SUCTION & LIQUID LINE SIZING CHARTS

USING LINE SIZING CHARTS

Basis

These line sizing charts are based on a suction pressure drop equivalent to a 2°F change in saturation pressure and liquid line pressure drop of 5 psi. For R-404A Low Temperature 1 psi; for R-404A and R-22 Medium Temperature 2 psi is used. This is the maximum allowable pressure drop for the entire piping run regardless if it is 50' or 250'. The advantage of the graphic representation of this information is to show just how close to full capacity a particular selection is. This is true for both the condensing unit capacities on the individual specification sheets or the separate suction line sizing charts. When the suction line graphs are arranged according to temperature the relationship of temperature and line sizing become readily apparent. The lower the temperature, the larger the line required for the same heat load.

Equivalent Feet

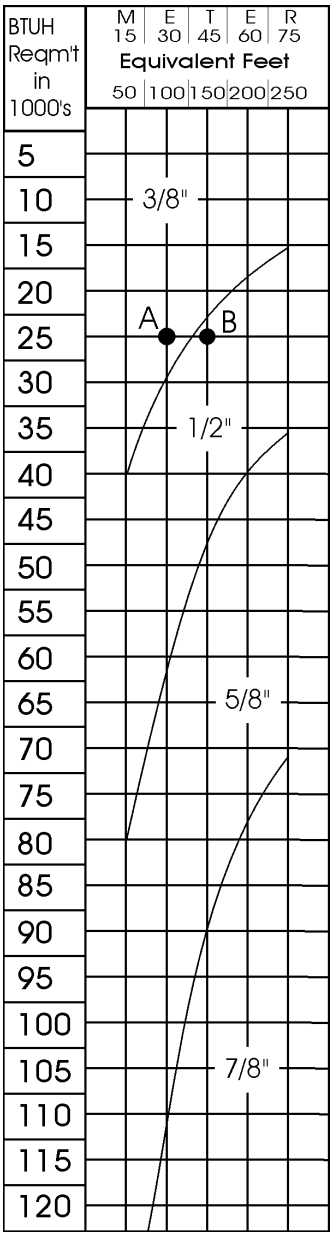
Notice the phrase "Equivalent Feet" (applies to meters as well). Fittings added to a refrigerant line induce an added pressure drop in the line. The added pressure drop is accounted for by adding extra length (see chart on page MI-11) to the piping run which will equal the same pressure drop produced by the fittings. In order to determine the equivalent footage, add the actual length of the piping run and the equivalent footage assigned for each particular fitting. Plot the intersection of the horizontal BTUH line with the vertical equivalent footage line. The area in which the plotted point falls in the recommended line size.

Liquid Line Sizing

Due to the lack of space, the specification sheets have just one column for a liquid line size. The line sizes given on the specification sheets are based on a 5 pound pressure drop for the entire piping run, from 50' to 250'.

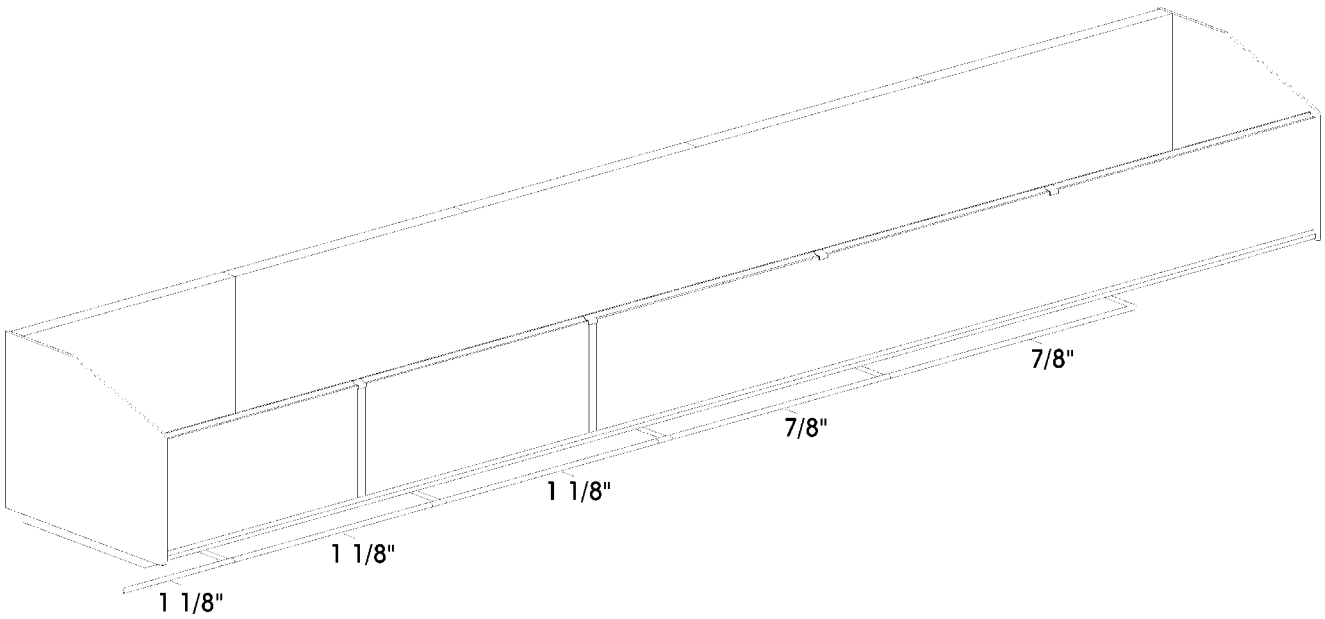
Example: A 25,000 BTUH load will require a 3/8" line for 100 equivalent feet (Point A). At 150 equivalent feet, a 1/2" line would be required for the same load (Point B).

Liquid Line Sizing



Sizing Suction & Liquid Sub-Feed Line Properly

NOTE: Liquid & suction line lengths over 300 equivalent feet are discouraged by TYLER. Contact Applications Engineering for recommendations exceeding 300 equivalent feet!



CASE-TO-CASE SUCTION LINE SUB-FEED BRANCH LINE SIZING														
FT	6	8	12	16	20	24	28	32	36	40	44	48	52	56
R-404A	1/2”	7/8”	7/8”	7/8”	7/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”	1-1/8”

Suction Line Sizing

The line sizing charts on each case specification sheet can be used to size the subfeed branch lines. When the line serves one case. select the size specified for 50 equivalent feet for the 8’ or 12’ case. This may be as small as 5/8” (example service meat cases), or as large as 1-3/8” (example multi-shelf ice cream cases). Select each suceeding step on the basis of the number of feet of case being served by that portion of the suction line.

Liquid Line Sizing

Use the liquid line size chart on page MI-10 to determine the appropriate size in the same manner as for suction lines.

Exception - In the case of gas defrost, follow the special instructions on page MI-6 making and sizing a liquid line manifold at the case.

Low temp suction lines and all liquid lines must be insulated in all Nature’s Cooling and Enviroguard applications! Horizontal suction lines should slope 1/2” per 10’ toward the compressor to aid in good oil return.

REFRIGERATION PIPING

Successful Installation of a Refrigeration System is Dependent Upon:

1. Good piping practices - with properly sized and installed lines as described in this section.
2. Cleanliness of all refrigeration piping is of the utmost importance in the installation procedure.

The use of gaseous nitrogen or carbon dioxide flowing at low pressure through the lines while they are being welded is necessary to assure relative freedom from oxides and scale which can clog the small ports on pilot operated valves and other valves in this system.

Some Possible Consequences of Poor Piping:

- Increased oil requirements.
- Decreased operating efficiency and loss of capacity.
- Increased chances of fouling vital components.
- Failed compressors.

When **NC-2, NC-3** or **Enviroguard** is employed, **ALL LIQUID LINES** to and from the parallel rack (all the way from the building entrance to the fixtures) **MUST BE INSULATE!** Allowing subcooled liquid to warm in the lines cancels the energy saving advantage of subcooling the liquid and may even cause liquid to “flash”. Flashing occurs when liquid converts to gas before reaching the expansion valve; this will cause erratic valve feed and subsequent loss of refrigeration.

ALL LOW TEMP SUCTION LINES MUST BE INSULATED in order to assure cool suction gas to the compressor. Cool gas is necessary to aid in cooling the motor windings (Head cooling fans help and sometimes are required by the compressor manufacturer). Compressor motor failure can result if the suction gas from fixtures warms too much on its way to the compressor.

WITH GAS DEFROST, INSULATION ON THE SUCTION LINE helps maintain the temperature of the hot gas flowing to the cases during defrost.

Insulation on suction and liquid lines helps make the whole system more efficient. Insulate - it pays!

The purpose of this section is to stress some of the more important aspects of piping, and areas in which difficulties are most likely to occur. This information is general, and cannot allow for all the possible factors in a given installation which can accumulate to make it less than acceptable. Page MI-? on pressure drop emphasizes the importance of properly designing the piping system.

Materials

Use only clean, dry, sealed refrigeration grade copper tubing. Make copper to copper joints with phos-copper alloy or equal. Make joints of dissimilar metals of 35% silver solder. To prevent contamination of the line internally, limit the soldering paste or flux to the minimum required. Flux the male portion of the connection, never the female.

Piping should be purged with dry nitrogen or carbon dioxide during the brazing process. This will prevent formation of copper oxide and scale inside the piping which can easily clog the small ports on pilot operated and other valves in the system.

CAUTION

Pressure regulators must be used with nitrogen or carbon dioxide.

Service Valves

Field installed ball type service valves ARE RECOMMENDED TO FACILITATE SERVICING between the machine rack, the remote condenser, and the heat recovery coil.

Use long radius elbows rather than short radius elbows. Less pressure drop and greater strength make the long radius elbows better for the system. This is particularly important on discharge hot gas lines for strength, and suction lines for reduced pressure drop.

Vibration Isolation and Piping Support

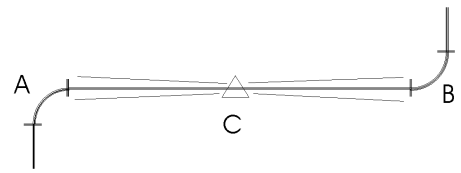
Piping must be properly supported to minimize line vibration. Vibration is transmitted to the piping by movement of the compressor and pressure pulsations of the refrigerant as it is pushed through the piping.

Insufficient and improper supporting of tubing can cause excessive line vibration resulting in:

- Excessive noise.
- Noise transmission to other parts of building.
- Vibration transmission of floors, walls, etc.
- Vibration transmission back to compressor and other attached components.
- Decreased life of all attached components.
- Line breakage.

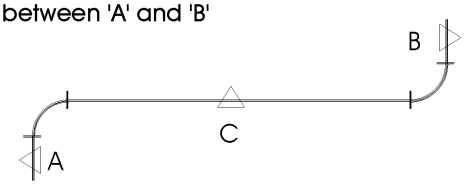
Guidelines For Good Piping

1. A STRAIGHT RUN OF PIPING, must be supported at each end. Longer runs will require additional supports along the length; usually these are not more than 8’ intervals, depending on tubing size and situation. Clamps should be properly anchored and rubber grommets installed between the piping and clamp to prevent line chafing.



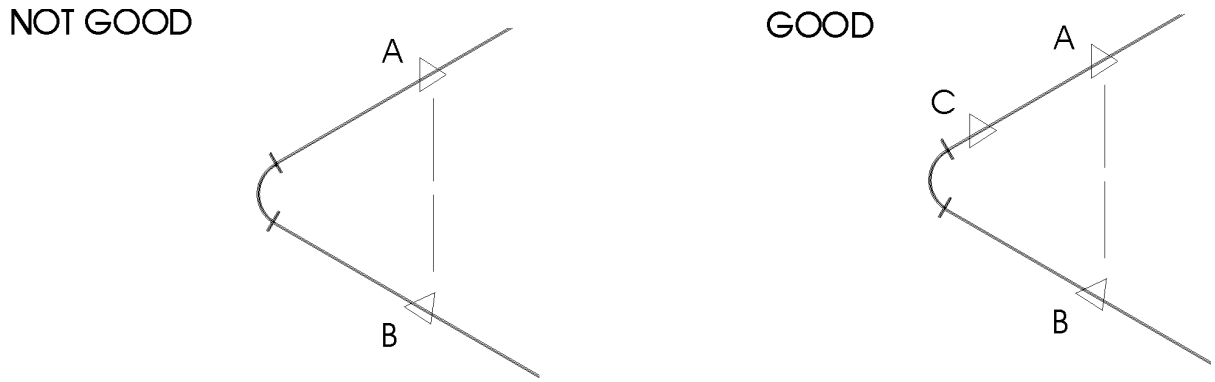
NOT GOOD:
Tubing will vibrate or rotate about point 'C'

GOOD:
Long runs will require additional supports between 'A' and 'B'



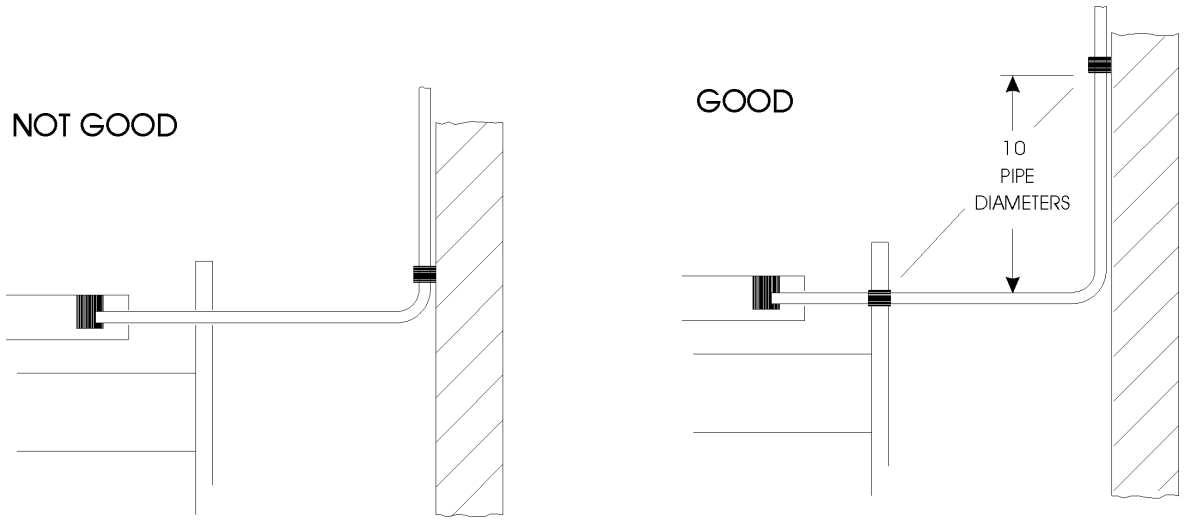
GOOD:
Support at 'C' may not be necessary for very short runs

Supporting Corners



2. CORNERS MUST BE SUPPORTED and cannot be left free to pivot around the A-B axis as shown above.

Don't Overdo It!



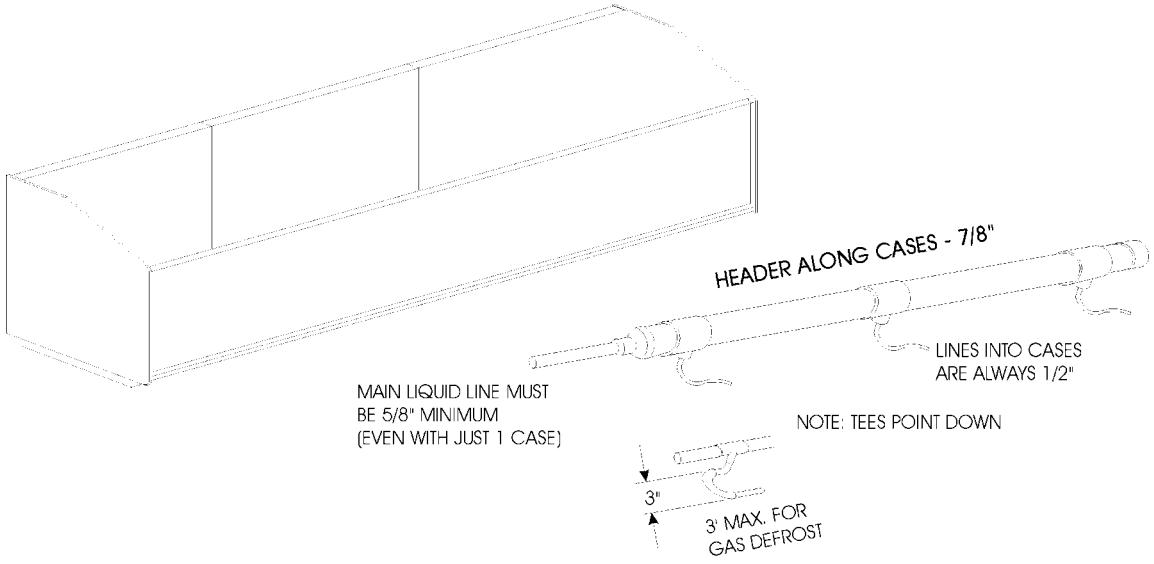
3. DON'T OVER SUPPORT PIPING when it is attached to the compressor rack. It must be free to float without stress.

4. DON'T USE SHORT RADIUS ELBOWS: They can have excessive internal stress which can lead to failure.

5. CHECK ALL PIPING AFTER THE SYSTEM HAS BEEN PLACED IN OPERATION: Excessive vibration must be corrected as soon as possible. Extra supports are cheap when compared to the potential refrigerant loss caused from failed piping.

PROPER LINE SIZING IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR! Applications Department recommendations are listed on the System Summary Sheet furnished (if requested) with the job. Also, refer to the line sizing charts in these instructions. **Horizontal suction lines should slope 1/2" per 10' toward the compressor to aid in good oil return!**

Gas Defrost Liquid Lines



Branch Lines

Liquid lines to the cases should be branched off the bottom of the header. This ensures a full coulmn of liquid to the expansion valve. A branch line from the header to an individual case should not be over 3' long and must have a 3" expansion loop incorporated.

Don't Cross Pipe Systems

Do not run suction or liquid lines through cases that are part of a separate system, especially if either has gas defrost. If there is no way to avoid this, insulate the piping for the portion that runs through the other cases.

Allow For Expansion

The temperature variations of refrigeration and defrost cycles cause piping to expand and contract. The expansion of piping must be taken into consideration, otherwise a piping failure will result. The following are typical expansion rates for copper tubing:

-40°F to -100°F = 2.5" per 100 feet of run (ultra low temp)

0°F to -40°F = 2" per 100 feet of run (low temp)

0°F to +40°F = 1.5" per 100 feet of run (medium temp)

+30°F to +50°F = 1" per 100 feet of run (high temp)

Expansion loops are designed to provide a definate amount of travel. Placing the loop in the middle of a piping run will allow for maximum pipe expansion with the minimal amount of stress on the loop. Don't use 45 degree elbows for loop construction because they will not allow the lines to flex. Refer to the charts on the next page for expansion loop lengths. Suction and liquid lines cannot be joined together or be allowed to touch. Pipe hangers must not restrict the expansion and contraction of piping.

Insulation on suction and liquid lines makes the whole system more efficient! Insulate - it pays!

Expansion Loop Sizing

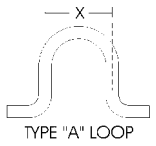
Chart #1 is to be used for A, B and C type loops.

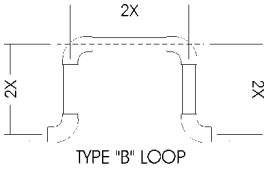
Chart #2 gives the total length of the expansion joint (L) along the outer surface.

Example: Given a 200 foot run of 1-3/8" medium temp piping; there will be a linear expansion of 3" to compensate for (medium temp 1.5" per 100 feet). Pipe diameter has no affect on the amount of linear expansion but is needed for determining the size of the expansion loop. Find the 3" column at the top of Chart #1 and go down until it crosses the 1-3/8" row. The X dimension is 24". If using type A loop, it will be 24"; 48" for type B; and 72" for type C.

Chart #1

TUBE OD	'X' LENGTH - (IN INCHES) FOR LINEAR EXPANSION OF:									
	1/2"	1"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	7"
7/8"	8"	11"	13"	15"	17"	19"	22"	24"	27"	29"
1-1/8"	9"	12"	15"	17"	20"	21"	25"	28"	30"	33"
1-3/8"	10"	14"	17"	19"	22"	24"	27"	31"	34"	36"
1-5/8"	10"	15"	18"	21"	24"	26"	30"	33"	37"	39"
2-1/8"	12"	17"	21"	24"	27"	30"	34"	38"	42"	45"
2-5/8"	13"	19"	23"	27"	30"	33"	38"	42"	46"	50"
3-1/8"	15"	21"	25"	29"	33"	36"	41"	46"	51"	55"
4-1/8"	17"	24"	29"	34"	38"	41"	48"	53"	58"	63"
5-1/8"	19"	26"	32"	37"	42"	46"	53"	59"	65"	71"
6-1/8"	20"	29"	35"	41"	46"	50"	58"	65"	71"	77"





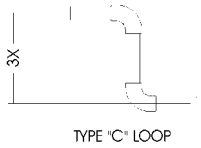
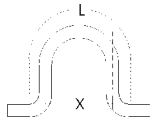
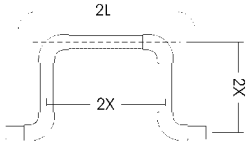
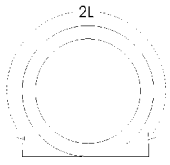


Chart #2

TUBE OD	'X' LENGTH - (IN INCHES) FOR LINEAR EXPANSION OF:									
	1/2"	1"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	7"
7/8"	24"	34"	42"	49"	54"	60"	69"	77"	84"	91"
1-1/8"	28"	39"	48"	55"	62"	68"	78"	87"	96"	104"
1-3/8"	30"	43"	53"	61"	68"	75"	86"	97"	106"	114"
1-5/8"	33"	47"	58"	66"	74"	81"	94"	105"	115"	124"
2-1/8"	38"	54"	66"	76"	85"	93"	108"	120"	132"	142"
2-5/8"	42"	60"	73"	85"	95"	104"	120"	134"	147"	158"
3-1/8"	46"	65"	80"	92"	103"	113"	131"	146"	160"	173"
4-1/8"	53"	75"	92"	106"	119"	130"	150"	168"	184"	198"
5-1/8"	59"	84"	102"	118"	132"	147"	167"	187"	205"	224"
6-1/8"	65"	91"	112"	129"	145"	158"	183"	204"	224"	242"



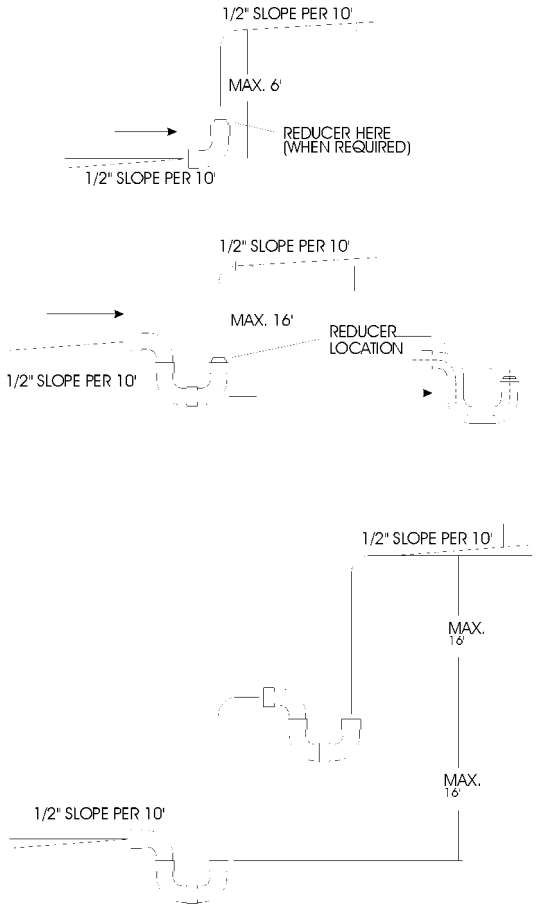




Suction Line Riser Recommendations

1. Risers which can be Installed without a Trap

Suction line sizing is based on a design pressure drop which relates to the velocity of the gasses moving through the line. Acceptable velocities for horizontal suction lines (with proper 1/2” slope per 10’ run) range from 500’ to more than 1500’ per minute. A properly sized line at the low range of its capacity will have a low velocity and one at full capacity will have velocities exceeding 1500 fpm. A specified minimum velocity is required to keep oil moving along with the gas when the pipe is vertical. The charts on the next page shows the size selection which will assure oil return up a riser. This size may be the same as the horizontal suction line selection or it may be one size smaller. If the selection point on the chart is close to the dividing line between sizes, use the smaller size. The reducer fitting must be placed after the elbow. Long elbows can be used to make the trap, or a P-trap can be used. **Do not use short elbows**.



2. Risers which Require a P-Trap

Low temperature systems must be designed knowing that oil is more difficult to move as the temperature is lowered. The refrigerant gas also has a lower capacity to mix with the oil. A trap will allow oil to accumulate, reducing the cross section of the pipe and thereby increase the velocity of the gas. This increased velocity picks up the oil. The velocity chart is to be used to determine if the horizontal line size has sufficient velocity in the vertical position to carry the oil along. Generally, the riser will have to be reduced one size.

3. Risers Requiring Use of Two Traps

The use of two traps is necessary on long risers for the collection of oil during an off cycle. One trap would not be large enough to contain all coating a riser over 16’, and could result in an oil slug delivered to the compressor system.

Supporting Lines: Properly supprting the lines suspended from a wall or ceiling is very important. Line supports should isolate the lines from contact with metal. When gas defrost is used, consideration should be given to rolling or sliding supports which allow free expansion and contraction. These supports would be used in conjunction with expansion loops described on page MI-7.

MAXIMUM RECOMMENDED SPACING BETWEEN SUPPORTS FOR COPPER TUBING			
O.D. Line Size (In.)	Max. Span (Ft.)	O.D. Line Size (In.)	Max. Span (Ft.)
5/8”	5’	3-1/8”	12’
1-1/8”	7’	3-5/8”	13’
1-5/8”	9’	4-1/8”	14’
2-1/8”	10’	- - -	- - -

Vertical Riser Suction Line Size Charts

Proper line sizing is very important. When sizing for a suction line riser, use the proper chart. These charts are based on maintaining minimum velocities in the risers. This will assure that the oil mixed with the refrigerant will return to the compressor. Improper line sizing could cause less than optimum performance or pose the possibility of compressor damage due to oil failure.

Suction line sizing charts apply to horizontal runs only. **DO NOT use them for sizing vertical runs.** Liquid line sizing charts can be used for both horizontal and vertical runs.

CAUTION

When in doubt about oil return (due to a point being near a line), use the smaller size line.

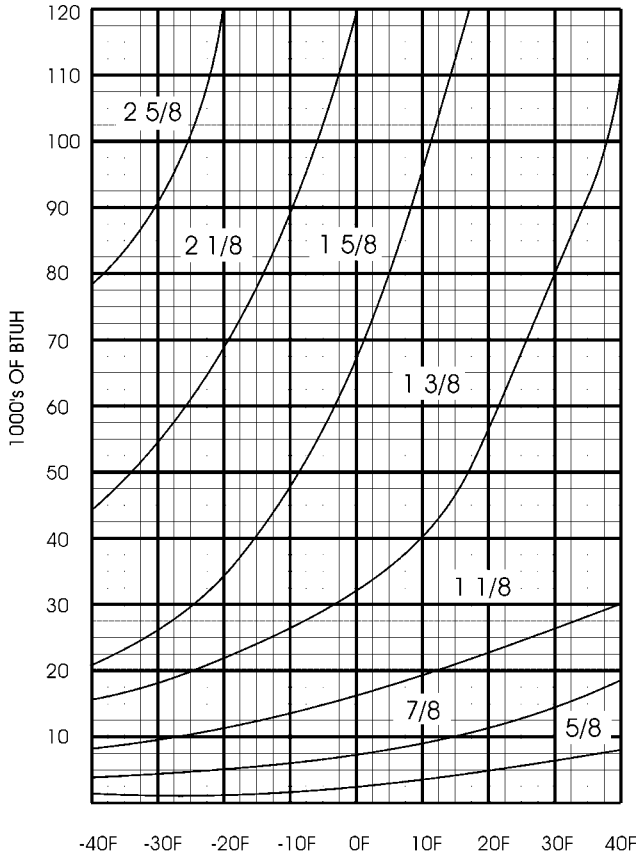
Any sizing of riser or any other suction line, or device, must be considered in view of the total system. The addition of any suction line pressure drop must be ignored.

If suction"P-traps" are used, it is recommended that they be sized according to the horizontal line sizing.

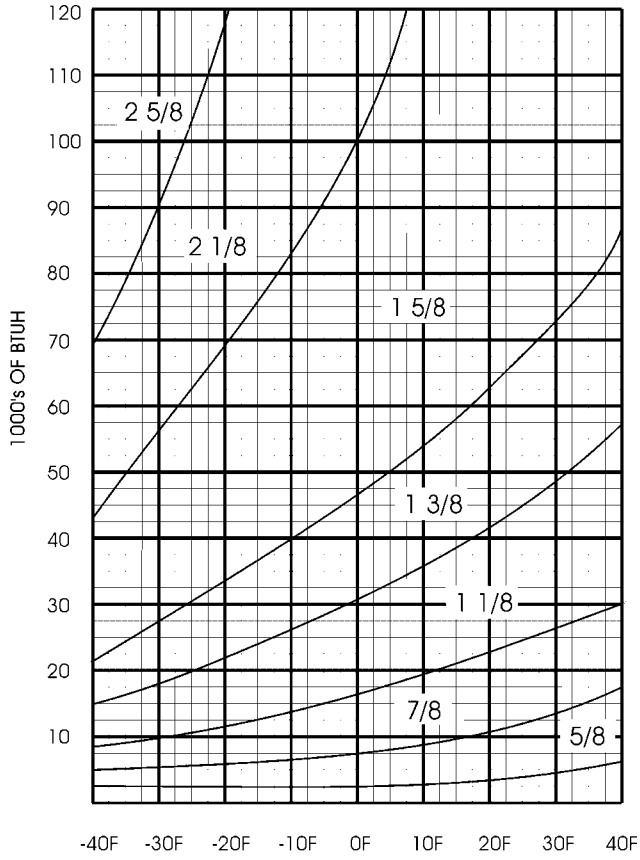
IMPORTANT!

Do not arbitrarily reduce vertical risers without consulting these charts. Unnecessary vertical suction line reduction can cause excessive pressure drop, resulting in loss of system capacity.

R-22



R-404A



Line Sizing Guidelines

Minimum Horizontal Suction Velocity = one half of Minimum Riser Velocity.

Maximum Pressure Drop

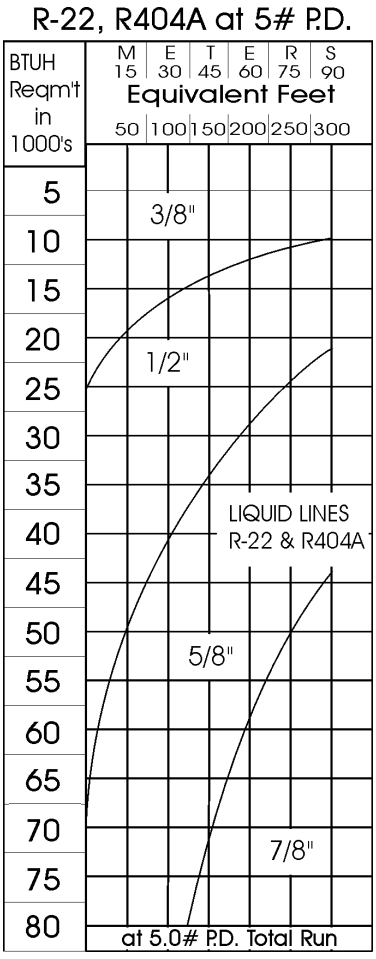
R-22MT = 2.21 R-22LT = 1.15 R-404A = 2.46 R-404A = 1.33

MINIMUM RISER VELOCITY				
	R-22MT	R-22LT	R-404AMT	R-404ALT
1/2”	560	850	440	660
5/8”	630	950	490	740
7/8”	750	1130	590	890
1-1/8”	860	1300	670	1010
1-3/8”	960	1440	750	1120
1-5/8”	1040	1570	810	1230
2-1/8”	1200	1810	930	1410
2-5/8”	1330	2010	1040	1570

MINIMUM HORIZONTAL SUCTION VELOCITY				
	R-22MT	R-22LT	R-404AMT	R-404ALT
1/2”	280	425	220	330
5/8”	315	475	245	370
7/8”	375	565	295	445
1-1/8”	430	650	335	505
1-3/8”	480	720	375	560
1-5/8”	520	785	405	615
2-1/8”	600	905	465	705
2-5/8”	665	1005	520	785

NOTE: Use R-404A information for R-504 & R-507

R-22 & R-404A Liquid Line Sizing Chart

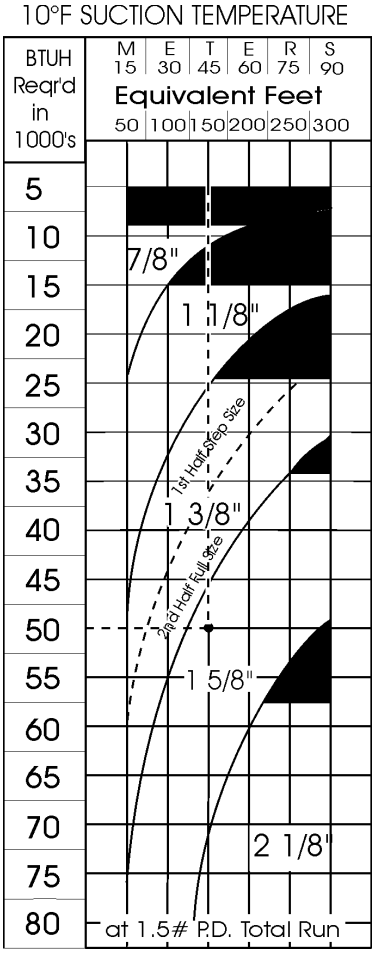


USING SUCTION LINE SIZING CHARTS CORRECTLY

Suction Line Sizing Charts

The Suction Line Sizing charts include R-404A and R-22 suction temperatures, and lengths to 300 equivalent feet.* These charts are based on DuPont data and extensive field experience. The advantage of the graph presentation of information is to show just how close to full capacity a particular selection is. The suction line graphs are arranged according to temperature, and the relationship of temperature and line size becomes readily apparent. The lower the temperature, the larger the line for the same heat load.

*To determine the "Equivalent Feet" (or Meters), add the length of the pipe and the equivalent footage assigned for each particular fitting. See chart below.



Find the Proper Chart

Find the proper chart based on refrigerant and suction temp. Simply match BTUH load on the horizontal lines with equivalent feet on the vertical line. The point formed by the intersection will indicate the proper size unless it is a dark area. Selections falling inthe dark areas of the charts show that the gas velocity is too slow to assure proper oil return, even with properly sloped lines. Reducing the line one size will increase velocity and pressure drop. Added pressure drop will require greater refrigeration capacity. Be sure the system can handle the added load. See the vertical riser charts for proper sizing of vertical suction lines on page MI-10.

Step Sizing

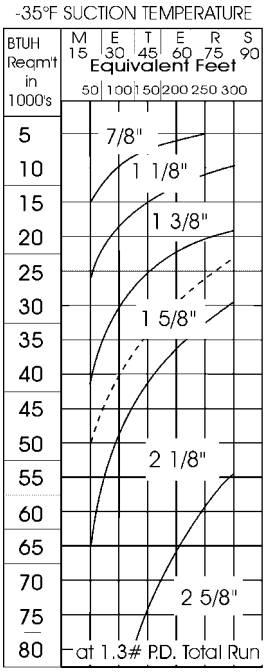
Step sizing is suggested for selections falling in the first half of a size range. Pipe one size smaller (than the indicated run) can be used for 50' of the run closest to the cases when the entire run is 100 equivalent feet or more. To show this principle, one size range on each suction chart has been bisected by a dotted line to indicate the "First Half-Step Size" and the "2nd Half - Full Size". The purpose of step sizing is to assure better oil return out of the evaporators.

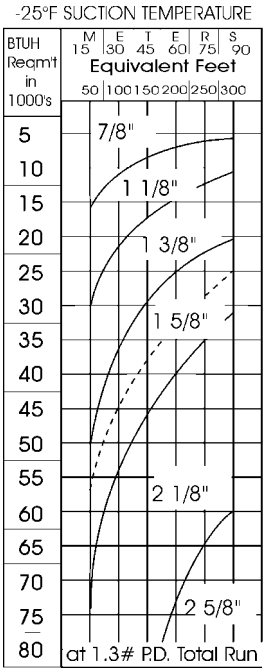
Example: Given a 50,000 BTUH load with R-404A at 10°F Suction Temp and 150 Equivalent ft. of line, a 1-5/8" line is required. Since the selection point is in the first half of the range 50' equivalent feet may be sized 1-3/8" usually applied to the first 50' closest to the evaporators, but any 1-3/8" vertical riser height should be subtracted from the 50' step sizing.

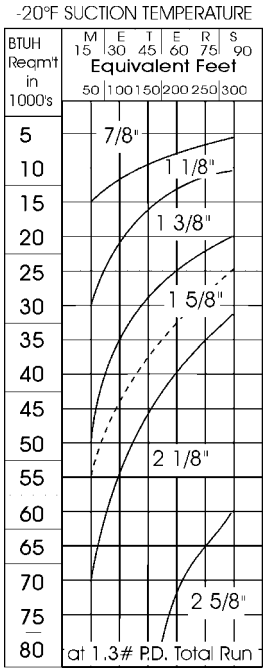
EQUIVALENT LENGTH OF PIPE FOR FITTINGS & VALVES (FEET)

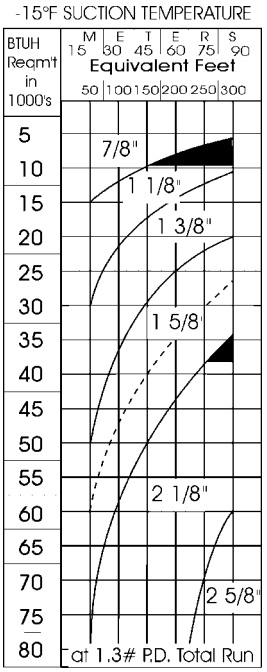
Line Size O.D.	Global Valve	Angle Valve	90° Elbow	45° Elbow	Tee, Sight Glass	T-Branch
1/2	9	5	0.9	0.4	0.6	2.0
5/8	12	6	1.0	0.5	0.8	2.5
7/8	15	8	1.5	0.7	1.0	3.5
1-1/8	22	12	1.8	0.9	1.5	4.5
1-3/8	35	17	2.8	1.4	2.0	7.0
2-1/8	45	22	3.9	1.8	3.0	10.0
2-5/8	51	26	4.6	2.2	3.5	12.0
3-1/8	65	34	5.5	2.7	4.5	15.0
3-5/8	80	40	6.5	3.0	5.0	17.0

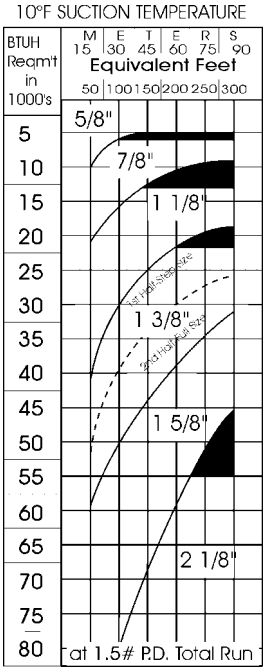
R-22 Suction Line Sizing

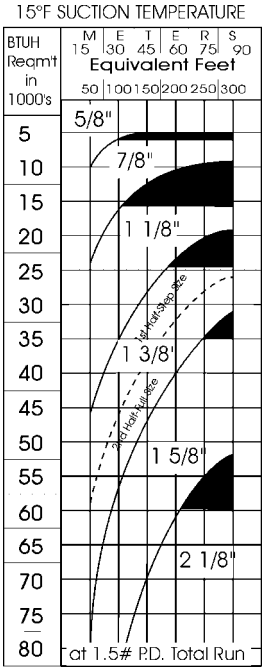


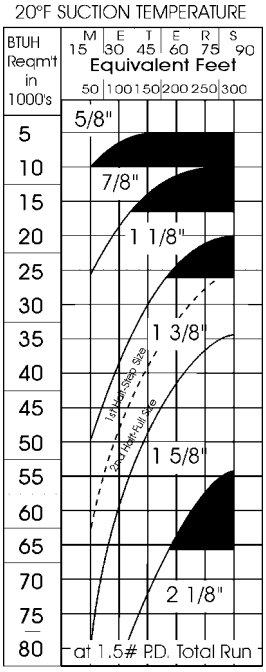


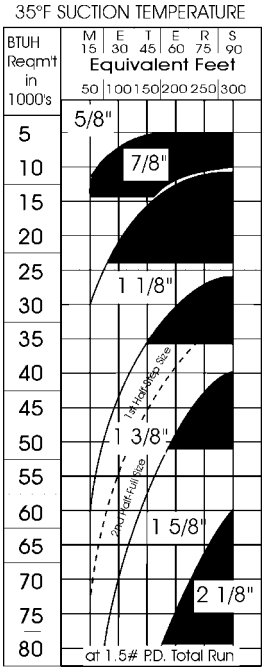












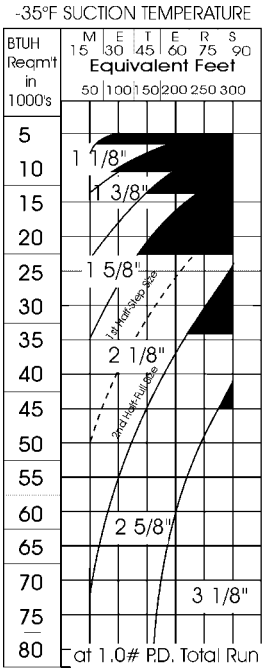
Step Sizing

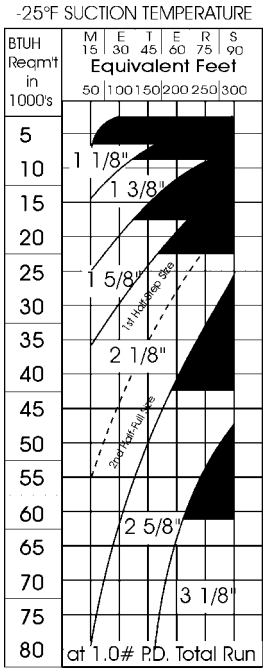
Step sizing is suggested for selection in the first half of a size range. Pipe ine size smaller can be used in the 50' closest to the cases when the entire run is 100' or more. Selections falling in the **BLACK AREAS** of the chart show that the gas velocity is below **750** fpm, which is too slow to assure proper oil return. Reducing one size will assure good oil return by increasing velocity, but the added pressure drop will require greater refrigeration capacity. Be sure the compressor selection is adequate.

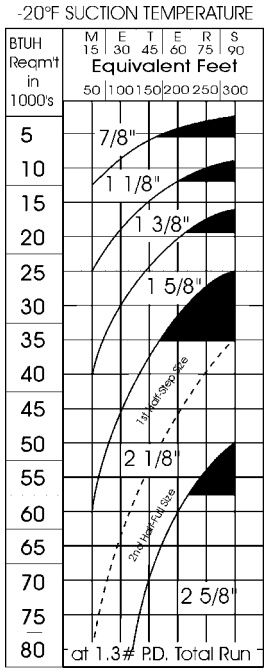
NOTE:

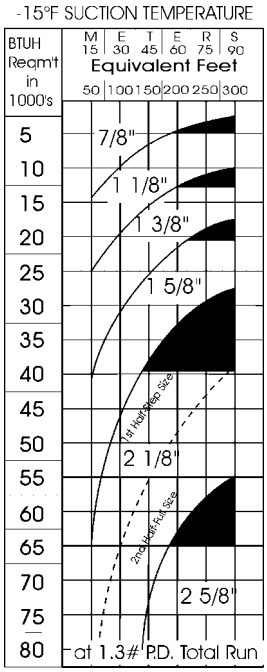
All horizontal suction lines should be sloped 12" per 10' toward the compressor.
See vertical riser charts for proper vertical suction line sizing.

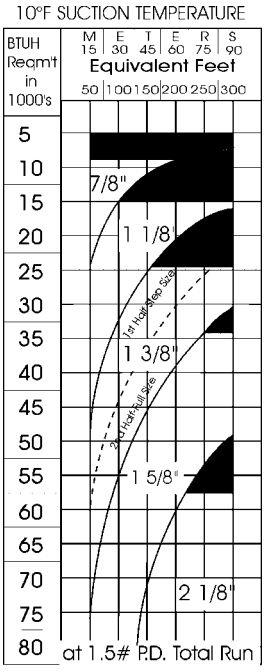
R-404A Suction Line Sizing

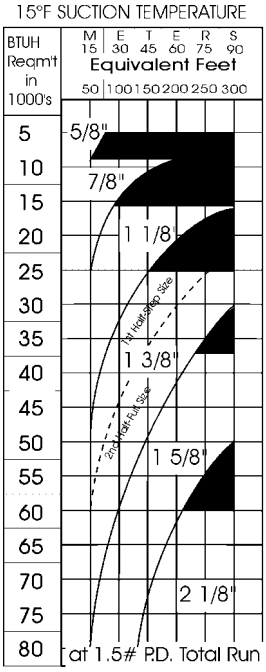


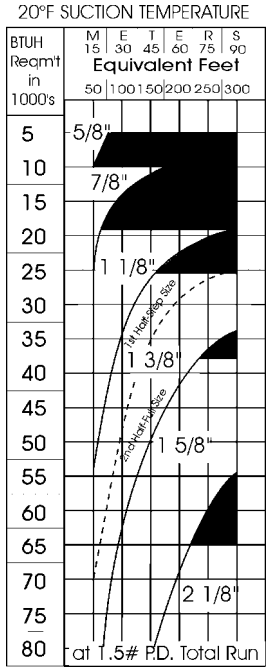


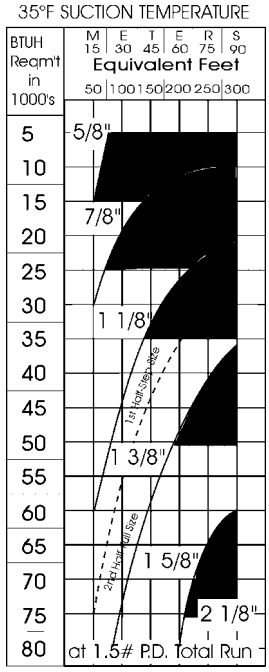












Step Sizing

Step sizing is suggested for selection in the first half of a size range. Pipe ine size smaller can be used in the 50' closest to the cases when the entire run is 100' or more. Selections falling in the **BLACK AREAS** of the chart show that the gas velocity is below **500** fpm, which is too slow to assure proper oil return. Reducing one size will assure good oil return by increasing velocity, but the added pressure drop will require greater refrigeration capacity. Be sure the compressor selection is adequate.

NOTE:

All horizontal suction lines should be sloped 12" per 10' toward the compressor.
See vertical riser charts for proper vertical suction line sizing.

Avoiding Excessive Pressure Drop

Pressure drop and resultant capacity losses are becoming more common with the increased use or EPR valves, suction line filters, accumulators and suction manifolds on parallel systems. Each device stands on its own individual merit by contributing to case or system performance. But when all the resultant pressure drops are added, the end result is lower overall system performance. The symptoms may lead one to believe that the system is undersized, but a thorough check using a differential pressure gauge will very likely show where the real trouble lies.

Some Pressure Drop Built In

In general, most manufacturers rate their equipment by allowing for approximately two pounds pressure drop in the suction line between the evaporator to the compressor. Pressure drop built into the evaporator is usually considered by the designer and can frequently be larger than two pounds. This is to provide refrigerant velocities high enough to ensure good oil movement even in the coldest parts of the refrigeration system.

Avoiding Excessive Loss of Capacity

1. Size liquid and suction lines by accurately figuring the proper equivalent length.

   EQUIVALELNT LENGTH = ACTUAL PIPING + LENGTH EQUIVALENCE FOR FITTINGS AND COMPONENTS

   Use the equivalent length chart located on page MI-11 to determine the appropriate length for the fittings.

2. If possible, avoid high pressure drop components, such as various types of control valves, manifolds, tees, accumulators and filters. These devices should only be used, **after all the factors have been considered.** The disadvantages must be outweighed by the advantages of combining systems, paralleling compressor, obtaining better case temperature control, protecting the compressors and/or safeguarding the system.

3. If suction line filters are to be used, size them properly. Use a filter which is the same as main line size or one size over the suction service valve (whichever is larger).

When Losses Are Not Made Up

When pressure drop losses are not properly compensated for, an increase in case entering air temperature can be expected. This will be particularly noticeable when condensing unit is operating at its design ambient condition (90°F or 100°F).

The following approximations can be made:

Low Temp Case; each 10% increase (2# P.D.) raises entering air temp about 3°F.

Medium Temp Case; each 10% increase raises entering air temp about 2°F.

HIGH SIDE FIELD PIPING

Observe piping run limits for best performance.

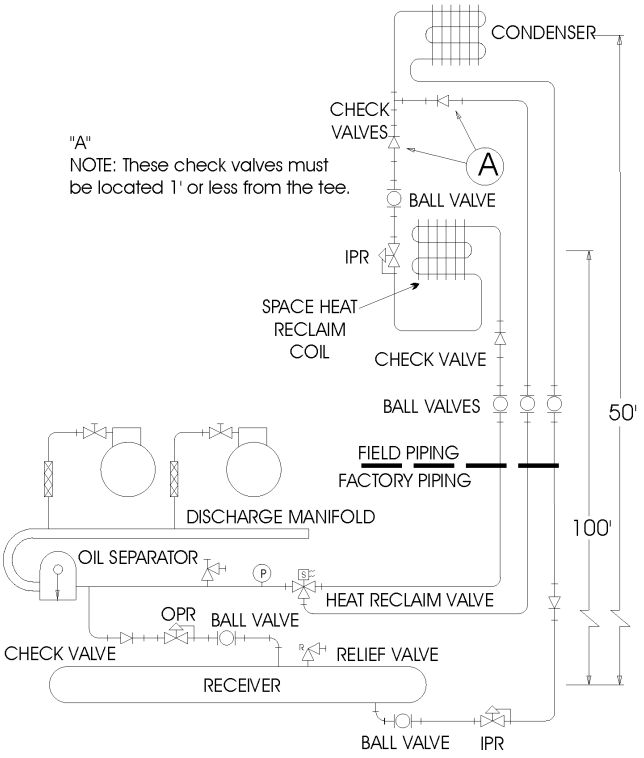
- Maximum 50 equivalent piping feet to Remote Condenser.
- Maximum 100 equivalent piping feet to Heat Recovery Coil.
- Maximum 200 equivalent piping feet total for entire circuit.
- Line size between remote condenser and Heat Recovery coil must be the same size as the discharge line.

Installation Notice

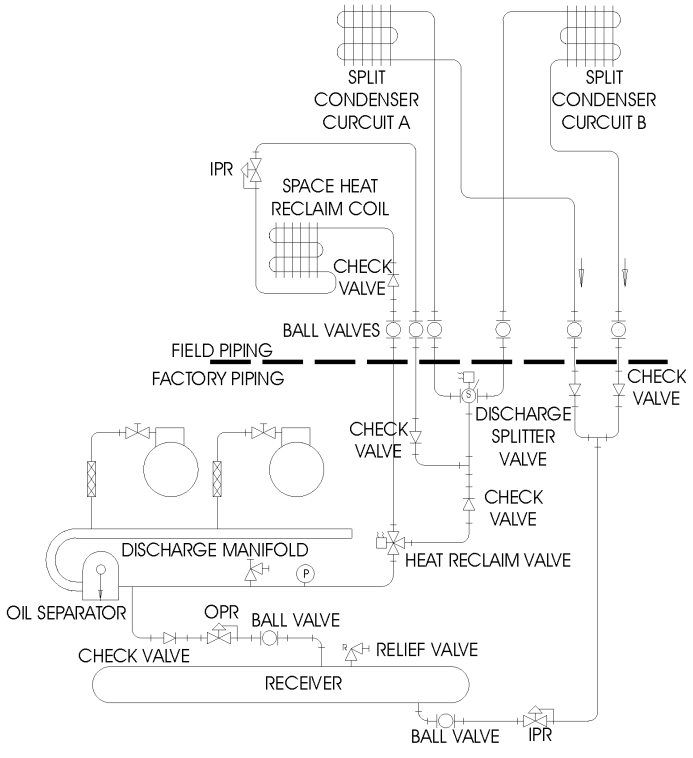
Remote condensers must be mounted enough in relation to the parallel rack so that the liquid drain on the condenser is at least 3' higher that the liquid return inlet on the receiver. This is necessary to ensure free draining. The schematics below show which items need to be installed as field piping. All items above the broken line are considered part of the field piping and are shipped loose. A detailed description can be found in the "Parallel Compressor & Envoroguard Installation & Service Manual".

All the components shown in the field piping diagram should be installed. If a heat recovery coil is used, 3 check valves must be installed as shown in the diagram. One is placed in the normal flow piping to the condenser and the other two at the inlet and outlet of the HR coil. An optional IPR valve for the HR coil will also need to be field installed on the coil, for NC-2 only. Isolation ball valves are recommended for the system and can be ordered as optional equipment.

Schematics Are Representative Only



Optional Split Condenser Piping
Both discharge and liquid return must be piped symetrically relative to the condenser.



Discharge to Remote Condenser & Heat Recovery Line Sizing

CAPACITY BTUH	R-22 EQUIVALENT LENGTH 50’	R-22 EQUIVALENT LENGTH 100’	R-404A EQUIVALENT LENGTH 50’	R-404A EQUIVALENT LENGTH 100’	CAPACITY BTUH	R-22 EQUIVALENT LENGTH 50’	R-22 EQUIVALENT LENGTH 100’	R-404A EQUIVALENT LENGTH 50’	R-404A EQUIVALENT LENGTH 100’
6,000	3/8	1/2	1/2	1/2	75,000	7/8	1-1/8	1-1/8	1-1/8
12,000	1/2	1/2	5/8	5/8	100,000	1-1/8	1-1/8	1-1/8	1-3/8
18,000	5/8	5/8	5/8	7/8	150,000	1-1/8	1-3/8	1-3/8	1-3/8
24,000	5/8	7/8	7/8	7/8	200,000	1-3/8	1-3/8	1-3/8	1-5/8
36,000	7/8	7/8	7/8	7/8	300,000	1-3/8	1-5/8	1-5/8	2-1/8
48,000	7/8	7/8	7/8	1-1/8	400,000	1-5/8	2-1/8	2-1/8	2-1/8
60,000	7/8	1-1/8	1-1/8	1-1/8	500,000	2-1/8	2-1/8	2-1/8	2-1/8

Recommended Liquid Line Sizing (Condenser to Receiver or Liquid Line Manifold)

CAPACITY BTUH	R-22 CONDENSER TO RECEIVER	R-22 RECEIVER TO EVAPORATOR 50’	R-22 RECEIVER TO EVAPORATOR 100’	R-404A CONDENSER TO RECEIVER	R-404A RECEIVER TO EVAPORATOR 50’	R-404A RECEIVER TO EVAPORATOR 100’
6,000	3/8	1/4	3/8	3/8	1/4	3/8
12,000	1/2	3/8	3/8	1/2	3/8	1/2
18,000	1/2	3/8	3/8	5/8	1/2	1/2
24,000	5/8	3/8	1/2	5/8	1/2	5/8
36,000	5/8	1/2	1/2	7/8	1/2	5/8
48,000	7/8	1/2	5/8	7/8	5/8	5/8
60,000	7/8	1/2	5/8	7/8	5/8	7/8
75,000	7/8	1/2	5/8	7/8	5/8	7/8
100,000	7/8	5/8	7/8	1-1/8	7/8	7/8
150,000	1-1/8	7/8	7/8	1-3/8	7/8	7/8
200,000	1-1/8	7/8	7/8	1-3/8	1-1/8	1-1/8
300,000	1-3/8	1-1/8	1-1/8	1-5/8	1-3/8	1-3/8
400,000	1-5/8	1-1/8	1-1/8	1-5/8	1-3/8	1-3/8
500,000	1-5/8	1-1/8	1-3/8	2-1/8	1-3/8	1-3/8

Piping Procedures for Air Cooled Condensers

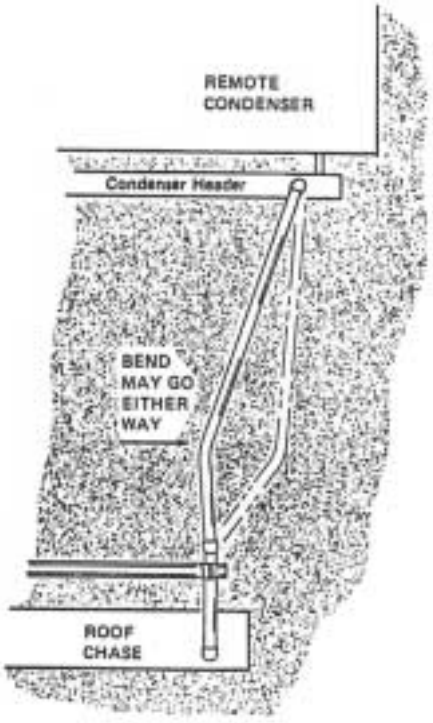
When installing the condenser thermal expansion , it can be compensated for by an inverted piping configuration as shown in Figure 1 on page MI-18. This arrangement will act as an expansion loop for the pipe. All piping should also be run at various offset angles to help compensate for thermal expansion, (see View A).

Figure 1 shows a view of a desirable inlet piping configuration. The piping out of the roof chase (if used) should angle from a vertical to a horizontal. This horizontal run should be supported from below. (All pipes must be individually clamped to the support to help minimize vibration). The piping should then angle upwrds at 90 degrees. This section of piping should also be supported to minimize longitudinal vibrations.

From this point the piping will be redirected in the horizontal direction once again. This horizontal run should use offset piping to where it will need to be attached to the condenser. The 90 degree downward redirection completes the inverted piping configuration.

In all cases try to minimize the “X” and “L” dimensions in your piping runs. In the case of “X”; the longer the unsupported horizontal length, the greater the likelihood of static stresses and vibration being placed on the condenser tube sheet.

Outlet piping does not require the inverted configuration, but should otherwise be braced and supported in the same manner as stated above.



View 'A'

Vibration Isolation & Piping Support

Piping must be properly supported to minimize line vibration. Vibration is transmitted to the piping by movement of the compressor and pressure pulsations of the refrigerant as it is pushed through the piping. Insufficient and improper supporting of tubing can cause excessive line vibration resulting in:

- Excessive noise.
- Noise transmission to other parts of building.
- Vibration transmission of floors, walls, etc.
- Decreased life of all attached components.
- Line breakage.

A straight run of piping must be supported at each end. Longer runs require additional supports along the length, (usually not more than 8 foot intervals) depending on tubing size and situation. Clamps should be properly anchored and rubber grommets installed between the piping and clamp to prevent line clafing.

NOTE

A platform should be placed over any piping, to or from the condenser, that is likely to be stepped on. Most probable spots for this would be near the condenser shell or roof hatch.

Materials

Use only clean, dry, selaed refrigeration grade copper tubing. Make copper to copper joints with phos-copper alloy or equal. Make joints of dissimilar metals of 35% silver solder. To prevent contamination of the line internally, limit the soldering paste or flux to the minimum required. Flux only the male portion of the connection, never the female portion.

Piping should be purged with dry nitrogen or carbon dioxide during the brazing process. This prevents formation of copper oxide and scale inside the piping which can easily clog the small ports on pilot operated and other valves in the system.

CAUTION

Pressure regulators must always be used with nitrogen or carbon dioxide.

Service Valves

Field installed ball type service valves **are recommended to facilitate servicing** between the machine rack, the remote condenser and the heat recovery coil.

Use long radius elbows rather than short elbows. Less pressure drop and greater trength make the long radius elbows better for the system.

Thermal Expansion

Thermal expansion and construction cause piping systems to move. When installing piping to a condenser, this movement must be compensated for to prevent damage to the installed equipment. This motion can be accommodated by using the natural flexibility of the piping system during layout, by designing expansion loops, using expansion joints or the employment of fittings. The method selected depends on space, cost, serviceability and maintenance requirements.

Thermal expansion and construction should be provided for by the use of piping bends, elbows, offsets or changes in direction of the piping run.

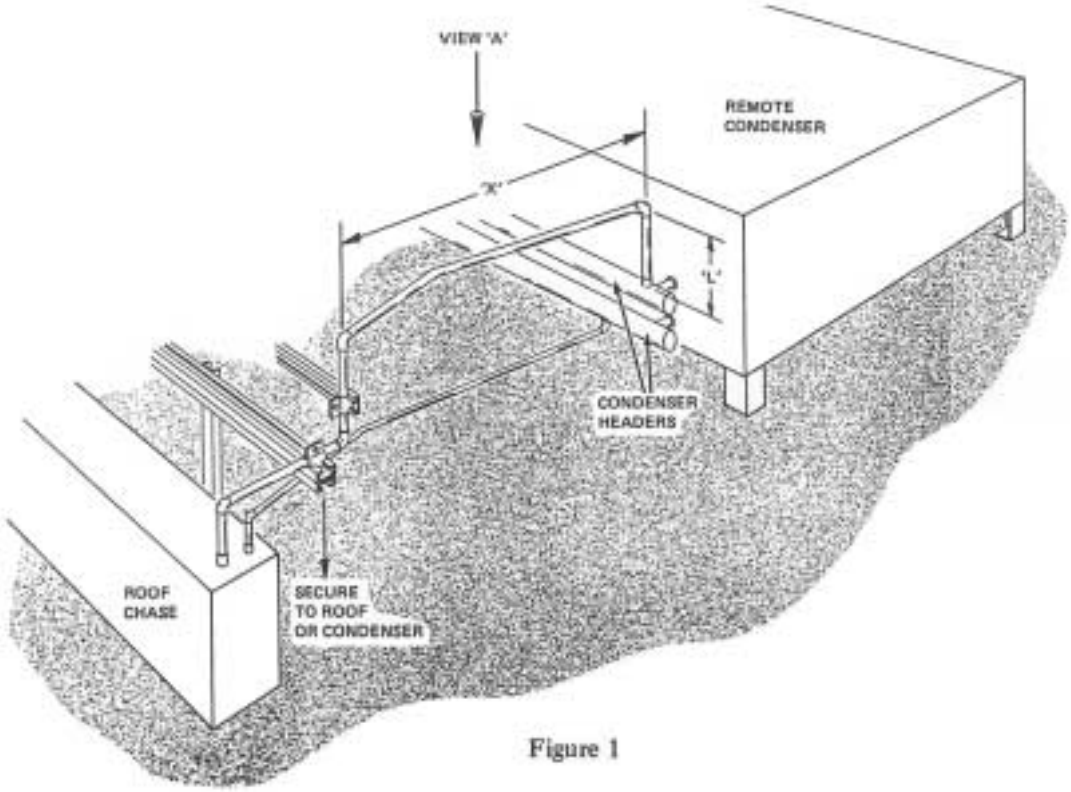


Figure 1

RECOMMENDED CASE TEMPERATURE & DEFROST CONTROL SETTINGS

Case / Models Alpine/Advantage/Alegro	Disch. Air Temp.	Defrost Htr. Amps 6'	8'	12'	EPR Settings R-22	R-404A	Defrost Control Per Day, Fail-safe, Term. Temp. Electric	Time Off	Gas
LF5	-28°	4.5[1]	---	---	6	12	2 @ 36/50°	-----	2 @ 15/55°
NCSX, NCSGX	-25°	---	13.8	20.6	3	8	1 @ 36/50°	-----	1 @ 25-30/55°
NCN(G)X, NCBX (2)	-25°	---	13.8	20.6	3	8	1 @ 36/50°	-----	1 @ 25-30/55°
NCEX	-25°	8.6	---	---	3	8	1 @ 36/50°	-----	1 @ 25-30/55°
NCJCX, NCJGCX	-25°	---	21.6	34.6	3	8	1 @ 36/50°	-----	1 @ 25-30/55°
NCJECX, NCJGECX	-25°	7.8	---	---	3	8	1 @ 36/50°	-----	1 @ 25-30/55°
NTJCX, NTJGCX (DUAL TEMP)	-25°/ -15°	---	21.6	34.6	3/ 7	8/ 14	1 @ 36/50°/ 1 @ 60/50°	----- -----	1 @ 25-30/55°/ 2-3 @ 20-25/55°
NCWX	-25°	---	13.8	20.6	3	8	1 @ 46/50°	-----	1 @ 25-30/55°
LF5	-20°	4.5[1]	---	---	10	17	2 @ 36/50°	-----	2 @ 15/55°
LFSC5	-19°	8.7[1]	---	---	---	---	-----	2 @ 36	-----
NMF, NMFG	-15°	6.5	6.9	10.3	7	14	1 @ 60/50°	-----	2 @ 16-20/55°
NFX, NFSX, NFSGX	-15°	---	6.9	10.3	7	14	1 @ 60/50°	-----	2-3 @ 20-25/55°
NFN(G)X, NFB(G)X (2)	-15°	---	6.6	10.3	7	14	1 @ 60/50°	-----	2-3 @ 20-25/55°
NFEX, NFEGX	-15°	8.6	---	---	7	14	1 @ 60/50°	-----	2-3 @ 20-25/55°
NFJCX, NFJGCX	-15°	---	13.8	20.6	7	14	1 @ 60/50°	-----	2-3 @ 20-25/55°
NFJECX, NFJGECX	-15°	7.8	---	---	7	14	1 @ 60/50°	-----	2-3 @ 20-25/55°
NFMJCX, NFMJGCX (DUAL TEMP)	-15°/ +22°	---	13.8	20.6	7/ 37	14/ 50	1 @ 60/50°/ 1 @ 36/50°	----- -----	2-3 @ 20-25/55°/ 2-3 @ 16-20/55°
NFWX, NFWGX	-15°	---	13.8	20.6	7	14	1 @ 46/50°	-----	2-3 @ 20-25/55°
NFWEX	-15°	6.9	---	---	7	14	1 @ 46/50°	-----	2-3 @ 20-25/55°
N6F, N6FL	-10°	19.5	26.0	41.8	10	17	2-3 @ 40/55°	-----	3-4 @ 22-25/60°
P5FG, P5FGN (101/E2 with HEAT)	-8°	5.8[2]	9.5[3]	16.8[4]	19	27	1 @ 46/60°	-----	1 @ 20-25/55°
(ELIMINAATOR)	-8°	5.8[2]	9.5[3]	16.8[4]	12	19	1 @ 46/60°	-----	1 @ 20-25/55°
NFL	-5°	6.5	6.9	10.3	13	21	1 @ 46/50°	-----	2 @ 17-20/55°
P5FG, P5FGN (101/E2 with HEAT)	+1°	5.8[2]	9.5[3]	16.8[4]	18	26	1 @ 46/60°	-----	1 @ 18-20/55°
(ELIMINAATOR)	+1°	5.8[2]	9.5[3]	16.8[4]	17	25.5	1 @ 46/60°	-----	1 @ 18-20/55°
NMW	+18°	12.9	13.8	20.6	33	44	4 @ 40/50°	4 @ 40	4 @ 20/55°
NMWE	+18°	17.2[5]	18.1[5]	24.9[5]	33	44	4 @ 40/50°	4 @ 40	4 @ 20/55°
NMWEE	+18°	21.5[6]	22.4[6]	29.2[6]	33	44	4 @ 40/50°	4 @ 40	4 @ 20/55°
LN5	+20°	4.3[1]	---	---	43	56	2 @ 30/50°	-----	2 @ 15/55°
LNSC5	+20°	7.5[1]	---	---	43	56	-----	2 @ 30	-----
NFX, NFSX, NFSGX	+22°	---	6.9	10.3	37	49.5	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFN(G)X, NFB(G)X (2)	+22°	---	6.6	10.3	38	50	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFEX, NFEGX	+22°	8.6	---	---	38	50	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFJCX, NFJGCX	+22°	---	13.8	20.6	37	50	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFJECX, NFJGECX	+22°	7.8	---	---	37	50	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFWX, NFWGX	+22°	---	13.8	20.6	38	50	1 @ 36/50°	-----	2-3 @ 16-20/55°
NFWEX	+22°	6.9	---	---	38	50	1 @ 36/50°	-----	2-3 @ 16-20/55°

Case / Models NSF Advantage/Alegro	Disch. Air Temp.	Defrost Htr. Amps 6'	8'	12'	EPR Settings R-22	R-404A	Defrost Control Per Day, Fail-safe, Term. Temp. Electric	Time Off	Gas
N3MGE	+23°	4.9	---	---	38	50	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
LPFMT (Self-Serve)	+23°	---	---	---	38	50	-----	4 @ 40	-----
LPFDT (Self-Serve)	+23°	---	---	---	38	50	-----	4 @ 40	-----
LPFDT (Dome)	+24°	---	---	---	38	50	-----	4 @ 40	-----
N6F, N6FL (Meat)	+24°	19.5	26.0	41.8	38	50	2 @ 40/55°	-----	4 @ 12-15/60°
N2PSE (Bulk)	+24°	4.9	---	---	43	56	-----	6 @ 28	-----
N2PSE (Meat/Deli)	+24°	4.9	---	---	38	49	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
NNG, TNG (Deli)	+25°	---	---	---	38	50	-----	6 @ 28	-----
N3MG, N3HM, N3HMG	+27°	6.5	6.9	10.3	38	50	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
N3HME, N3HMGE	+27°	4.9	---	---	38	50	-----	6 @ 26	-----
NSSD	+27°	6.5	6.9	10.3	37	49	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
NMHP, NMGHP	+27.5°	---	---	---	49[7]	62[7]	-----	4 @ 44	-----
NM, NMG	+28°	6.5	6.9	10.3	38	50	4 @ 19/50°	4 @ 34	4 @ 12-15/55°
NHMGHP	+28°	---	---	---	49[7]	62[7]	-----	4 @ 44	4 @ 15/45°
N2MHP, N6MHP	+28°	---	---	---	48[7]	61[7]	-----	6 @ 26	-----
N3HMHP, N3HMGHP	+28°	---	---	---	49[7]	62[7]	-----	6 @ 28	-----
N4MHP, N4MGHP	+28°	---	---	---	49[7]	62[7]	-----	6 @ 28	-----
N5MG	+28°	---	6.9	10.3	38	50	6 @ 36/50°	6 @ 32	6 @ 12-15/55°
N2PS (Bulk)	+28°	6.5	6.9	10.3	43	56	-----	6 @ 28	-----
N2PS (Meat/Deli)	+28°	6.5	6.9	10.3	38	49	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
NNG, TNG (Cheese)	+28°	---	---	---	43	56	-----	6 @ 28	-----
LDRL	+28°	---	---	---	37	49	-----	4 @ 45	-----
LPD (Pizza)	+28°	---	---	---	38	50	-----	4 @ 30	-----
RCCG (Riser Opt. 2)	+28°	---	---	---	35	46	-----	4 @ 30	-----
RCCG (Std. Riser) (Riser Opt. 1)	+28°	---	---	---	38	50	-----	4 @ 30	-----
LDSSI	+28.5°	---	---	---	44	57	-----	4 @ 40	-----
N3MGHP, N3MGHPE, N3MGHPEX	+29°	---	---	---	49[7]	62[7]	-----	4 @ 32	-----
N5MHP, N5MGHP	+29°	---	---	---	49[7]	62[7]	-----	6 @ 26	-----
LPFMT (Dome)	+29°	---	---	---	38	50	-----	4 @ 40	-----
N2P (Meat/Deli)	+30°	6.5	6.9	10.3	38	49	6 @ 36/50°	6 @ 28	6 @ 12-15/55°
NLD, NFD, NVD	+30°	---	---	---	36	47	-----	1 @ 46	-----
TLD, TLD(2, 4, 6) (L/R)	+30°	---	---	---	52	67	-----	4 @ 20	-----
N6DHP(LR/MR)	+31°	---	---	---	52[7]	66[7]	-----	6 @ 16	-----
NHDHP(L/M) (Shelving)	+31°	---	---	---	52[7]	66[7]	-----	6 @ 24	-----
(Peg Bars/Mixed)	+31°	---	---	---	50[7]	64[7]	-----	6 @ 26	-----
(Produce Insert)	+31°	---	---	---	55[7]	70[7]	-----	6 @ 24	-----
N6D(LR/MR)	+32°	---	6.9	10.3	44	57	4 @ 24/41°	4 @ 24	4 @ 15/55°
NHD(L/M)	+32°	4.7	6.9	10.3	44	57	4 @ 24/41°	4 @ 24	4 @ 15/55°
LDFL	+32°	---	---	---	43	56	-----	4 @ 45	-----
LD-48	+32°	---	---	---	41	53	-----	6 @ 20	-----
N2P (Bulk)	+33°	6.5	6.9	10.3	43	56	-----	6 @ 28	-----

Case / Models NSF Advantage/Alegro	Disch. Air Temp.	Defrost Htr. Amps 6'	8'	12'	EPR Settings R-22	R-404A	Defrost Control Per Day, Fail-safe, Term. Temp. Electric	Time Off	Gas
N6D(L/M/H)	+33°	4.7	6.9	10.3	44	57	4 @ 24/41°	4 @ 24	4 @ 15/55°
N6PHPM26 (Bulk)	+33°	---	---	---	54[7]	68[7]	-----	6 @ 12	-----
LD-54	+33°	---	---	---	41	53	-----	6 @ 20	-----
NP (Bulk)	+34°	---	---	---	43	56	-----	3-4 @ 40	-----
P5NG, P5NGN	+34°	---	---	---	51	65	-----	1 @ 34	-----
N6DN(L/M/H)	+34°	4.7	6.9	10.3	44	57	6 @ 18/41°	6 @ 18	6 @ 15/55°
N6DHP(L/M/H) (Shelving)	+34°	---	---	---	52[7]	66[7]	-----	6 @ 16	-----
(Peg Bars/Mixed)	+34°	---	---	---	50[7]	64[7]	-----	6 @ 18	-----
(Produce Insert)	+36°	---	---	---	55[7]	70[7]	-----	6 @ 16	-----
TLM, TLF	+34°	---	---	---	37	49	-----	2 @ 70	-----
TLM(2/4/6) (L/R)	+34°	---	---	---	37	49	-----	2 @ 70	-----
LD-60	+34°	---	---	---	41	53	-----	6 @ 20	-----
LRPHP	+34°	---	---	---	50[7]	64[7]	-----	6 @ 12	-----
N6F, N6FL (Dairy)	+35°	19.5	26.0	41.8	49	62	2 @ 40/55°	-----	4 @ 12-15/60°
N5P (Bulk)	+35°	---	---	---	43	56	-----	3 @ 40	-----
NPW, NPWE, NPWEE, NPE (Bulk)	+35°	---	---	---	43	56	-----	1 @ 60	-----
N5D, N5DH, N5DL	+35°	---	---	---	37	49	-----	4 @ 24	-----
N5DSC	+35°	---	---	---	---	---	-----	6 @ 28	-----
LD-72	+35°	---	---	---	41	53	-----	6 @ 20	-----
N2PSSC (Bulk)	+35°	---	---	---	---	---	-----	4 @ 18	-----
NRPIE, NRPIEE	+35°	---	---	---	43	56	-----	1 @ 60	-----
NLBR	+36°	---	---	---	51	65	-----	6 @ 20	-----
NLBS	+36°	---	---	---	---	---	-----	6 @ 20	-----
FDESC (Floral)	+37°	---	---	---	---	---	-----	6 @ 25	-----
N1P, N4P (Bulk)	+38°	---	---	---	43	56	-----	3-4 @ 40	-----
N3P(L/H) (Bulk)	+38°	---	---	---	43	56	-----	3 @ 40	-----
N4PHP (Bulk)	+39°	---	---	---	60[7]	75[7]	-----	2 @ 10	-----
N1PHP (Bulk)	+42°	---	---	---	60[7]	75[7]	-----	2 @ 10	-----
NLM, NLF, NFM, NFF, NVM, NVF	N/A[8]	---	---	---	36	47	-----	1 @ 110	-----

NOTES:
1) Defrost Heater Amps based on 5-foot case.
2) Defrost Heater Amps based on 2-door case.
3) Defrost Heater Amps based on 3-door case.
4) Defrost Heater Amps based on 5-door case.
5) Defrost Heater Amps based on case with 1 end case.
6) Defrost Heater Amps based on case with 2 end cases.
7) ADD 0.5# to EPR setting for each 1000 foot rise in elevation.
8) N/A = Not Available.

SUGGESTED TEMPERATURE CONTROLLING FOR CASES & WALK-IN COOLERS*:

Electric Defrost

For Parallel systems with Electric Defrost, the following controls are suggested for temperature control and defrost:

1. All walk-in coolers should have a thermostat control wired to a liquid solenoid. The defrost solenoids for each circuit will be wired to a defrost timer.
2. All medium temperature cases will have an EPR valve with a solenoid mounted at the rack for defrost. The defrost solenoids for each circuit will be wired to a defrost timer.
3. All low temperature walk-in coolers and cases will have suction stop EPR valves mounted on the rack. No defrost solenoids are required because the defrost timer will be wired to the suction stop EPR valve.

Gas Defrost

For Parallel systems with Gas Defrost, the following controls are suggested for temperature control and defrost:

1. Walk-in coolers with gas defrost will be controled by suction stop EPR valves.
2. All medium temperature cases with gas defrost will be controlled wi a suction stop EPR valve.
3. All low temperature walk-in coolers and cases with gas defrost will be controlled with a suction stop EPR valve.

*Cases and walk-in coolers connected to an Enviroguard system should be set to the temperature and defrost control settings listed in the Enviroguard Installation & Service Manual.