grounded

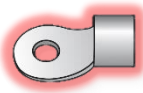
DVM Indoor Units

Main Power Wiring - MCU

MCU-S4NEE1N power and COM connections



- Connect the 1Ø/208-230V circuit(s) to the 1(L) and 2(N) terminals in each MCU and 2/3 zone EEV kit
- Ensure the unit is properly grounded well for proper operation and safety
- Use ring connectors to connect high voltage



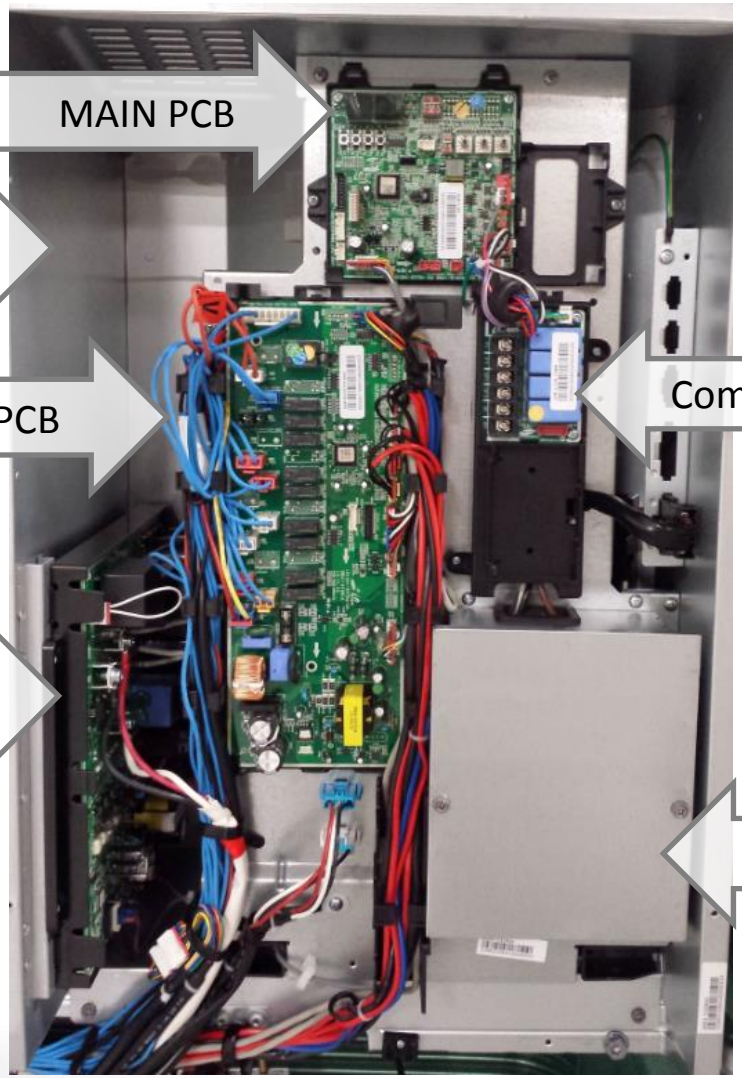
- Additional L/N connections are available to power indoor units (not typically used in North America)

System Communication

System Communication

Outdoor Unit Control Box – Single Compressor Model

Outdoor unit control box



NOTE: Outdoor units with 2 compressors will have a second IPM in this location (IPM 2)

System Communication

Outdoor Unit Communication Connections

F1 / F2

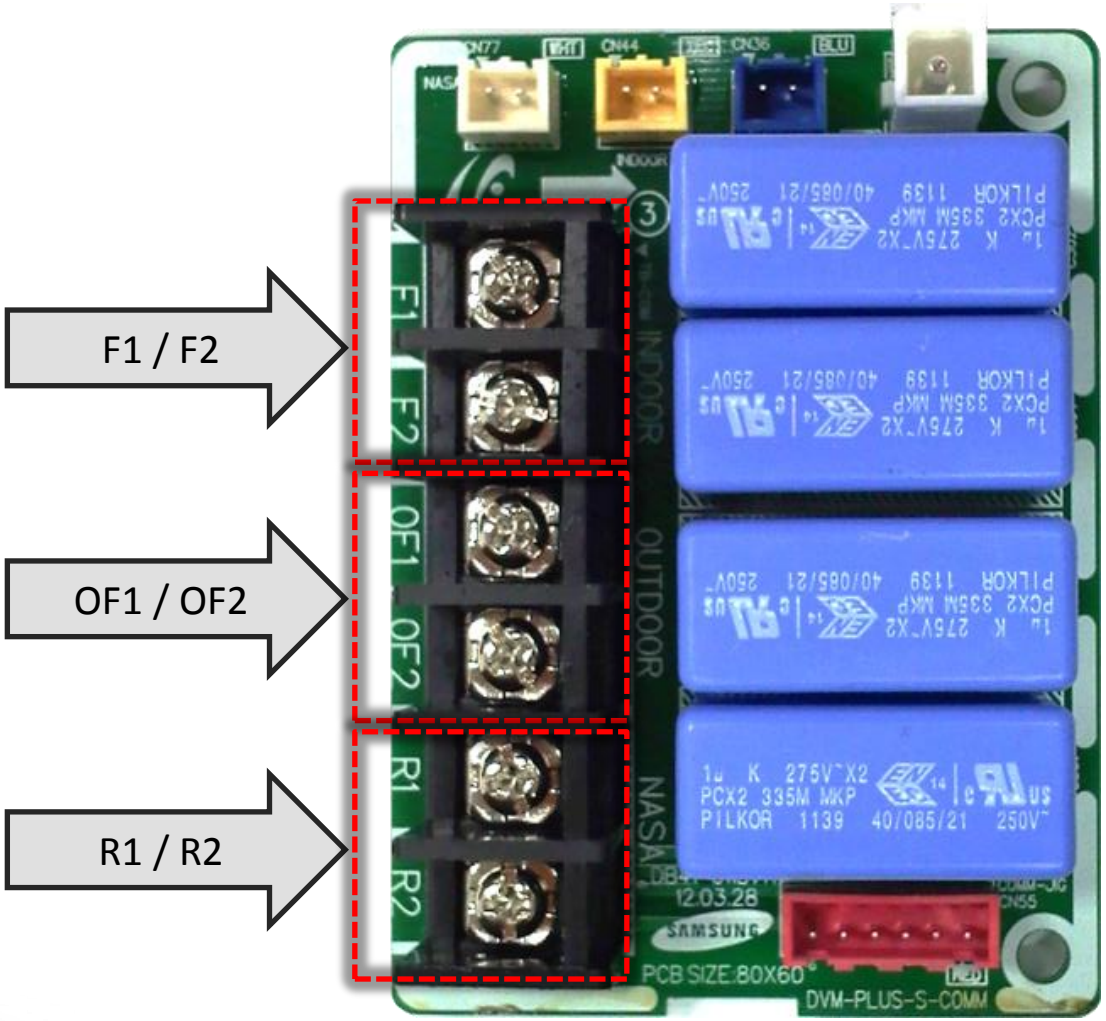
Communication from the MAIN outdoor unit to all indoor units, MCU's, and EEV kits on that refrigerant system (more details on next page)

OF1 / OF2

Communication from the MAIN outdoor unit to the SUB1 and SUB2 outdoor units (only used when the system has more than 1 outdoor unit).

R1 / R2

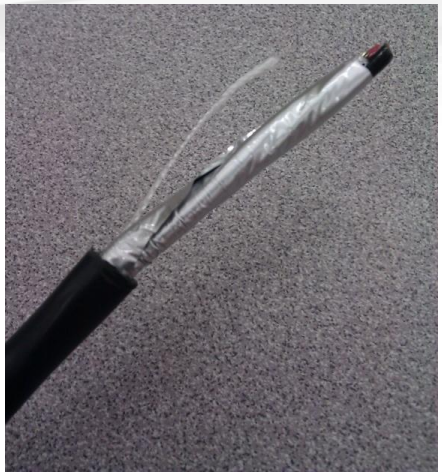
Communication from the MAIN outdoor unit to central control options (DMS2, BACnet, LON, touch controller)



System Communication

F1/F2

Main Communication Cable - F1/F2



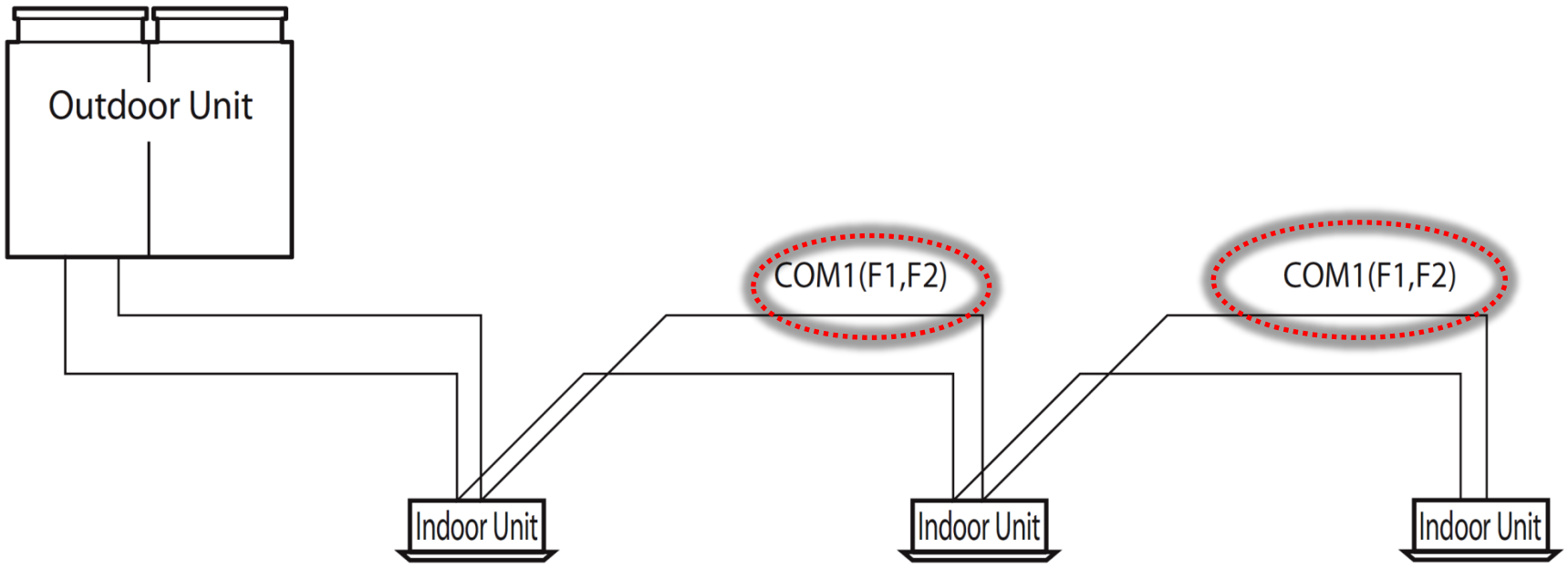
- F1/F2 (Com 1) is what allows communication between the outdoor unit and the indoor air handlers and MCU's
- This will be the only point of communication between all units on systems with no upper level controls
- F1/F2 (Com 1) is system specific (at no time should F1/F2 from one system connect to a separate system)
- RS485 Communication
- A separate cable from each piece of equipment inside back to the outdoor unit(s) is not necessary

- **Always use 2 X 16AWG, shielded cable for all communication cables**

System Communication

F1/F2 – Heat Pump Systems

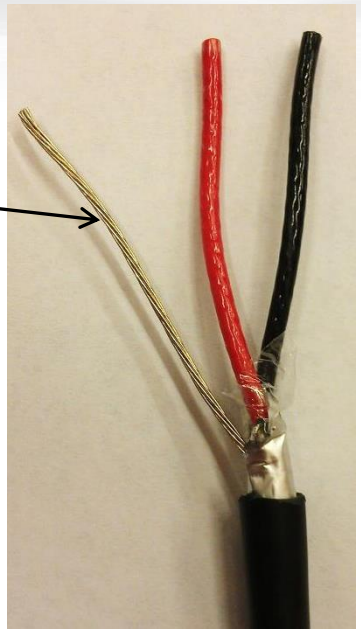
- **Does not need to be connected in any particular order** between all F1/F2 terminals throughout the system in regards to Main address
- Connect F1/F2 the most efficient way in regards to materials
- Maximum 3,280’ from outdoor to farthest indoor unit.
- Must connect to all indoor units and 2/3 port EEV kits (if installed)

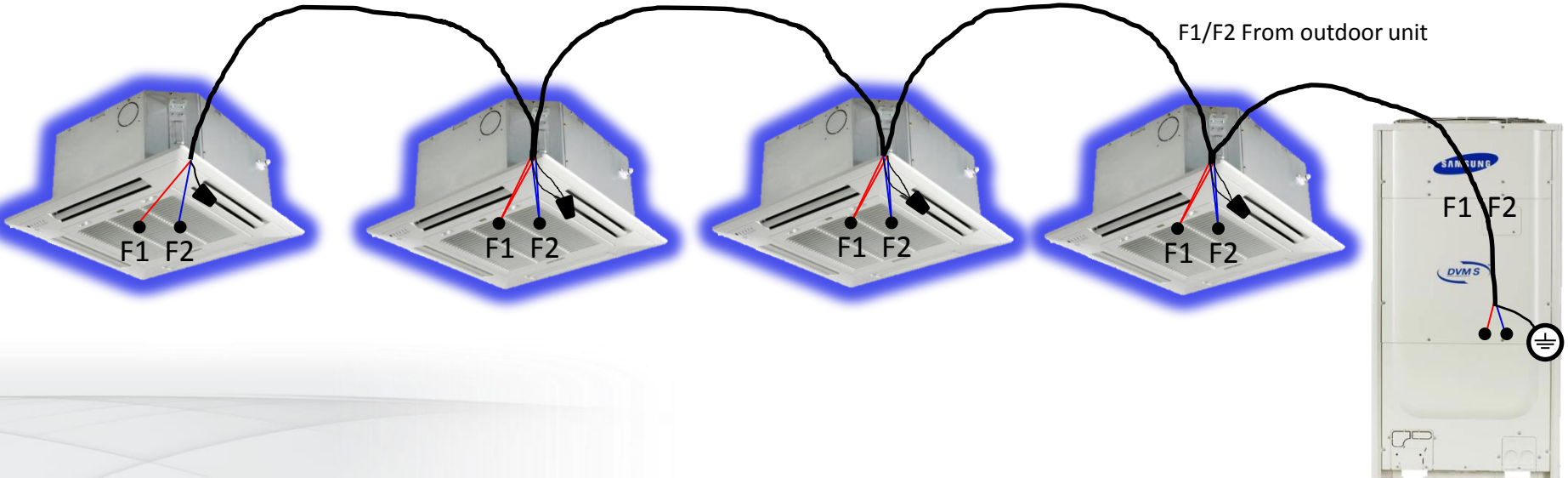


System Communication

F1/F2

- Ground the bare wire in the outdoor unit on a separate point than the main electrical service ground
- Bond this wire throughout the system to carry the ground throughout the system
- Do not ground at indoor units, outdoor unit only
- This will allow any interference to be eliminated
- Do this for all communication points (F1/F2, R1/R2, etc.)

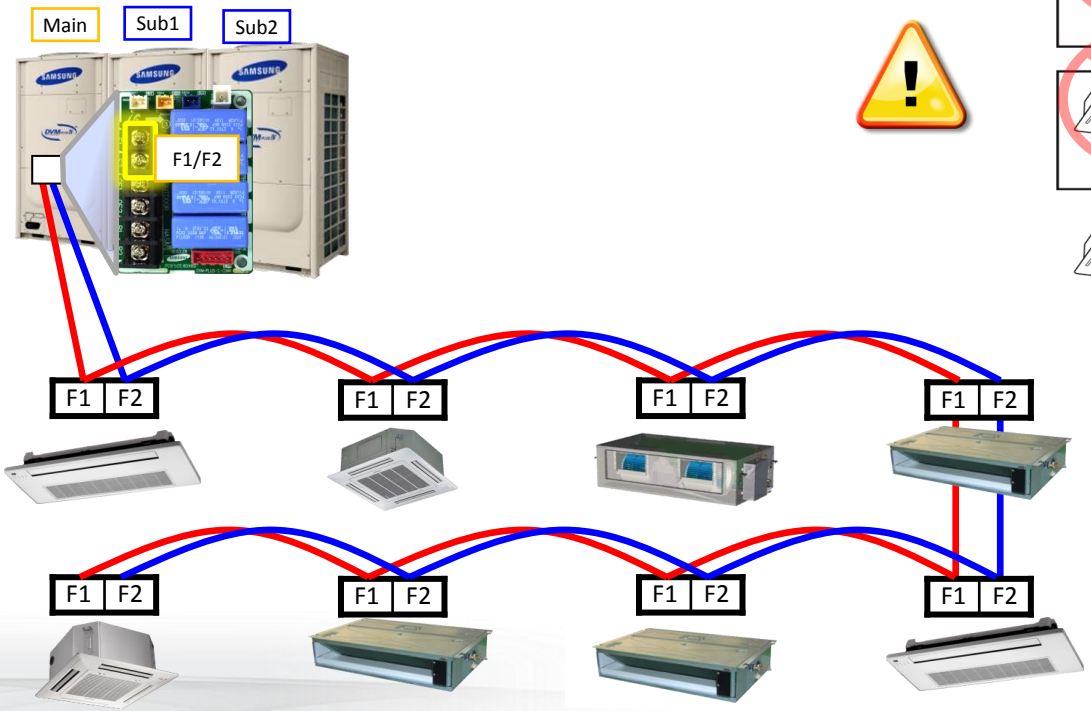


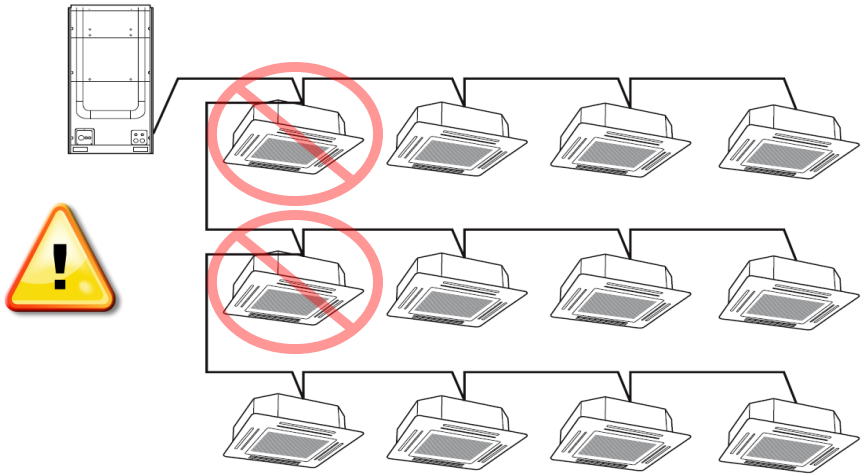


System Communication

F1/F2

- Avoid making a single piece of equipment a “hub” for communication connections
- Daisy chain from one unit to the next

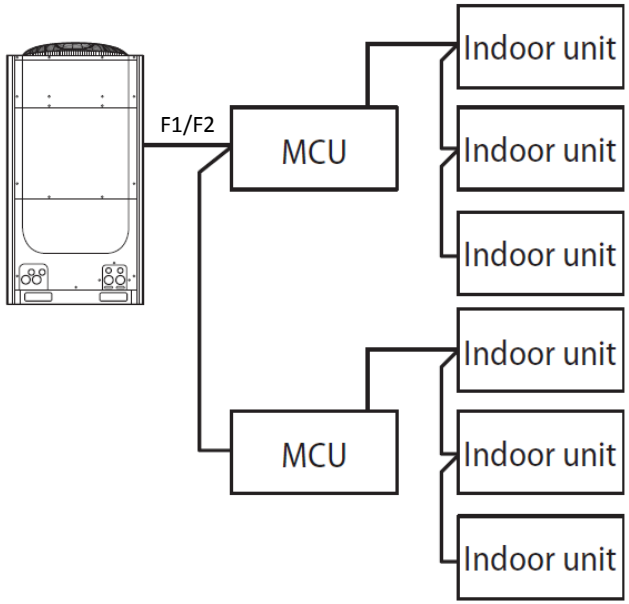


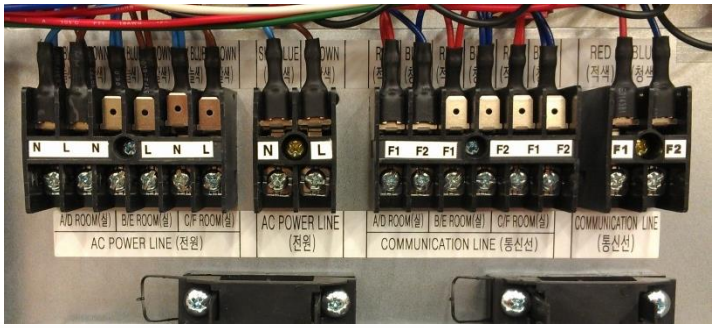


System Communication

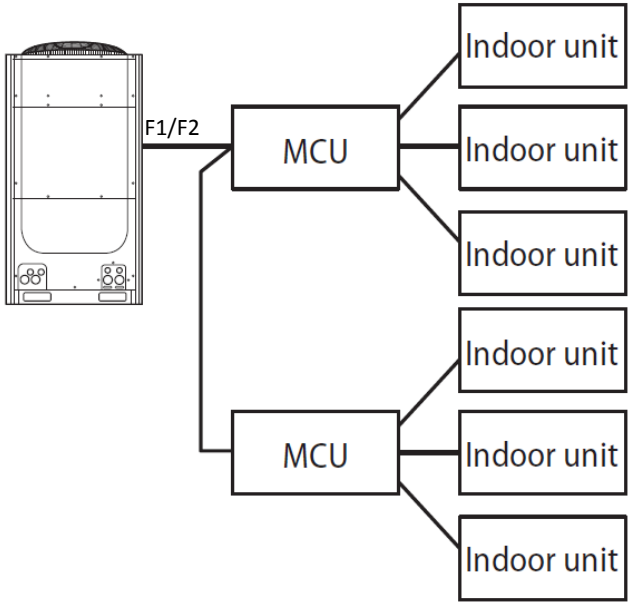
F1/F2

- Treat MCU's like indoor units when installing the main communication cable
- Each MCU requires an F1/F2 connection
- MCU's have multiple F1/F2 connections ports inside to allow connection of indoor units if desired
- It is recommended that F1/F2 is connected from the outdoor unit to the MCU's first, then connect indoor units to F1/F2





COM1 and Power connections in MCU PCB box



System Communication

F1/F2

Avoid running communication lines near:

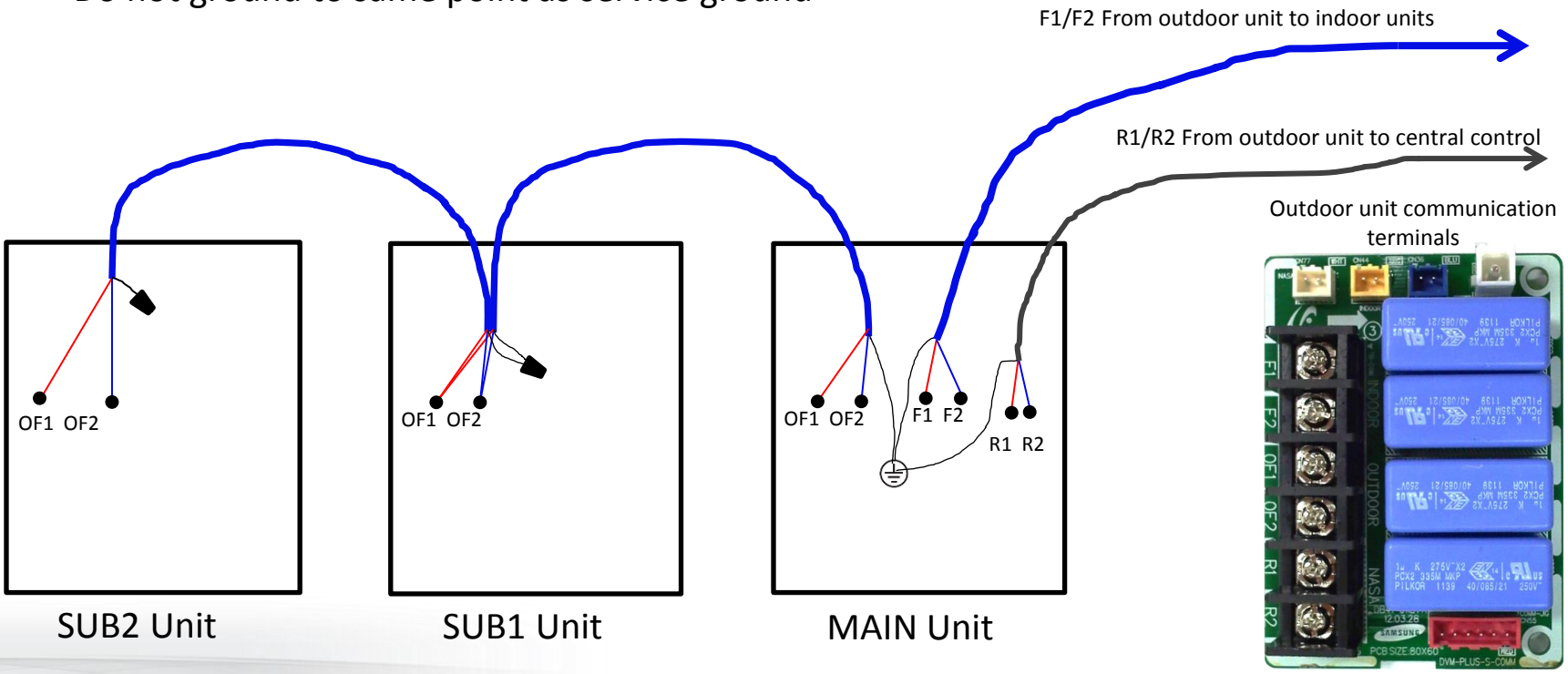
- Ballasts
- Fluorescent lights
- High voltage lines
- Equipment that generates electromagnetic waves (maintain minimum 10’ clearance)

System Communication

F1/F2 and OF1/OF2

Multi-module systems and central control communication wires

- Use 2 x 16 AWG shielded cable
- These terminals are wired together to allow the main outdoor unit to communicate and control the sub units when multiple units are piped together
- Ground one end of the OF1/OF2 communication wire between outdoor units
- Do the same for other communication wires from the outdoor units (ex: R1/R2)
- Do not ground to same point as service ground

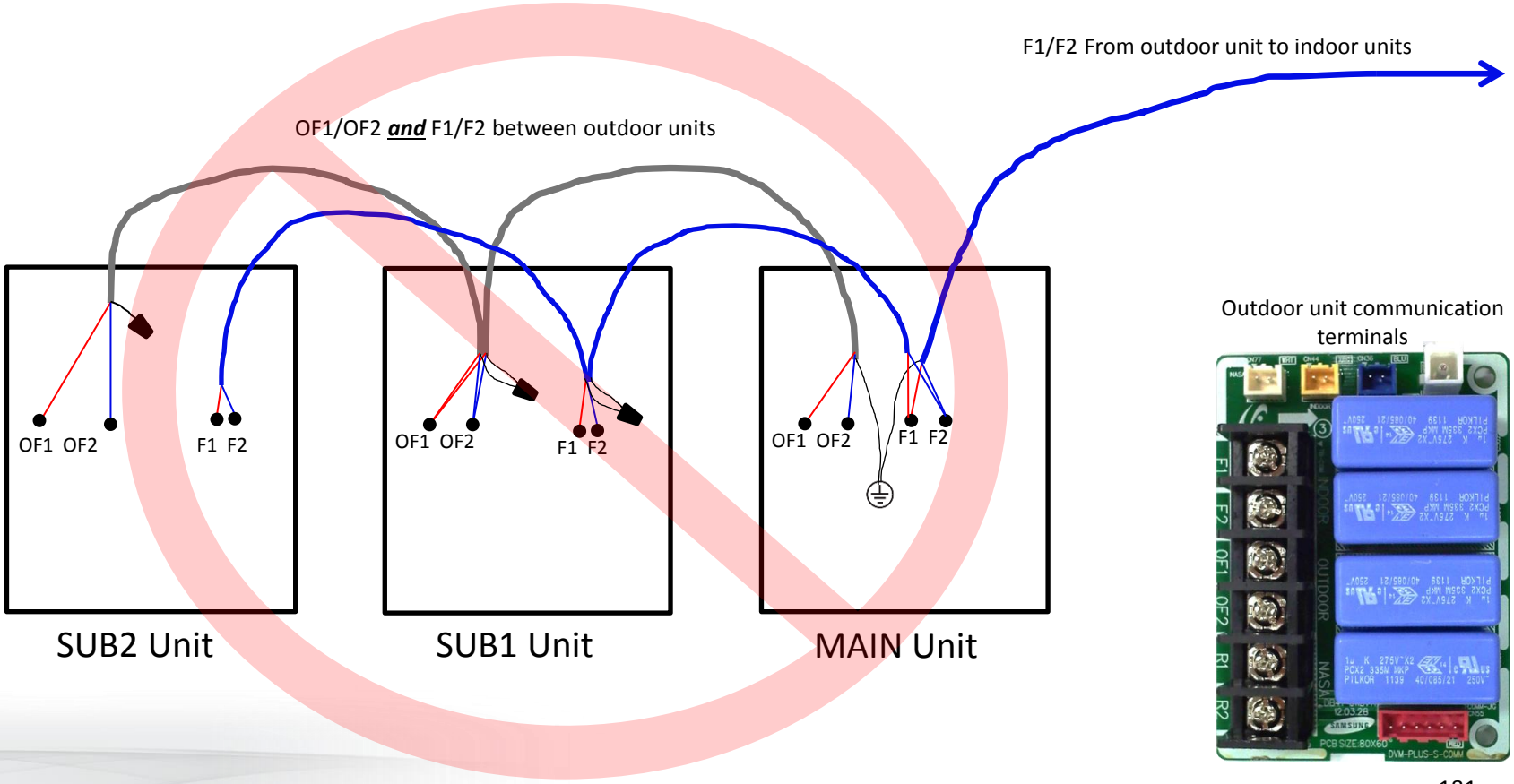


System Communication

F1/F2 and OF1/OF2 - WARNING

Multi-module system communication connections

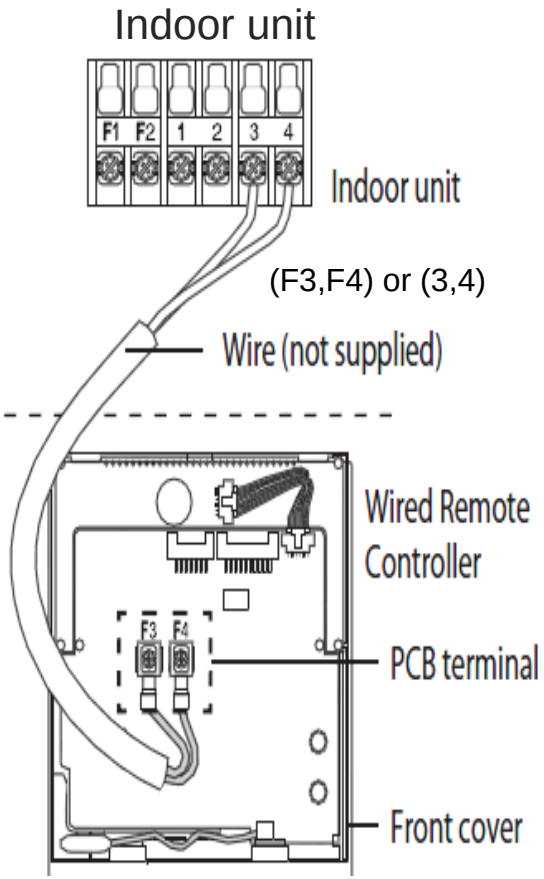
- For modular systems, **NEVER** connect F1/F2 from the MAIN unit to the sub units, only OF1/OF2
- Connecting both F1/F2 and OF1/OF2 between the MAIN and SUB units will cause addressing and communication error codes.



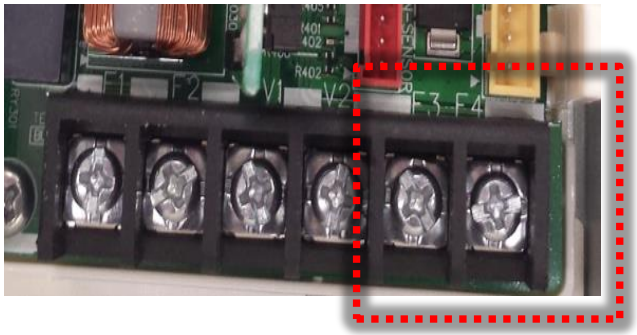
Outdoor unit communication terminals

Individual Control System
Wired Controller Connection (NASA)

- F3/F4 is not polarity sensitive



Indoor unit PCB



MWR-WE10N

Refrigerant Safety

This data is for general reference. Always refer to ASHRAE handbooks for complete refrigerant safety standards, design considerations, and practices.

DVM S

Refrigerant Safety – RCL

- Due to the nature of VRF products, attention must be paid to the total system refrigerant volume
- RCL (refrigerant concentration limit) volumes are defined in ASHRAE standards 15 and 34
- Theses values will aid in the safe design of VRF systems
- Standards are in place to prevent injury due to catastrophic refrigerant leaks that can cause hypoxia due to oxygen displacement from refrigerant in a building's occupied space

Example
on following page

This data is for general reference. Always refer to ASHRAE handbooks for complete refrigerant safety standards, design considerations, and practices.

Samsung – We are Very Competitive

- Heat Recovery Air Cooled
  - Vapor Injection for 100% Heating Capacity at 0F
- Heat Recovery Geo/Water Cooled
- Heat Pump Air Cooled
  - Flash Injection for 100% Heating Capacity at -13F
- Mini-Split & Multi-Split Systems
- AHU Kits

JACCO

Thank You

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