



**INDEPENDENT  
SUPPLY COMPANY INC**  
*an Employee Ownership Company*

## **REFERENCE TOOLS**



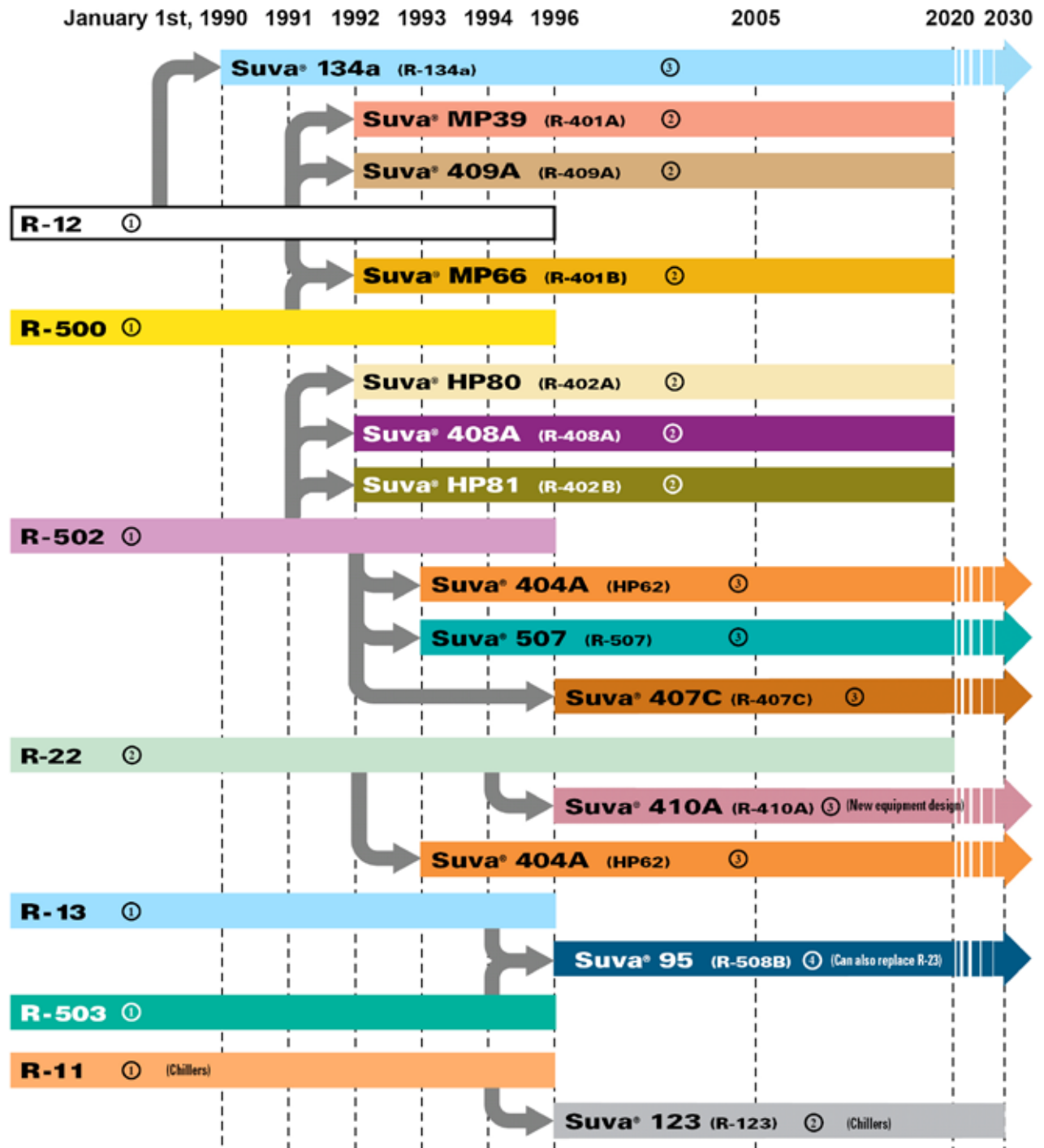
# **REFERENCE SECTION**

## **REFERENCE MATERIAL INDEX**

CFC Replacement Guide.....	1-4
Suggested Oil Guide.....	2
Retrofit Guidelines .....	3
Pressure Control Setting Guidelines.....	4
Pressure/Temperature Charts.....	5-6
Canadian Climatic Conditions.....	7
Insulation Requirements for Storage Rooms.....	8
Operating Conditions for Storage Rooms.....	8
“U” Values of Insulation.....	9
Average Air changes Per 24 Hours .....	10
Heat Removed in Cooling Air to Storage Temperatures .....	11
Storage Requirements.....	12-13
Space, Weight and Density Data.....	14
Storage Condition for Cut Flowers and Nursery Stock .....	15
Electrical Motor Heat Gain.....	16
Heat Equivalent of Occupancy .....	16
Rapid Cooling Load Selection .....	17
Equipment Selection.....	18-20
Metric to Imperial Conversions .....	21-22
R22 Line Sizing Charts .....	23-28
HFC Piping Design Goals.....	29-30
HFC Application Considerations .....	31
HFC Code Regulations.....	32
HFC General Design Principals.....	33
HFC Capacity versus Line Pressure Drop.....	34
HFC ‘Quick Pick’ Criteria .....	35
SUVA 134 Piping Guidelines .....	36-41
SUVA 404A (R404A) Piping Guidelines.....	42-46
SUVA 407C (R407C) Piping Guidelines .....	47-50
SUVA 410A (R410A) Piping Guidelines.....	51-54
SUVA 507 (R507) Piping Guidelines .....	55-59
SUVA 95 (R508B) Piping Guidelines .....	60-62
Typical Refrigeration Piping Schematic .....	63
Equivalent Length of Valves and Fittings.....	64
Copper Tubing Specifications.....	65
Refrigerant Piping Expansion and Contraction.....	66-67
Weight of Refrigerant in Copper Tubing .....	68
Refrigerant Receiver Capacities .....	69
Temp./Pressure Chart Complete Range of Temp. Applications.....	70
Cooling Requirements .....	71
Air Requirements for Air-Cooled Condensers.....	71
Water Requirements for Condensing Units .....	71
Formulas.....	71
Pulleys and Belt Lengths .....	72

# DuPont Refrigerants

## General Replacement Guide



**NOTE: WHEN RETROFITTING WITH SUGGESTED REPLACEMENTS, REFER TO SPECIFIC RETROFIT LITERATURE AND THE EQUIPMENT MANUFACTURER FOR DETAILED PROCEDURES.**

① CFC refrigerant

② HCFC refrigerant

③ HFC refrigerant

④ PFC refrigerant

Suva® is a DuPont registered trademark.

# DuPont Refrigerants

## Suggested Oil Guide

### Stationary Refrigeration Applications

#### Direct Expansion Applications

Refrigerant	Lubricant*
R-12 ①	MO or AB
• 134a (R-134a) ③	POE
• MP39 (R-401A) ②	MO or AB
• 409A (R-409A) ②	MO or AB
R-500 ①	MO or AB
• MP66 (R-401B) ②	MO or AB
R-13 ①	MO or AB
R-503 ①	MO or AB
R-23 ③	POE
• 95 (R-508B) ④	POE

Refrigerant	Lubricant*
R-502 ①	MO or AB
• 404A (HP62) ③	POE
• 507 (R-507) ③	POE
• HP80 (R-402A) ②	AB
• 408A (R-408A) ②	AB
• HP81 (R-402B) ②	MO or AB
R-22 ②	MO or AB
• 407C (R-407C) ③	POE
• 410A (R-410A) ③	POE

MO = Mineral Oil

• Suva® Refrigerants

③ HFC Refrigerant

AB = Alkylbenzene

① CFC Refrigerant

④ PFC Refrigerant

POE = Polyol Ester

② HCFC Refrigerant

\* HCFC refrigerants are also compatible with POE lubricants. Some fractional horsepower replacement compressors are shipped with POE.

#### Oil Change Guidelines

- Where possible, use OEM-recommended oil type, charge size, and viscosity.
- When converting many CFC systems to an HCFC service refrigerant (Suva® MP39, 409A, MP66, HP80, 408A, or HP81), AB is the recommended lubricant for optimum oil return. One compressor oil change to AB will typically remove between 50 and 80% of the existing MO which satisfies the recommendations/requirements of most compressor manufacturers.

**Note:** Many compressors already contain AB lubricant, therefore no oil change is required when converting to an HCFC.

- Field experience has shown that Suva® MP39, 409A, MP66, and HP81 work successfully with the existing MO in many unitary and other close-coupled systems.
- When converting a CFC system to an HFC refrigerant [Suva® 134a, 404A (HP62), 507, 407C, or 95], POE is the recommended lubricant. At least 95% of the MO, or AB should be replaced with POE of similar viscosity. This typically requires multiple oil changes.

#### What to Expect After Retrofit

Refrigerant	Compared to	Discharge Pressure (psi)	Suction Pressure (psi)	Discharge Temperature (F)	Refrigeration Capacity (%)	Expected Superheat (F)
<b>R-12 replacements</b>						
134a	R-12	+10	-2	-10	-10	-4
MP39	R-12	+20	Same	+25	+10	-3
MP66	R-12	+30	+2	+30	+15	-1
409A	R-12	+25	Same	+30	+10	-4
<b>R-502 replacements</b>						
HP80	R-502	+40	+5	-5	+15	+4
HP81	R-502	+30	+5	+15	+15	Same
408A	R-502	+5	Same	+20	+5	-3
404A (HP62)	R-502	+20	Same	-10	Same	+2
507		+30	Same	-15	Same	+4
<b>R-22 replacements</b>						
407C	R-22	+15	Same	-15	Same	+1
407C	R-502	-5	-8	+30	-5	-4
<b>R-13, R-23, R-503 replacements</b>						
95	R-503	+2	Same	-40	-2	Same

+ is increase  
- is decrease

This information is intended to serve as a guide; the actual performance may vary.

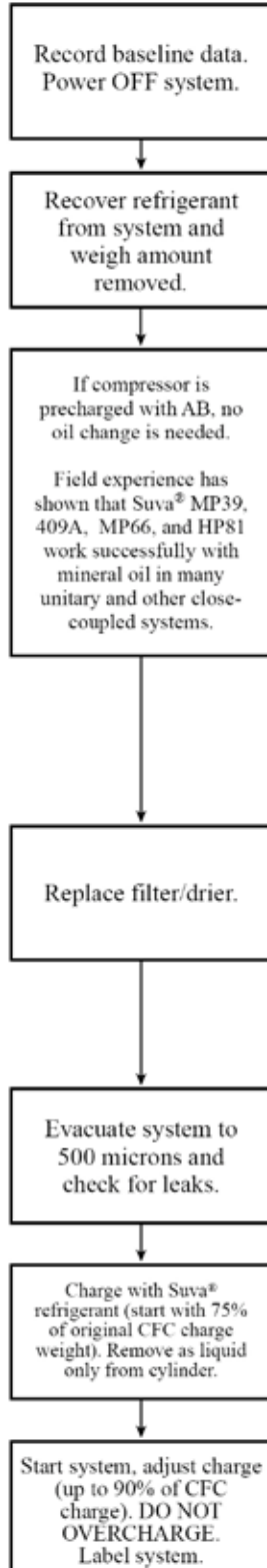
# DuPont Refrigerants

## General Retrofitting Guide

### Retrofit to HCFC

#### No Oil Change

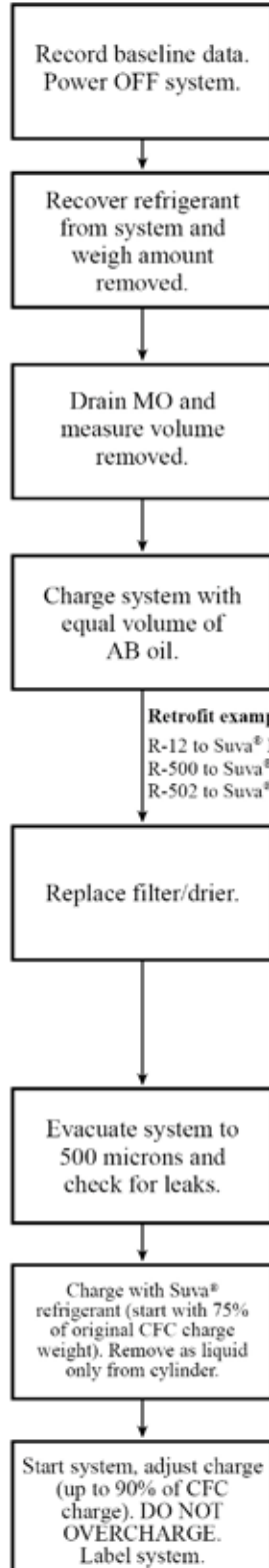
For systems containing AB or close-coupled systems not requiring an oil change from MO.



### Retrofit to HCFC

#### Single Oil Change

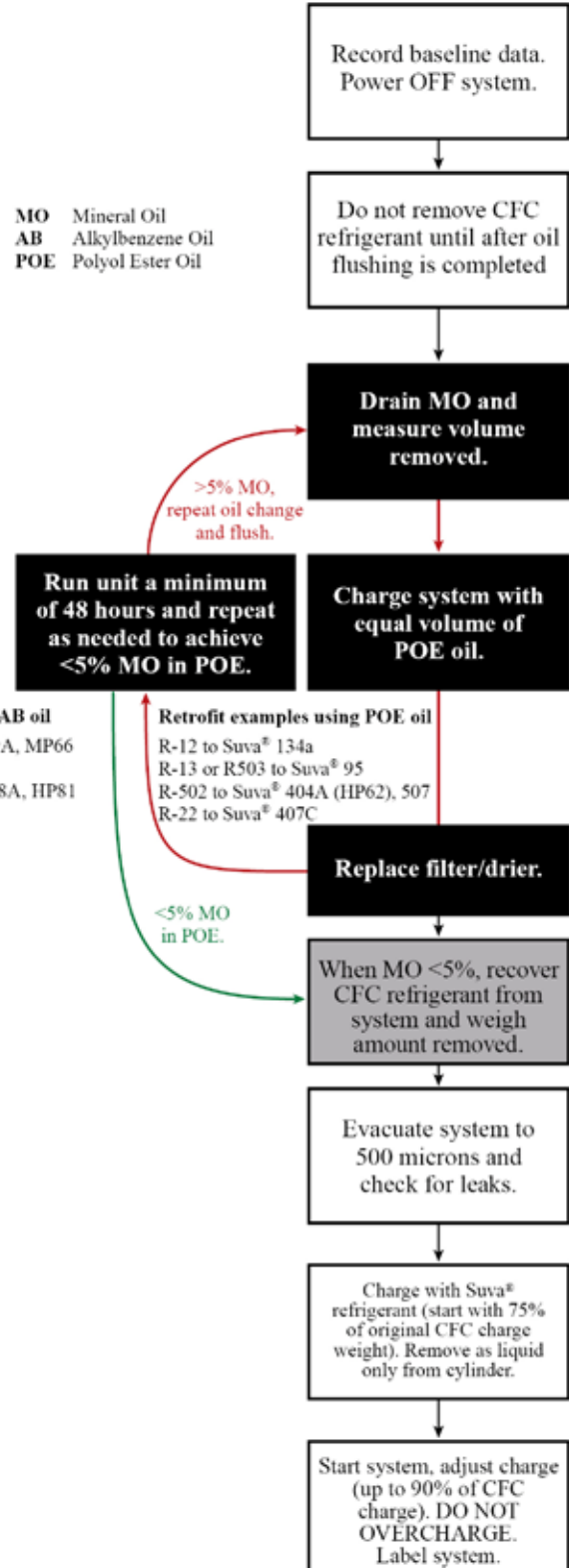
For systems requiring a single oil change from MO.



### Retrofit to HFC

#### Multiple Oil Changes

MO Mineral Oil  
AB Alkylbenzene Oil  
POE Polyol Ester Oil



\*For detailed information, please see our retrofit guidelines.

# DuPont Refrigerants

## Cross Reference Guide

ASHRAE#	Tradenames	Manufacturers	Type	DuPont Cylinder Sizes	Lubricant	Evaporator Temperature			Applications
						High	Med	Low	
<b>R-12 Replacements</b>									
<b>R-134a</b>	<b>Suva® 134a</b> Genetron® 134a Forane® 134a Klea® 134a	<b>DuPont</b> Honeywell Arkema INEOS	HFC	30 lb. DAC 125 lb. Cyl 1/2 Ton Tank (1025 lbs) Ton Tank (1750 lbs)	POE	X	X		Commercial refrigeration Appliances Chillers Automotive A/C; new & retrofit
<b>R-401A</b>	<b>Suva® MP39</b> Genetron® MP39	<b>DuPont</b> Honeywell	HCFC	30 lb. DAC 125 lb. Cyl 1/2 Ton Tank (1000 lbs) Ton Tank (1700 lbs)	MO or AB	X	X		Positive displacement refrigeration equipment Supermarket systems; medium temp Walk-in coolers
<b>R-409A</b>	<b>Suva® 409A</b> Genetron® 409A Forane® 409A	<b>DuPont</b> Honeywell Arkema	HCFC	30 lb. DAC 125 lb. Cyl Ton Tank (1750 lbs)	MO or AB	X	X		Positive displacement refrigeration equipment Supermarket systems; medium temp Walk-in coolers
<b>R-500 Replacements</b>									
<b>R-401B</b>	<b>Suva® MP66</b> Genetron® MP66	<b>DuPont</b> Honeywell	HCFC	30 lb. DAC 125 lb. Cyl Ton Tank (1700 lbs)	MO or AB		X	X	Closest performance match to R-500 Best retrofit choice for R-12 freezers R-12 transport refrigeration equipment
<b>R-502 Replacements</b>									
<b>R-404A</b>	<b>Suva® 404A</b> Genetron® 404A Forane® 404A	<b>DuPont</b> Honeywell Arkema	HFC	24 lb. Cyl 100 lb. Cyl 1/2 Ton Tank (800 lbs) Ton Tank (1300 lbs)	POE	X	X	X	New equipment & retrofit for commercial refrigeration R-502 transport refrigeration
<b>R-507</b>	<b>Suva® 507</b> Genetron® AZ50 Forane® 507	<b>DuPont</b> Honeywell Arkema	HFC	25 lb. DAC 100 lb. Cyl Ton Tank (1400 lbs)	POE	X	X	X	New equipment & retrofit for commercial refrigeration R-502 transport refrigeration
<b>R-408A</b>	<b>Suva® 408A</b> Genetron® 408A Forane® 408A	<b>DuPont</b> Honeywell Arkema	HCFC	24 lb. DAC 100 lb. Cyl Ton Tank (1500 lbs)	MO or AB	X	X	X	Existing commercial refrigeration equipment
<b>R-402A</b>	<b>Suva® HP80</b> Genetron® HP80	<b>DuPont</b> Honeywell	HCFC	27 lb. DAC 110 lb. Cyl Ton Tank (1400 lbs)	MO or AB	X	X	X	Existing commercial refrigeration equipment
<b>R-402B</b>	<b>Suva® HP81</b> Genetron® HP81	<b>DuPont</b> Honeywell	HCFC	13 lb. DAC Ton Tank (1500 lbs)	MO or AB		X	X	Ice machines and other selected applications
<b>R-22 Replacements</b>									
<b>R-407C</b>	<b>Suva® 407C</b> Genetron® 407C Forane® 407C Klea 407C	<b>DuPont</b> Honeywell Arkema INEOS	HFC	25 lb. DAC 115 lb. Cyl Ton Tank (1550 lbs)	POE	X			Positive displacement A/C equipment New commercial and light commercial A/C. Existing residential and commercial/ light commercial A/C - always consult the OEM for guidance.
<b>R-410A</b>	<b>Suva® 410A</b> Puron® Genetron® 410A Forane® 410A	<b>DuPont</b> Carrier Honeywell Arkema	HFC	25 lb. DAC 110 lb. Cyl Ton Tank (1350 lbs)	POE	X			Positive displacement A/C - <b>NEW</b> residential & commercial A/C & heat pumps designed for R-410A. May be used in some existing R-22 A/C systems, but extensive changes required - always consult the OEM.
<b>R-404A</b>	<b>Suva® 404A</b> Genetron® 404A Forane® 404A	<b>DuPont</b> Honeywell Arkema	HFC	24 lb. Cyl 100 lb. Cyl 1/2 Ton Tank (800 lbs) Ton Tank (1300 lbs)	POE	X	X	X	New equipment & retrofit for commercial refrigeration
<b>R-507</b>	<b>Suva® 507</b> Genetron® AZ50 Forane® 507	<b>DuPont</b> Honeywell Arkema	HFC	25 lb. DAC 100 lb. Cyl Ton Tank (1400 lbs)	POE	X	X	X	New equipment & retrofit for commercial refrigeration
<b>R-13, R-23, R-503 Replacements</b>									
<b>R-508B</b>	<b>Suva® 95</b> Genetron® 508B	<b>DuPont</b> Honeywell	PFC	10 lb. Cyl 20 lb. Cyl 70 lb. Cyl Ton Tank (1100 lbs)	POE		Below -40°F		New & existing VLT (below -40°F) applications Cascade refrigeration systems
<b>R-11 Replacements</b>									
<b>R-123</b>	<b>Suva® 123</b> Genetron® 123 Forane® 123	<b>DuPont</b> Honeywell Arkema	HCFC	100 lb. Drum 200 lb. Drum 625 lb. Drum	MO	X	X		New and existing centrifugal chillers (consult OEM)
<b>R-114 Replacements</b>									
<b>R-124</b>	<b>Suva® 124</b> Genetron® 124 Forane® 124	<b>DuPont</b> Honeywell Arkema	HCFC	30 lb. DAC 145 lb. Cyl Ton Tank (2000 lbs)	AB	X	X		Industrial refrigeration & A/C High ambient A/C

**Footnotes:** • Suva® HFC refrigerants: (1) long-term replacements, (2) zero ozone depletion, (3) no phase-out date  
• ALL Suva® refrigerants are UL classified  
• ALL Suva® refrigerants have A1 ASHRAE Safety Classification, except Suva® 123 which has a B1 ASHRAE Safety Classification.

AB = Alkylbenzene  
MO = Mineral Oil  
POE = Polyol Ester



# Pressure Control Setting Guide

(approximate)

## Direct Expansion Applications

This **pressure control setting guide** provides you with **approximate** settings that can be used as starting points to help you **optimize** your system. Recognize that the values expressed can vary with specific conditions, such as actual relative humidity, pressure drop, store layout, equipment location and design. If your current settings for R-12 or R-502 vary from the baseline values given below, the alternative refrigerant settings will vary proportionately.

Applications		Desirable Case or Box Temperature (°F)	R-502		HP80		408A		HP81		HP62		R-12		MP39		409A		MP66		R-134a	
			Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In
Ice Cream	Open	-27 to -22	2	17	2	18	1	17	0	15	2	17	—	—	—	—	—	—	14"	1"	—	—
	Closed	-15 to -10	6	23	6	25	5	23	4	21	6	23	—	—	—	—	—	—	12"	3	—	—
Frozen Food	Open	-10 to -5	17	29	18	31	16	28	14	27	17	29	4"	5	4"	4	4"	3	2"	6	4"	4
	Closed	-5 to 0	21	33	22	35	20	32	19	30	21	33	0	7	0	6	0	5	2	8	0	6
Deli Case	Serving	43 to 45	43	68	47	75	43	68	42	68	44	69	11	27	12	26	11	25	14	29	12	26
Fresh Meat	Cooler	34 to 38	33	55	36	60	33	55	32	54	34	56	5	19	6	18	5	17	8	20	6	18
	Cases	38 to 42	35	64	39	70	35	64	34	63	36	65	7	24	8	23	7	22	10	26	8	23
Dairy	Serving	50 to 60	53	68	59	75	53	68	52	68	54	69	16	27	17	26	16	25	19	29	17	26
	Storage	31 to 36	35	57	39	63	35	57	34	56	36	58	7	21	8	20	7	19	10	22	8	20
Produce	Serving	40 to 45	49	79	53	87	49	79	48	78	50	80	14	33	15	32	14	31	18	35	15	32
	Storage	35 to 40	37	68	41	75	37	68	37	68	38	69	8	27	9	26	8	25	11	29	9	26
Meat Prep	Product	28 to 32	52	68	59	75	52	68	52	68	53	69	16	27	17	26	16	25	19	29	17	26
	Room	42 to 47	33	79	36	87	33	79	32	78	34	80	5	33	6	32	5	31	8	35	6	32
Walk-In Coolers	Meat	28 to 32	52	70	57	77	52	70	51	69	53	71	16	27	17	26	16	25	19	29	17	26
	Poultry	20 to 30	51	68	56	75	51	68	50	68	52	69	15	27	16	26	15	25	18	29	16	26
	Fish	32 to 34	53	79	59	78	53	79	52	78	54	80	16	27	17	26	16	25	19	29	17	26
	Dairy	33 to 35	60	82	66	90	60	82	59	82	61	83	23	40	24	39	23	38	27	43	24	39
Produce		36 to 42	64	84	70	92	64	84	63	84	65	85	26	41	27	40	26	39	30	44	27	40
	Bakery	35 to 40	60	82	66	90	60	82	59	82	61	83	23	40	24	39	23	38	27	43	24	39
Walk-In Freezers	Grocery	-15 to -12	11	23	12	25	10	22	9	21	11	23	9"	2	9"	1	9"	0	7"	3	9"	1
	Meat	-5 to 0	21	33	22	35	20	32	19	30	21	33	0	7	0	6	0	5	2	8	0	6
	Bakery	0 to -5	24	36	27	40	24	36	23	35	25	37	1	9	2	8	1	7	4	10	2	8
Beverage	Milk	35 to 40	53	68	59	75	53	68	52	68	54	69	16	27	17	26	16	25	19	29	17	26
	Beer	36 to 43	55	71	60	78	55	71	54	70	56	72	17	27	18	26	17	25	20	29	18	26
Fur Storage	Shock	10 to 15	33	51	36	56	33	51	32	50	34	52	5	17	6	16	5	15	8	18	6	16
	Storage	30 to 35	63	93	69	101	63	92	62	92	64	94	22	40	23	39	22	38	26	43	23	39
Cut Flowers	Display	32 to 35	10	93	75	101	10	92	68	92	11	94	25	40	26	39	25	38	29	43	26	39
Ice Cuber	Dry Type	-5 to 0	25	48	27	52	24	48	23	46	25	48	2	15	2	14	1	13	4	17	2	14
Soda Fountain		29 to 33	55	70	60	77	55	70	54	69	56	71	17	27	18	26	17	25	20	29	18	26
Salad Bars		40 to 42	49	78	53	86	49	78	48	77	50	79	14	32	15	31	14	30	18	35	15	31
Domestic	Refrigerator	36 to 46	64	84	70	92	64	84	63	84	65	85	26	43	27	42	26	41	30	46	27	42
	Freezer	-10 to 0	17	33	18	35	16	32	14	30	17	33	4"	7	4"	6	4"	5	2"	8	4"	6

Note: Pressure values expressed in psig or inches Hg.

\*For R-507 applications, use R-404A settings.

The information contained herein is based on technical data and tests that we believe to be reliable. It is intended for use by persons having technical skill, at their own discretion and risk. Because conditions of use are outside of DuPont control, we can assume no liability for results obtained or damages incurred through the application of the data presented.

**For further information: (800) 235-SUVA**  
**In Canada: (800) USE-SUVA**  
[www.suva.com](http://www.suva.com)



*The miracles of science™*



**TABLE 1  
CANADIAN CLIMATIC CONDITIONS**

CITY	WINTER	SUMMER		CITY	WINTER	SUMMER	
	DB °F	DB °F	WB °F		DB °F	DB °F	WB °F
<b>Alberta</b>				<b>Nova Scotia</b>			
Calgary	-27	84	65	Amherst	-11	84	72
Edmonton	-29	85	68	Halifax	1	79	69
Grande Prairie	-39	83	66	Kentville	-3	85	72
Jasper	-31	83	66	New Glasgow	-9	81	72
Lethbridge	-27	90	68	Sydney	-1	82	71
Fort McMurray	-41	86	69	Truro	-8	82	73
Medicine Hat	-29	93	70	Yarmouth	5	74	68
Red Deer	-31	84	67	<b>Ontario</b>			
<b>British Columbia</b>				Belleville	-11	86	75
Dawson Creek	-37	82	66	Chatham	0	89	76
Kamloops	-21	94	68	Cornwall	-13	89	75
Nanaimo	16	83	68	Hamilton	-3	88	76
New Westminster	15	84	69	Kenora	-32	84	73
Penticton	0	92	70	Kingston	-11	87	75
Prince George	-33	84	66	Kitchener	-6	88	75
Prince Rupert	-2	74	60	London	-4	87	76
Trail	-5	92	68	North Bay	-22	84	71
Vancouver	15	79	68	Ottawa	-17	90	75
Victoria	20	77	64	Owen Sound	-6	84	73
<b>Manitoba</b>				Peterborough	-13	87	75
Brandon	-30	89	74	St. Catharines	-1	87	76
Churchill	-41	81	67	Sarnia	0	88	76
Dauphin	-31	87	74	The Sault	-7	85	73
Flin Flon	-41	87	70	Sudbury	-22	86	72
The Pas	-35	85	71	Thunder Bay	-27	85	72
Winnipeg	-30	89	75	Timmins	-33	87	72
<b>New Brunswick</b>				Toronto	-5	90	75
Campbellton	-18	85	72	Windsor	0	90	77
Chatham	-15	89	72	<b>Prince Edward Island</b>			
Edmundston	-21	87	73	Charlottetown	-7	80	71
Fredericton	-16	89	73	<b>Quebec</b>			
Moncton	-12	85	72	Chicoutimi	-26	-86	72
Saint John	-12	87	70	Granby	-19	88	75
<b>Newfoundland</b>				Hull	-18	90	75
Corner Brook	-5	76	67	Montreal	-16	88	75
Gander	-5	72	69	Quebec City	-19	87	74
Goose Bay	-27	85	68	Rimouski	-16	83	71
St. John's	3	77	69	St. Jerome	-17	88	75
Stephenville	-3	76	67	Sept Iles	-26	76	67
<b>Saskatchewan</b>				Shawinigan	-18	86	74
Moose Jaw	-29	-3	71	Sherbrooke	-25	86	74
Regina	-33	91	72	Trois Rivieres	-17	88	74
Saskatoon	-35	89	70	Val D'Or	-32	85	72
Swift Current	-28	93	70				

**TABLE 2  
INSULATION REQUIREMENTS FOR STORAGE ROOMS**

STORAGE TEMPERATURE °F	DESIRABLE INSULATION "U" FACTOR
-40° to -15°	0.03
-15° to 0°	0.04
0° to 25°	0.05
25° to 40°	0.06
40° and up	0.08

**TABLE 3  
OPERATING CONDITIONS FOR MEAT PREPARATION ROOMS**

TEMPERATURE °F	HUMIDITY	OPERATING T.D. °F	SYSTEM RUN TIME
50 to 55	60%	20 to 25	24 hours

**TABLE 4  
OPERATING CONDITIONS FOR FUR STORAGES**

TEMPERATURE °F	HUMIDITY	OPERATING T.D. °F	SYSTEM RUN TIME
35 to 40	55% to 65%	20 to 25	20 hours

*Positive defrost and heat required.*

**TABLE 5**  
**"U" VALUES OF VARIOUS INSULATIONS**

MATERIAL	THICKNESS (inches)	"R"	"U"
Polystyrene Foam... Styrofoam "SM" (blue) Styrofoam Roofmate (blue)	1	5.0	0.20
	2		0.10
	3		0.07
	4		0.05
	5		0.04
	6		0.035
	8		0.025
	Polyurethane Foam... Board as used in prefabricated boxes	1	6.25
2			0.08
3			0.055
4			0.04
5			0.032
6			0.027
8			0.02
Rigid Glass Fibre...		1	4.0
Glass...	single		1.0
	double		0.6
	triple		0.4
Cork...	1	3.3	0.3

MATERIAL	THICKNESS (inches)	"R"	"U"
Styrofoam... Beadboard (white)	1	3.57	0.28
	2		0.14
	3		0.09
	4		0.07
	5		0.055
	6		0.045
	8		0.035
	Gypsum board...	0.5	
Glass Fibre Batts...	1	3.33	0.30
	2 1/2		0.11
	3 1/2		0.08
	6		0.05
Sawdust...	1	1.68	0.06
	6		0.1
Wood...	1	1.2	0.85
Brick...	4		0.6
Concrete...	1	0.1	10.0
8" Concrete block...	8		0.9

**TABLE 6**  
**TRANSMISSION HEAT GAIN FACTORS**  
BTU/24 Hour/Square Foot of Outside Surface

WALL INSULATION "U" FACTOR (Table 5)	DESIGN TEMPERATURE DIFFERENCE °F *									
	10	20	30	40	50	60	70	80	90	100
.01	2.4	4.8	7.2	9.6	12.0	14.4	16.8	19.2	21.6	24.0
.02	4.8	9.6	14.4	19.2	24.0	28.8	33.6	38.4	43.2	48.0
.025	6.0	12.0	18.0	24.0	30.0	36.0	42.0	48.0	54.0	60.0
.030	7.2	14.4	21.6	28.8	36.0	43.2	50.4	57.6	64.8	72.0
.035	8.4	16.8	25.2	33.6	42.0	50.4	58.8	67.2	75.6	84.0
.040	9.6	19.2	28.8	38.4	48.0	57.6	67.2	76.8	86.4	96.0
.045	10.8	21.6	32.4	43.2	54.0	64.8	75.6	86.4	97.2	108.0
.050	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0	120.0
.055	13.2	26.4	39.6	52.8	66.0	79.2	92.4	105.6	118.8	132.0
.060	14.4	28.8	43.2	57.6	72.0	86.4	100.8	115.2	129.6	144.0
.065	15.6	31.2	46.8	62.4	78.0	93.6	109.2	124.8	139.4	156.0
.070	16.8	33.6	50.4	67.2	84.0	100.8	117.6	134.4	151.2	168.0
.075	18.0	36.0	54.0	72.0	90.0	108.0	126.0	144.0	162.8	180.0
.080	19.2	38.4	57.6	76.8	96.0	115.2	134.4	153.6	172.8	192.0
.085	20.4	40.8	61.2	81.6	100.0	122.4	142.8	163.2	183.6	204.0
.090	21.6	43.2	64.8	86.4	108.0	129.6	151.2	172.8	194.4	216.0
.095	22.8	45.6	68.4	91.2	114.0	136.8	159.6	182.4	205.2	228.0
.10	24.0	48.0	72.0	96.0	120.0	144.0	168.0	192.0	216.0	240.0
.20	48.0	96.0	144.0	192.0	240.0	288.0	336.0	384.0	432.0	480.0
.30	72.0	144.0	216.0	288.0	360.0	432.0	504.0	576.0	648.0	720.0
.50	120.0	240.0	360.0	480.0	600.0	720.0	840.0	960.0	1080.0	1200.0
1.00	240.0	480.0	720.0	960.0	1200.0	1440.0	1680.0	1920.0	2160.0	2400.0

\*For temperature differences greater than 100°F BTU/square foot factor will be in direct proportion e.g. for 120°F use factor for 60°F TD and multiply by 2.

**TABLE 6A  
SOLAR LOAD ALLOWANCE**

SURFACE COLOUR	°F TEMPERATURE DIFFERENCE TO BE ADDED TO VALUES IN TABLE 6 FOR SURFACES EXPOSED TO DIRECT SUNLIGHT			
	EAST WALL	SOUTH WALL	WEST WALL	FLAT ROOF
Dark	8	5	8	20
Medium	6	4	6	15
Light	4	2	4	9

*Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.*

**TABLE 7  
AVERAGE AIR CHANGES PER 24 HOURS**

Rooms above 32° F

VOLUME CUBIC FEET	AIR CHANGES PER 24 HOURS	VOLUME CUBIC FEET	AIR CHANGES PER 24 HOURS
250	38.0	8000	5.5
300	34.5	10000	4.9
400	29.5	15000	3.9
500	26.0	20000	3.5
600	23.0	25000	3.0
800	20.0	30000	2.7
1000	17.5	40000	2.3
1500	14.0	50000	2.0
2000	12.0	75000	1.6
3000	9.5	100000	1.4
4000	9.2	200000	1.1
5000	7.2	300000	1.0
6000	6.5	500000	0.9

Rooms below 32° F

VOLUME CUBIC FEET	AIR CHANGES PER 24 HOURS	VOLUME CUBIC FEET	AIR CHANGES PER 24 HOURS
250	30.0	6000	5.2
300	26.5	8000	4.5
400	23.5	10000	4.0
500	20.0	15000	2.8
600	17.5	20000	2.5
800	15.0	30000	2.0
1000	13.5	50000	1.5
1500	12.3	75000	1.2
2000	11.9	100000	1.0
3000	7.8	200000	0.9
4000	6.0	300000	0.85
5000	5.6	500000	0.8

*NOTE: for storage rooms with anterooms, reduce values by 50%; for heavy use rooms, increase values X 2.*

**TABLE 8**  
**HEAT REMOVED IN COOLING AIR TO STORAGE ROOM TEMPERATURE**  
 BTU PER CUBIC FOOT

**ROOMS ABOVE FREEZING**

STORAGE ROOM TEMPERATURE °F	TEMPERATURE OF OUTSIDE AIR °F									
	70		85		90		95		100	
	RELATIVE HUMIDITY PERCENT									
	50	60	50	60	50	60	50	60	50	60
65	-	-	0.32	0.52	0.58	0.81	0.85	1.12	1.15	1.46
60	.18	.18	0.58	0.78	0.83	10.6	1.10	1.37	1.39	1.70
55	.27	.27	0.80	1.00	1.05	1.28	1.32	1.59	1.61	1.92
50	.39	.51	1.01	1.21	1.26	1.49	1.53	1.79	1.82	2.13
45	.59	.72	1.20	1.40	1.45	1.68	1.71	1.98	2.00	2.31
40	.76	.89	1.37	1.57	1.62	1.85	1.88	2.15	2.17	2.48
35	.39	1.06	1.54	1.74	1.78	2.01	2.04	2.31	2.33	2.64
30	1.08	1.21	1.78	2.01	2.05	2.31	2.33	2.64	2.65	3.00

**ROOMS BELOW FREEZING**

STORAGE ROOM TEMPERATURE °F	TEMPERATURE OR OUTSIDE AIR °F									
	40		50		70		90		100	
	RELATIVE HUMIDITY PERCENT									
	70	80	70	80	50	60	50	60	50	60
30	0.21	0.26	0.55	0.62	1.09	1.21	2.05	2.31	2.65	3.00
25	0.37	0.43	0.71	0.78	1.19	1.36	2.20	2.46	2.79	3.14
20	0.52	0.58	0.86	0.93	1.39	1.51	2.33	2.60	2.93	3.28
15	0.66	0.72	1.00	1.07	1.50	1.63	2.46	2.72	3.05	3.40
10	0.80	0.85	1.13	1.20	1.63	1.75	2.58	2.84	3.17	3.52
5	0.92	0.97	1.25	1.32	1.74	1.87	2.69	2.95	3.28	3.63
0	1.04	1.09	1.36	1.43	1.80	1.98	2.80	3.06	3.38	3.74
-5	1.15	1.20	1.47	1.55	1.92	2.05	2.90	3.16	3.48	3.84
-1	1.26	1.31	1.58	1.65	2.05	2.18	3.00	3.26	3.58	3.93
-15	1.37	1.42	1.69	1.76	2.15	2.28	3.10	3.36	3.68	4.03
-20	1.47	1.52	1.79	1.86	2.25	2.38	3.19	3.46	3.77	4.12
-25	1.57	1.62	1.89	1.96	2.35	2.47	3.29	3.55	3.86	4.21
-30	1.67	1.72	1.99	2.06	2.44	2.56	3.38	3.64	3.95	4.30

*Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.*

**TABLE 9**  
**STORAGE REQUIREMENTS AND PROPERTIES OF PERISHABLE PRODUCTS**

COMMODITY	STORAGE TEMPERATURE °F	RELATIVE HUMIDITY %	STORAGE LIFE (WEEKS)	SPECIFIC HEAT ABOVE FREEZING BTU / # / °F	FREEZING POINT °F	SPECIFIC HEAT BELOW FREEZING BTU / # / °F	LATENT HEAT OF FUSION BTU / #
Apples	30-40	90*	12-32*	0.87	30.0	0.45	121
Apricots	32	90	1	0.88	30.1	0.46	122
Asparagus	32-36	95	2-3	0.94	30.9	0.48	133
Bananas	.*	85-95*	*	0.80	30.7	0.42	108
Beans - Green	40-45	95	1	0.91	30.7	0.47	127
Beans - Lima	32-40	90	<1	0.73	30.0	0.40	94
Beets - Roots	32	95	20	0.90	30.4	0.46	126
Blueberries	31-32	90-95	2	0.86	29.7	0.45	118
Broccoli	32	95	2	0.92	30.9	0.47	130
Brussels Sprouts	32	95	16	0.88	30.6	0.46	122
Cabbage	32	95	20	0.94	30.4	0.47	132
Carrots - Mature	32	95	28	0.90	29.5	0.46	126
Cauliflower	32	95	3	0.93	30.6	0.47	132
Celery	32	95	6	0.95	31.1	0.48	135
Cherries - Sweet	31-32	90-95	<1	0.54	28.8	0.44	114
Corn	32	95	1	0.79	30.9	0.42	106
Cucumbers	45-50	95	2	0.97	31.1	0.49	137
Eggs	29-31	80-85*	20	0.73	28.0	0.40	96
Garlic	32	65-70	30	0.69	30.6	0.40	89
Grapefruit	50-60	85-90*	32	0.90	30.0	0.46	127
Grapes	31-32	85-90*	2-24	0.86	29.7	0.45	118
Leeks	32	95	8	0.88	30.7	0.46	122
Lettuce	32	95	2	0.96	31.7	0.48	136
Cantaloupes	36-40	95	1	0.93	29.8	0.48	132
Honeydew Melons	45-50	90-95	12	0.94	30.4	0.48	133
Watermelons	50-60	90	2	0.97	31.3	0.48	133
Mushrooms	32	95	<1	0.93	30.4	0.47	130
Margarine	35	60-70	52	0.32	31.0	0.25	22
Onions - Dry	32	65-75	24	0.90	30.6	0.46	126
Onions - Green	32	95	3	0.91	30.4	0.47	127
Oranges	32-48	85-90*	3-12	0.90	30.6	0.46	124
Parsnips	32	95	20	0.84	30.4	0.44	112
Peaches	31-32	90-95	3	0.91	30.4	0.46	127
Pears	29-31	90-95*	8-28	0.86	29.2	0.45	118
Peas - Green	32	95	2	0.79	30.9	0.42	106
Peppers - Sweet	45-50	95	2	0.94	30.7	0.47	132
Plums	31-32	90-95	3	0.88	30.6	0.45	118
Potatoes - Main Crop	38-50	90	24	0.85	30.9	0.43	111
Radishes	32	95	3-12	0.95	30.7	0.48	134
Rutabagas	32	95	20	0.91	30.0	0.47	127
Spinach	32	95	2	0.94	31.5	0.48	133
Squash - Acorn	45-50	70-75	6	0.92	30.6	0.47	134
Squash - Summer	41-50	95	1	0.95	31.1	0.48	135
Strawberries	31-32	90-95	1	0.92	30.6	0.47	129
Tomatoes	45-50	85-90	1	0.90	31.1	0.48	134
Turnips	32	90-95	18	0.93	30.1	0.47	130
Dairy Products							
Cheese	30-45	65*	24-52*	0.50	17.0	0.31	54
Butter	32	75-85*	4	0.36	31.0	0.25	23
Milk	33	-	8-16	0.93	31.0	0.46	125
Milk - Condensed	40	-	100	0.42	-	0.28	40
Milk - Dry Whole	45-50	low	24-36	0.26	-	0.21	28
Fish*							
Fresh	31-34	95*	1	0.85	28.0	0.44	114
Smoked	32-36	80-90	1	0.72	28.0	0.39	92
Shellfish - Shrimp	31-34	95	1	0.81	28.0	0.43	109

\* = Special Requirement - See ASHRAE

Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.



**TABLE 9 - continued**  
**STORAGE REQUIREMENTS AND PROPERTIES OF PERISHABLE PRODUCTS**

COMMODITY	STORAGE TEMPERATURE °F	RELATIVE HUMIDITY %	STORAGE LIFE (WEEKS)	SPECIFIC HEAT ABOVE FREEZING BTU / # / °F	FREEZING POINT °F	SPECIFIC HEAT BELOW FREEZING BTU / # / °F	LATENT HEAT OF FUSION BTU / #
Meat							
Bacon	37-41	80-85	-	0.38	-	0.26	27
Beef - Fresh	32-34	88-92*	1-6	0.84	28.0	0.43	110
Ham - Fresh	32-34	85-90	<1	0.66	29.0	0.37	80
Ham - Cured	60-65	65-70	20	0.56	-	0.33	60
Lamb - Fresh	32-34	85-90	1	0.77	28.0	0.41	100
Pork - Fresh	32-34	85-90	1	0.57	28.0	0.33	.63
Veal - Fresh	32-34	90	1	0.74	28.0	0.40	94
Poultry	28-32	95	1-4	0.80	27.0	0.42	106

\* = Special Requirement - See ASHRAE

Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.

**TABLE 10**  
**SUGGESTED FREEZER TEMPERATURES AND STORAGE LIFE**

TEMPERATURE °F	LIFE - MONTHS	TEMPERATURE °F	LIFE - MONTHS
Bread	0	Vegetables	-10
Candy	0	Beef	-10
Ice Cream	-15	Lamb	-10
Butter	-10	Pork	-10
Eggs	0	Veal	-10
Fish	-10	Poultry	0
Shellfish	0	Ice	+10 to +25
	3-23		6-12
	12		8-12
	12		4-8
	6-12		12
	3-8		

**TABLE 11**  
**APPROXIMATE RATES OF EVOLUTION OR RESPIRATION OF HEAT AT TEMPERATURE INDICATED**

PRODUCT	BTU / POUND / 24 HOURS*			PRODUCT	BTU / POUND / 24 HOURS*		
	32°F	40°F	60°F		32°F	40°F	60°F
Apples	0.5	0.8	3.4	Melons - Honeydews	-	0.5	1.4
Asparagus	5.5	10.5	26.5	Mushrooms	2.9	7.8	-
Beans - Green	3.0	5.0	19.0	Okra	-	6.0	15.8
Beans - Lima	2.2	3.0	12.3	Onions	0.4	0.6	1.9
Beets	0.8	1.0	2.6	Onions - Green	1.8	4.9	9.0
Blueberries	1.2	1.4	6.8	Oranges	0.4	0.7	2.3
Broccoli	2.4	11.5	27.0	Peaches	0.6	0.9	4.1
Brussels Sprouts	2.7	5.4	11.8	Pears	0.6	0.8	4.1
Cabbage	0.8	1.2	2.6	Peas - Shelled	6.5	9.5	-
Carrots	0.8	1.4	4.0	Peppers - Green	1.3	2.4	4.3
Cauliflower	2.0	2.3	5.0	Peppers - Sweet	1.3	2.4	4.3
Celery	0.8	1.2	4.5	Plums	0.3	0.6	1.3
Cherries - Sweet	0.6	1.3	4.0	Potatoes - Immature	-	1.3	2.4
Corn	4.7	8.5	18.0	Potatoes - Mature	-	0.8	1.0
Cranberries	0.3	0.5	-	Raspberries	2.4	3.8	10.0
Cucumbers	0.3	-	-	Rutabaga	0.3	0.6	1.5
Grapefruit	0.4	0.5	1.6	Spinach	2.3	5.1	18.5
Grapes	0.3	0.6	1.8	Strawberries	1.6	2.7	9.0
Lemons	0.4	0.7	1.8	Sweet Potatoes	0.9	1.2	2.7
Lettuce - Head	1.4	1.8	4.4	Tomatoes - Green	0.3	0.5	3.1
Lettuce - Leaf	2.2	3.2	7.2	Tomatoes - Ripe	0.5	0.6	2.8
Melons - Canteloupes	0.6	1.0	4.3	Turnips	1.0	1.1	2.6

\* = Average Values - See ASHRAE handbook for specific varieties. Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.

## TABLE 12

### SPACE, WEIGHT AND DENSITY DATA FOR COMMODITIES STORED IN REFRIGERATED WAREHOUSES

COMMODITY	TYPE OF PACKAGE	OUTSIDE	AVERAGE	AVERAGE NET	AVERAGE	AVERAGE
		DIMENSIONS OF	GROSS	WEIGHT OF	GROSS	NET WEIGHT
		PACKAGE	WEIGHT OF	MERCHANDISE	WEIGHT	DENSITY
		INCHES	PACKAGE	LB	LB/FT3	LB/FT3
			LB	LB		
Apples	Wood box, Northwestern	19 1/2 x 11 x 12 3/16	50	42	33.1	27.8
	Fiber tray carton	20 1/2 x 12 1/2 x 13 1/4	46 3/4	43	23.8	21.9
	Fiber master carton	22 1/2 x 12 1/2 x 13	44 3/4	41	21.2	19.4
	Fiber bulk carton	10 x 12 1/2 x 13	44 3/4	41	25.0	22.9
	Pallet bin	47 x 47 x 30	1030	900	26.9	23.5
Beef						
Boneless	Fiber carton	28 x 18 x 6	146	140	83.4	80.0
Celery	Wirebound crates	20 1/4 x 16 x 9 3/4	60	55	32.8	30.0
	Fiber carton	16 x 11 x 10	36	32	35.4	31.4
Cheese	Hoops	16 x 16 x 13	84	78	43.6	40.5
	Wood, export	17 x 17 x 14	87	76	37.1	32.5
Chili Peppers	Bags	45 x 21 x 26	234	229	16.5	16.1
Citrus Fruits						
Oranges	Box	12 1/8 x 13 1/4 x 26 1/4	77	69	31.5	28.3
	Bruce box	13 x 11 x 26 1/4	88	83	40.5	38.2
	Pallet, 40 cartons	40 x 48 x 58 1/2	1690	1480	26.0	22.8
California Oranges	Fiber carton	16 3/8 x 10 1/16 x 10 1/2	40	37	38.0	35.2
Florida Oranges	Fiber carton	19 1/4 x 12 1/4 x 8	45	37	41.3	33.9
Lemons	Fiber carton	38 x 18 1/2 x 8	40	37	40.0	37.0
Grapefruit	Fiber carton	15 3/4 x 11 1/4 x 10 1/2	40	38	36.7	34.9
Coconut, Shredded	Bags	38 x 18 1/2 x 8	101	100	31.0	30.7
Cranberries	Fiber carton	15 3/4 x 11 1/4 x 10 1/2	26	24	24.1	22.2
Eggs, Shell	Wood cases	26 x 12 x 13	55	45	23.4	19.1
Eggs, Frozen	Cans	10 x 10 x 12 1/2	32	30	44.2	41.5
Frozen fishery products						
Blocks	4 / 13 1/2 lb carton	20 3/4 x 12 1/8 x 6 3/4	56	54	57.0	55.0
	4 / 16 1/2 lb carton	19 3/4 x 10 3/4 x 11 1/4	68	66	49.2	47.8
Filets	12 / 16 oz carton	12 3/4 x 8 5/8 x 3 13/16	13.5	12	55.8	49.6
	10 / 5 lb carton	14 1/2 x 10 x 14	52.25	50	44.6	42.7
	5 / 10 lb carton	14 1/2 x 10 x 14	52.2	50	44.5	42.7
Fish Sticks	12 / 8 oz carton	11 x 8 3/8 x 3 7/8	6.9	6	33.6	29.3
	24 / 8 oz carton	16 7/16 x 8 5/16 x 4 5/8	13.8	12	37.8	32.9
Frozen Fruit, Juice, Vegetables						
Asparagus	24 / 12 oz carton	13 1/2 x 11 3/4 x 8 1/4	21	18	27.7	23.8
Beans, Green	36 / 1 0 oz carton	12 1/2 x 11 x 8	25 1/2	22 1/2	40.1	35.3
Blueberries	24 / 12 oz carton	12 x 11 1/2 x 8	20	18	31.3	28.2
Broccoli	24 / 10 oz carton	12 1/2 x 11 1/2 x 8 1/2	18 1/2	15	26.2	21.2
Citrus Concentrates	Fiber carton 48 / 6 oz	13 x 8 3/4 x 7 1/2	27	26	54.7	52.7
Peaches	24 / 1 lb carton	13 1/2 x 11 1/4 x 7 1/2	27	24	41.0	36.4
Peas	6 / 5 lb carton	17 x 11 x 9 1/2	32	30	31.1	28.2
	48 / 12 oz carton	21 1/2 x 8 1/2 x 12 1/2	38	36	28.7	27.2
Spinach	24 / 14 oz carton	12 1/2 x 11 x 8 1/2	24	21	35.5	31.0
Strawberries	30 lb can	12 1/2 x 10 x 10	32	30	44.2	41.5
	24 / 1 lb carton	133 x 11 x 8	28	24	42.3	36.2
	450 lb barrel	35 x 25 x 25		450		35.5
Grapes, California	Wood lug box	6 1/2 x 15 x 18	31	28	32.4	29.2
Lamb, Boneless	Fiber box	20 x 15 x 5	57	53	65.7	61.0
Lettuce, Head	Fiber carton	20 1/2 x 14 1/4 x 9 1/2	37 1/2	35	24.7	
	Fiber carton	21 1/2 x 14 1/4 x 10 1/2	45-55	42-52	26.9	25.2
	Pallet, 30 cartons	42 x 50 x 66	1350	1170	16.8	14.6
Nuts						
Almonds, in shell	Sacks	24 x 15 x 33	91 1/2	90	13.3	13.1
Almonds, shelled	Cases	6 3/4 x 23 1/2 x 11	32	28	31.7	27.7
English Walnuts, In Shell	Sacks	25 x 11 x 31	103	100	20.9	20.3
English Walnuts, Shelled	Fiber carton	14 x 14 x 10	27	25	23.8	22.0
Peanuts, Shelled	Burlap bag	35 x 10 x 15	127	125	39.2	38.6
Pecans, In Shell	Burlap bag	35 x 22 x 12	126 1/2	125	23.7	23.4
Pecans, Shelled	Fiber carton	13 x 13 x 11	32	30	29.8	27.9
Peaches	3/4 bushel	16 7/8 top diameter	41	48	43.9	40.7
	1/2 bushel	14 1/2 top diameter	28	25	45.0	40.2
Pears	Wood box	8 1/2 x 11 1/2 x 18	52	48	51.0	47.1
Pears, Place Pack	Fiber carton	18 1/2 x 12 x 10	52	46	40.5	35.6

**TABLE 12 - continued**  
**SPACE, WEIGHT AND DENSITY DATA FOR COMMODITIES STORED IN REFRIGERATED WAREHOUSES**

COMMODITY	TYPE OF PACKAGE	OUTSIDE DIMENSIONS OF PACKAGE	AVERAGE GROSS WEIGHT OF PACKAGE	AVERAGE NET WEIGHT OF MERCHANDISE	AVERAGE GROSS WEIGHT DENSITY	AVERAGE NET WEIGHT DENSITY
		INCHES	LB	LB	LB/FT3	LB/FT3
Pork						
Bundle Bellies	Bundles	23 1/2 x 10 1/2 x 7	57	57	57.0	57.0
Loins, Regular	Wood box	28 x 10 x 10	60	54	37.0	33.3
Loins, Boneless	Fiber box	20 x 15 x 5	57	52	65.7	59.9
Potatoes	Sack	33 x 17 1/2 x 11	101	100	27.5	27.2
Poultry, Fresh Eviscerated						
Fryers, Whole, 24 - 30 to Package	Wirebound crate	24 x 10 x 7	65	60	27.5	25.4
Fryer Parts	Wirebound crate	17 3/4 x 10 12 1/2	54	50	42.1	38.9
Poultry, Frozen Eviscerated						
Ducks, 6 to Package	Fiber carton	22 x 16 x 4	32 1/2	31	39.9	38.0
Fowl, 6 to Package	Fiber carton	20 3/4 x 18 x 5 1/2	33 1/2	31	28.2	26.1
Fryers, Cut Up, 12 to Package	Fiber carton	17 1/4 x 15 3/4 x 4 1/4	30 1/2	28	45.4	41.7
Roasters, 8 to Package	Fiber carton	20 3/4 x 18 x 5 1/2	32 1/2	30	27.3	25.2
Turkeys						
3-6 lb, 6 to Package	Fiber carton	21 x 17 x 6 1/2	30	27	22.5	20.1
6-10 lb, 6 to Package	Fiber carton	26 x 21 1/2 x 7	52 1/2	48	23.3	21.2
10-13 lb, 4 to Package	Fiber carton	26 1/2 x 16 x 7 1/2	50	46	27.2	25.0
13-16 lb, 4 to Package	Fiber carton	29 x 18 1/2 x 9	67 1/2	62	24.2	22.2
16-20 lb, 2 to Package	Fiber carton	17 x 16 x 9	39	36	27.7	25.4
20-24 lb, 2 to Package	Fiber carton	19 x 16 1/2 x 9 1/2	47 1/2	44	27.6	25.5
Tomatoes						
Florida	Fiber carton	19 x 10 7/8 x 10 3/4	43	40	33.3	31.0
	Wirebound crate	18 3/4 x 11 15/16 x 12	64	60	41.3	38.7
California	Wood lug box	17 1/2 x 14 x 7 3/4	34	30	30.9	27.3
Texas	Wood lug box	17 1/2 x 14 x 6 5/8	34	30	36.2	31.9
Veal, Boneless	Fiber carton	20 x 15 x 5	57	53	65.7	61.0

**TABLE 13**  
**STORAGE CONDITIONS FOR CUT FLOWERS AND NURSERY STOCK**

COMMODITY	STORAGE TEMPERATURE °F	RELATIVE HUMIDITY %	APPROXIMATE STORAGE LIFE	METHOD OF HOLDING	HIGHEST FREEZING POINT °F
Cut Flowers					
Calla Lily	40	90 to 95	1 week	Dry pack	
Camellia	45	90 to 95	3 to 6 days	Dry pack	30.6
Carnation	31 to 32	90 to 95	3 to 4 weeks	Dry pack	30.8
Chrysanthemum	31 to 32	90 to 95	3 to 4 weeks	Dry pack	30.5
Daffodil/Narcissus	32 to 33	90 to 95	1 to 3 weeks	Dry pack	31.8
Gardenia	32 to 34	90 to 95	2 weeks	Dry pack	31.0
Gladiolus	36 to 42	90 to 95	1 week	Dry pack	31.4
Iris, tight buds	31 to 32	90 to 95	2 weeks	Dry pack	30.6
Lily, Easter	32 to 35	90 to 95	2 to 3 weeks	Dry pack	31.1
Orchid	45 to 55	90 to 95	2 weeks	Water	31.4
Peony, tight buds	32 to 35	90 to 95	4 to 6 weeks	Dry pack	30.1
Rose, tight buds	32	90 to 95	2 weeks	Dry pack	31.2
Snapdragon	40 to 42	90 to 95	1 to 2 weeks	Dry pack	30.4
Sweet Peas	31 to 32	90 to 95	2 weeks	Dry pack	30.4
Tulips	31 to 32	90 to 95	2 to 3 weeks	Dry pack	
Greens					
Asparagus/Plumousus	35 to 40	90 to 95	2 to 3 weeks	Polylined cases	26.0
Fern, Dagger/Wood	30 to 32	90 to 95	2 to 3 months	Dry pack	28.9
Holly	32	90 to 95	4 to 5 weeks	Dry pack	27.0
Laurel	32	90 to 95	2 to 4 weeks	Dry pack	27.6
Magnolia	35 to 40	90 to 95	2 to 4 weeks	Dry pack	27.0
Rhododendron	32	90 to 95	2 to 4 weeks	Dry pack	27.6
Salal	32	90 to 95	2 to 3 weeks	Dry pack	26.8

*Reprinted by permission from ASHRAE 1990 Refrigeration Handbook.*

**TABLE 14**  
**HEAT GAIN FROM TYPICAL ELECTRIC MOTORS**

MOTOR HP	BTU PER HOUR		
	LOCATION OF MOTOR AND DRIVEN EQUIPMENT WITH RESPECT TO COLD ROOM		
	MOTOR IN DRIVEN EQUIPMENT IN	MOTOR OUT DRIVEN EQUIPMENT IN	MOTOR OUT DRIVEN EQUIPMENT OUT
1/8	900	590	320
1/4	1180	640	540
1/3	1500	840	660
1/2	2120	1270	850
3/4	2650	1900	740
1	3390	2550	850
2	6640	5090	1350
3	9430	7640	1790
5	15500	12700	2790
7.5	22700	19100	3640
10	29900	24500	4490
15	44400	38200	6210
20	58500	50900	7610
25	72300	63600	8680
30	85700	76300	9440

*1/8 HP shaded pole; 1/3 and 1/2 HP split phase; 3/4 to 30 HP 3-phase  
Dry transformers produce 1000 BTU/Hr of heat per KVA  
Fork lift trucks produce 3000 BTU/Hr of heat per HP*

**TABLE 15**  
**HEAT EQUIVALENT OF OCCUPANCY**

COOLER TEMPERATURE °F	BTU PER 24 HOURS PER PERSON
50	17000
40	20000
30	23000
20	25000
10	29000
0	31000
-10	34000

## TABLE 16 RAPID COOLING LOAD SELECTIONS\*\*

Rapid cooling load selections for walk-in coolers and freezers. (Enter the table under the appropriate cooler or freezer application and determine the BTU load at the desired walk-in box size.  
95°F (35°C) Ambient Air Temperature Surrounding Box

Outside Dimensions of Walk-In Cooler or Freezer (Feet)	Walk-In Coolers R10 Insulation or Equivalent				0°F (-17.8°C) Walk-In Freezers (2) R15 Insulation or Equivalent				-20°F (-28.9°C) Walk-In Freezers (2) R20 Insulation or Equivalent			
	BTUH LOAD				BTUH LOAD				BTUH LOAD			
	+35°F (1.7°C) Room (1)		+30°F (-1.1°C) Room (2)		Storage Only - No Product Freezing	Food Freezing - lbs/24 hrs Product Entering at +40°F (+4.4°C)			Storage Only - No Product Freezing	Freezing - lbs/24 hrs Product Entering at +40°F (+4.4°C)		
	Average Usage	Heavy Usage	Average Usage	Heavy Usage		750	1500	3000		750	1500	3000
W x L x H												
6 x 6 x 9	3.050	3.650	2.950	3.500	3.550	8.800			3.500	9.500	15.500	27.500
6 x 7 x 9	3.500	4.200	3.450	4.050	4.100	9.350			4.000	10.000	16.000	28.000
6 x 8 x 9	3.800	4.650	3.650	4.450	4.350	9.600			4.500	10.500	16.500	28.500
6 x 9 x 9	4.200	5.100	4.050	4.900	4.650	9.900			4.850	10.900	16.900	28.900
6 x 10 x 9	4.600	5.600	4.400	5.400	4.950	10.200			5.100	11.100	17.100	29.100
7 x 7 x 9	3.900	4.750	3.750	4.550	4.400	9.650			4.550	10.600	16.600	28.600
7 x 8 x 9	4.350	5.300	4.200	5.100	4.800	10.000			4.900	10.900	16.900	28.900
7 x 9 x 9	4.750	5.800	4.550	5.600	5.050	10.300	15.600		5.250	11.300	17.300	29.300
7 x 10 x 9	5.150	6.400	4.950	6.150	5.550	10.800	16.100		5.750	11.800	17.800	29.800
7 x 12 x 9	5.900	7.350	5.700	7.050	6.100	11.400	16.700		6.350	12.400	18.400	30.400
8 x 8 x 9	4.800	5.850	4.600	5.600	5.150	10.400	15.700		5.300	11.300	17.300	29.300
8 x 9 x 9	5.250	6.450	5.050	6.200	5.600	10.900	16.200		5.800	11.800	17.800	29.800
8 x 10 x 9	5.700	7.100	5.500	6.800	6.000	11.300	16.600		6.150	12.200	18.200	30.200
8 x 12 x 9	6.600	7.950	6.350	7.650	6.600	11.900	17.200		6.800	12.800	18.800	30.800
8 x 14 x 9	7.500	9.300	7.200	8.950	7.400	12.700	18.000		7.450	13.500	19.500	31.500
9 x 9 x 9	5.750	7.150	5.500	6.850	6.000	11.300	16.600		6.200	12.200	18.200	30.200
9 x 10 x 9	6.250	7.750	6.000	7.450	6.350	11.600	16.900		6.600	12.600	18.600	30.600
9 x 12 x 9	7.300	9.050	7.000	8.700	7.100	12.400	17.700		7.300	13.300	19.300	31.300
9 x 14 x 9	8.200	10.500	7.900	10.100	7.850	13.100	18.400		8.000	14.000	20.000	32.000
9 x 16 x 9	9.050	11.700	8.700	11.200	8.500	13.800	19.100		8.800	14.800	20.800	32.800
10 x 10 x 9	6.850	8.400	6.700	8.050	6.700	12.000	17.300	27.700	7.000	13.000	19.000	31.000
10 x 12 x 9	7.800	9.650	7.500	9.250	7.650	12.900	18.200	28.700	7.750	13.800	19.800	31.800
10 x 14 x 9	8.900	11.200	8.550	10.800	8.350	13.600	18.900	29.400	8.550	14.600	20.600	32.600
10 x 16 x 9	9.650	12.300	9.300	11.800	9.000	14.300	19.600	30.000	9.400	15.400	21.400	33.400
10 x 18 x 9	10.600	13.400	10.200	12.900	10.000	15.300	20.600	31.000	10.100	16.100	22.100	34.100
12 x 12 x 9	9.050	11.100	8.700	10.700	8.450	13.700	19.000	29.500	8.850	14.900	20.900	32.900
12 x 14 x 9	10.000	12.700	9.600	12.200	9.350	14.600	19.900	30.400	9.650	15.700	21.700	33.700
12 x 16 x 9	11.000	13.900	10.600	13.400	10.100	15.400	20.700	31.100	10.400	16.400	22.400	34.400
12 x 18 x 9	12.100	15.300	11.600	14.700	11.100	16.400	21.700	32.100	11.300	17.300	23.300	35.300
12 x 20 x 9	13.200	16.200	12.700	15.600	11.700	17.000	22.300	32.700	12.200	18.200	24.200	36.200
12 x 22 x 9	14.200	17.600	13.600	16.900	12.500	17.800	23.100	33.500	13.100	19.100	25.100	37.100
14 x 14 x 9	11.150	14.100	10.700	13.600	10.200	15.500	20.800	31.200	10.500	16.500	22.500	34.500
14 x 16 x 9	12.350	15.500	11.900	14.900	11.200	16.500	21.800	32.200	11.400	17.400	23.400	35.400
14 x 18 x 9	13.500	16.900	13.000	16.300	12.100	17.350	22.600	33.100	12.300	18.300	24.300	36.300
14 x 20 x 9	14.750	18.100	14.200	17.400	12.800	18.100	23.400	33.800	13.100	19.100	25.100	37.100
14 x 22 x 9	15.750	19.500	15.100	18.700	13.400	18.700	24.000	34.400	14.200	20.200	26.200	38.200
14 x 24 x 9	16.700	20.900	16.000	20.100	14.300	19.600	24.900	35.300	15.000	21.000	27.000	39.000
16 x 16 x 9	13.500	17.100	13.000	16.400	12.200	17.500	22.800	33.200	12.500	18.500	24.500	36.500
16 x 18 x 9	14.850	18.000	14.300	17.300	13.000	18.300	23.600	34.000	13.300	19.300	25.300	37.300
16 x 20 x 9	16.100	20.000	15.500	19.200	13.900	19.200	24.500	34.900	14.000	20.000	26.000	38.000
16 x 22 x 9	17.300	21.400	16.600	20.500	14.800	20.100	25.400	35.800	15.500	21.500	27.500	39.500
16 x 24 x 9	17.800	22.800	17.100	21.900	15.600	20.900	26.200	36.600	16.300	22.300	28.300	40.300
18 x 18 x 9	16.300	20.200	15.700	19.400	14.000	19.300	24.600	35.000	14.200	20.200	26.200	38.200
18 x 29 x 9	17.500	21.700	16.800	20.800	15.100	20.400	25.700	36.100	15.000	21.000	27.000	39.000
18 x 22 x 9	18.900	22.700	18.200	21.800	15.800	21.100	26.400	36.800	16.400	22.400	28.400	40.400
18 x 24 x 9	19.900	24.800	19.100	23.800	16.600	21.900	27.200	37.600	17.300	23.300	29.300	41.300
20 x 20 x 9	19.300	23.100	18.500	22.200	16.000	21.300	26.600	37.000	15.800	21.800	27.800	39.800
20 x 22 x 9	20.200	26.600	19.400	25.600	16.700		27.300	37.700	17.400		29.400	41.400
20 x 24 x 9	21.400	28.600	20.500	27.500	17.400		28.000	38.400	18.000		30.000	42.000
22 x 22 x 9	21.100	28.200	20.300	27.100	17.300		27.900	38.300	17.600		29.600	41.600
22 x 24 x 9	22.400	30.100	21.500	28.900	18.400		29.000	39.400	18.800		30.800	42.800
24 x 24 x 9	24.100	32.300	23.100	31.000	19.500		30.100	40.500	20.000		32.000	44.000

(1) Based on 16 HR compressor operation      (2) Based on 20 HR compressor operation

\* For ice cream hardening rooms, use food freezing sections with 750 lbs = 250 gallons, 3000 lbs = 1000 gallons

\*\* This table is for quick selection only. For detailed calculations use Keeprite Load Forms.

# EQUIPMENT SELECTION

## SYSTEM "TD" AND RELATIVE HUMIDITY

When selecting an evaporator coil, the temperature difference (TD) between the room and the refrigerant will govern the relative humidity in the space (assuming the room is properly sealed). The closer the temperature difference between room and suction temperatures in selecting the evaporator, the larger the evaporator and the higher the relative humidity in the room.

Conversely, a large system TD reduces the size of the evaporator and causes it to do more drying and therefore lowers the RH.

The following table can be used as a guide. Knowing the product relative humidity requirement, the evaporator should be selected as follows:

RELATIVE HUMIDITY % (RH)	TD (°F)
Over 90%	8
80-90	10
70-80	15
50-70	20

Too low relative humidity will result in excessive weight loss in the product as well as surface deterioration. Too high relative humidity speeds the growth of bacteria and surface slime. See Table 9 for recommended relative humidity values for different products.

In the case of freezers, the problem is slightly different but in order to avoid excessive frost accumulation on the coil and to prevent product dehydration during long term storage, most evaporators are selected for 10°F TD.

## SYSTEM RUN TIME AND DEFROSTING OPERATION

When the design suction temperature is over 32°F, a defrost cycle is not normally required and it is common practice to select equipment based on 24-hour compressor operation.

### Air Defrost

For suction temperatures above 26°F and room temperatures above 34°F, off cycle (air defrost) can generally be used. This involves cycling the compressor off with a time clock while the evaporator fans remain in operation and room air melts the ice on the coil. For every two hours of compressor operation we need to have one hour of air defrost. Compressor operation is therefore based on 16 hours per day. Compressor must be located in a warm room.

For room temperatures below +35°F, a positive defrost is required. With Electric Defrost, equipment can be selected on the basis of 18-20 hours operation. With Hot Gas Defrost, operating time can be as high as 22 hours.

This does however depend on the type of equipment used and the latent load in the storage.

The type of defrost used is generally a matter of either contractor or owner preference. Different areas of the country tend to use on particular type of defrost more than another.

### Electric Defrost

This is the most common method in use today. Equipment cost is about the same as with hot gas, but installed cost can be lower. Operating cost is about 15% higher with electric defrost than with hot gas and a fair amount of heat and moisture is released in the room during defrost.

### Hot Gas Defrost

This is still the most efficient method of defrosting regardless of storage temperature. Defrost is very quick with minimum room temperature rise. For room temperatures between +25°F and +35°F a single evaporator per compressor will work. For rooms from 0°F to +20°F, two evaporators per compressor are required and three per compressor below 0°F. Defrost one evaporator at a time with the others operating normally to produce the hot gas. The suction accumulator should be sized to hold 2.5 times the operating charge of the defrosting evaporator.

### General

Because of high suction pressure (and high load) after defrost, compressor selection must be checked to see that it can operate in a higher range than actual design point. If not, a pressure limiting expansion valve or a crankcase pressure regulator may be required to keep suction pressure down to acceptable values. This is very important in case of a blast freezer. On large air defrost systems (gravity coils for example) it is a good idea to have solenoids in the liquid and suction lines so refrigerant will not migrate during defrost.

A continuous pump down cycle should be used on Electric Defrost systems.

## COMPRESSOR/CONDENSING UNITS

The four main types of compressors used on commercial refrigeration today are:

Open - belt drive low speed (500-1500 RPM)

Open - direct driven medium speed (1200 or 1750 RPM)

Semi-hermetic - 1750 RPM

Hermetic (welded) - 3600 RPM

The type of compressor used is often a matter of personal preference, but it should be remembered that the life of the compressor decreases with increased speed, increased condensing temperature and increasing compression ratios.

On commercial refrigeration applications, compressors are most commonly used with air cooled condensers. They are also used with water cooled condensers and occasionally with evaporative condensers. Water restrictions in recent years and simpler maintenance are the reasons for the popularity of air cooled systems.

The air cooled condenser may be an integral part of the compressor unit (air cooled condensing unit) or it may be remotely located (on the roof, for example).

Compressor/condensing units are generally classified as high, medium or low temperature. Approximate evaporating temperatures are high: +30°F to +50°F; medium: -10°F to +30°F; and low: -40°F to -10°F.

A choice of refrigerants, R22 and R502, is available depending on the application.

Knowing the room load, room temperature and desired suction temperature (room temperature minus TD = suction temperature) a condensing unit can be selected. **As the range of models (capacities) is far more limited in condensing units than in evaporators, it is usual practice to select the closest size of condensing unit that will do the job, then select the evaporator(s) to balance with that condensing unit at the correct TD.**

When it is possible that the compressor may on occasion be the coldest spot in the system, crankcase heaters must be used.

Capacity control is seldom used on refrigeration systems due to the flywheel effect of the mass in storage. Occasionally it is used to provide unloaded compressor start-up and reduced current inrush. Capacity control can create oil return and compressor overheating problems.

Refrigerant receivers are generally used and are sized to hold the system operating charge +10%.

In any critical application, two completely independent systems should be used. In any event, each and every room should be on a separate and independent system.

## EVAPORATORS

The spacing of the fins on the evaporator coil must be considered for each application. While high fin density (12 fins/inch) does give increased coil capacity, it also increases the problem of dirt and frost collection. In the majority of commercial refrigeration applications, the fin spacings used are 8, 6 and 4 fins/inch. Generally speaking, 8 fins/inch is used down to +32°F coil temperature, while spacing of 4 and 6 fins/inch are used whenever frost will be present. The closer the fins are together, the more rapidly the coil capacity will fall off as the frosts builds up.

On most low temperature applications, 6 fins/inch can be used as long as the evaporator capacity is reduced by 15% (x 0.85) when making the selection. This 15% frost reduction is a truer

representation of the capacity of a unit averaged over the 4-6 hours between defrost cycles. For a minimum down-time, the selection should be based on a 4 fin/inch coil and its normal capacity reduced by 5% (x 0.95). In most cases, holding freezers are selected with 6 fin/inch coils while blast freezers use 4 fins/inch.

Once the space and product loads have been established, the type of evaporator most suitable for the application should be selected. This selection will depend on:

- i) Storage temperature
- ii) Relative humidity
- iii) Air velocity
- iv) Size and shape of room

Refer to Table 9 for recommended storage temperature and relative humidity. As most rooms handle more than one product, compromise may be necessary. Next, establish what form (if any) of defrost will be required.

Following are the various types of evaporators that are available and descriptive data on their use.

### LOW VELOCITY UNIT COOLERS (LOW AIR UNITS)

Outlet velocity less than 150 FPM

Temperature range = 28°F and above

Capacity range @ 10°F, TD = 4500 - 27000 BTU/Hr/unit

Air flow range = 200 f/m face velocity, 1200 CFM/ton

The application of Low Velocity Unit Coolers is similar to that for gravity fin coils, but they usually result in a lower first cost to the owner and are therefore gradually replacing the fin coil. They are installed between-the-rails in the meat rooms. Common applications are: meat cutting and packaging rooms, cut flower boxes, fruit and vegetable storages and ice storages. Low Velocity Unit Coolers are available with electric defrost or hot gas defrost for applications in the 28°F-34°F range, and without defrost for rooms over 34°F. The Low Velocity Unit Cooler has a power operated fan to give an more positive air flow than the gravity coil.

### UNIT COOLERS

Temperature range = -40°F and above

Capacity range = 790-90,000 BTU/Hr/unit @ 10°F TD

Air flow range + 500-600 f/m face velocity, 1500-2000 CFM/ton

This is the most common type of evaporator in use today. They are used at all temperatures in all types of storages, and are available with hot gas or electric defrosts. This type of unit handles larger quantities of air than low velocity coolers and is able to "throw" the air 30-40 feet with a one-foot drop. The most common application is the food store walk-in freezers occasionally. Unit coolers are generally considered the most economical evaporator that can be used on a first cost basis.

## BLAST COOLERS

Temperature range = -40°F and above  
Capacity range = 85000-180000 BTU/Hr/unit @ 10°F TD  
Air flow range = 2500-4000 CFM/ton  
Air throw = 40-100 feet  
Static pressure capability = up to 0.75" ESP wg

Blast coolers are very large unit coolers, and replace Product coolers in most applications. They are most commonly used in blast freezing applications.

## PRODUCT COOLERS

Temperature range = -40°F and above  
Capacity range = 26000-385000 BTU/Hr/unit @ 10°F TD  
Air flow range = 1600-2500 CFM/ton

Product coolers are the largest and the most versatile form of evaporator and are generally found in the larger jobs. They are available for all refrigerants and with all types of defrost systems. Air quantity, coil rows, fin spacing and coil area are all variable. They are commonly used with ductwork and models are available for floor mounting as well as ceiling suspension. While more expensive in first cost than unit coolers, they are often a necessity in larger storages are commonly found in blast freezers.

## SELECTION

Knowing the type of evaporator to be used, the actual selection must be made to balance with the condensing unit selection. The condensing unit should be selected first, as there are only a fixed number of sizes available in condensing unit, while

there is virtually an unlimited selection in evaporators. When selecting hot gas or electric defrost type units, allowance must be made for frosting of the coil and the capacity rating of the unit reduced accordingly. With electric defrost units, where the heaters are internally located in blank tubes, the capacity must be reduced to allow for the loss of surface compared to a standard coil. Manufacturers usually recommend a rating correction factor for electric defrost coils. It is always good practice with any storage (and particularly with freezers) to have two completely independent systems. In the event of a breakdown of one system, the other unit will slow down the temperature rise in the room until the defective system is repaired and placed back into service.

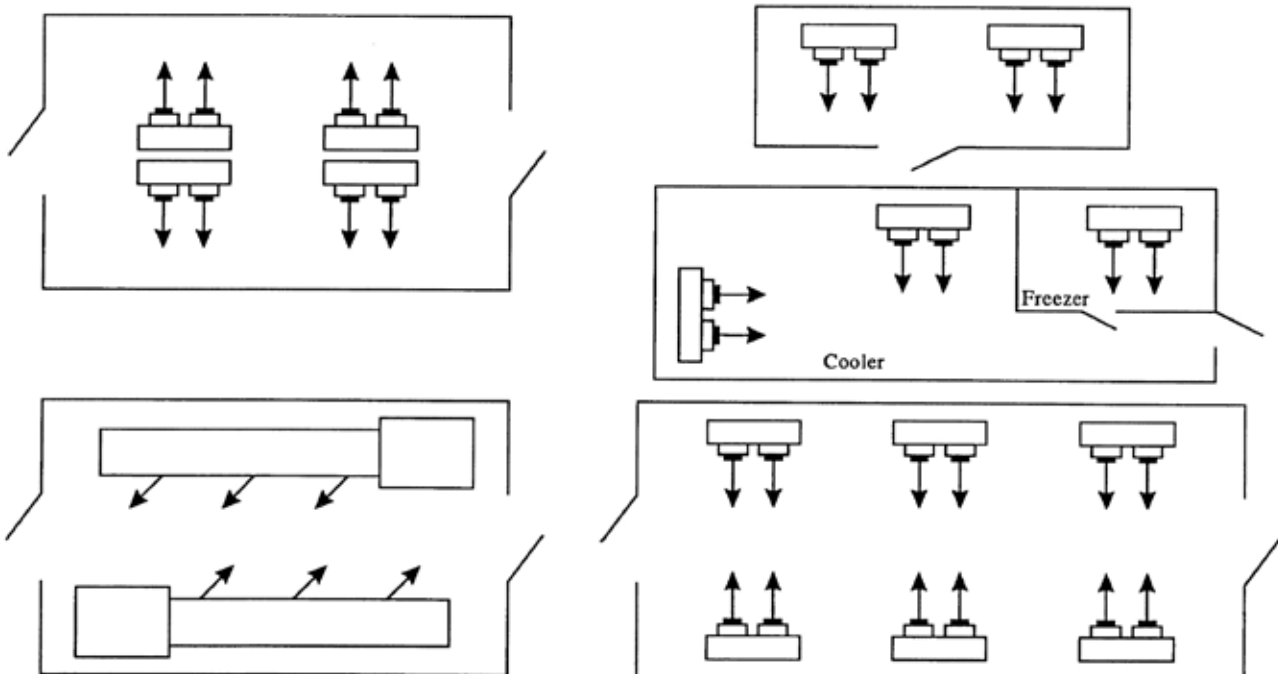
## EVAPORATOR LAYOUT

This is a far more important subject than many designers realize. Some general rules that must be followed are:

- i) AIR PATTERN MUST COVER THE ENTIRE ROOM
- ii) NEVER LOCATE EVAPORATORS OVER DOORS
- iii) LOCATION OF AISLES, RACKS, ETC. MUST BE KNOWN
- iv) LOCATION RELATIVE TO COMPRESSORS FOR MINIMUM PIPE RUNS
- v) LOCATION OF CONDENSATE DRAINS FOR MINIMUM RUN

The size and shape of the storage will generally govern the type and number of evaporators to be used and their location. The following are some typical examples:

## DRAWING 1 RECOMMENDED EVAPORATOR LOCATIONS





**TABLE 33  
METRIC-ENGLISH-METRIC CONVERSION TABLE**

<b>LENGTH</b>								
mm	x	.039	=	in.	x	25.4	=	mm
cm	x	.39	=	in.	x	2.54	=	cm
m	x	3.28	=	ft.	x	.305	=	m
<b>AREA</b>								
mm <sup>2</sup>	x	.0015	=	in. <sup>2</sup>	x	645.2	=	mm <sup>2</sup>
cm <sup>2</sup>	x	.155	=	in. <sup>2</sup>	x	6.45	=	cm <sup>2</sup>
m <sup>2</sup>	x	10.76	=	ft. <sup>2</sup>	x	.093	=	m <sup>2</sup>
<b>VOLUME</b>								
l	x	.001	=	m <sup>3</sup>	x	1000	=	l
cm <sup>3</sup>	x	.061	=	in. <sup>3</sup>	x	16.39	=	cm <sup>3</sup>
m <sup>3</sup>	x	35.3	=	ft. <sup>3</sup>	x	.028	=	m <sup>3</sup>
m <sup>3</sup>	x	264.2	=	US gal	x	.0038	=	m <sup>3</sup>
m <sup>3</sup>	x	220.1	=	Imp gal	x	.0045	=	m <sup>3</sup>
l	x	.264	=	US gal	x	3.785	=	l
l	x	.220	=	Imp gal	x	4.546	=	l
<b>MASS</b>								
g	x	.035	=	oz.	x	28.35	=	g
kg	x	2.2	=	lb.	x	.454	=	kg
<b>POWER AND ENERGY</b>								
kW	x	1.34	=	BHP	x	.746	=	kW
W	x	3.41	=	Btu/h	x	.293	=	W
kcal/h	x	3.97	=	Btu/h	x	.252	=	kcal/h
kW	x	.284	=	tons	x	3.517	=	kW
<b>FLOW RATE</b>								
l/s	x	2.12	=	cfm	x	.472	=	l/s
m <sup>3</sup> /s	x	2118	=	cfm	x	.00047	=	m <sup>3</sup> /s
l/s	x	15.85	=	US gpm	x	.063	=	l/s
l/s	x	13.16	=	Imp gpm	x	.076	=	l/s
<b>VELOCITY</b>								
m/s	x	3.28	=	fps	x	.305	=	m/s
m/s	x	196.8	=	fpm	x	.0051	=	m/s
<b>PRESSURE</b>								
kPa	x	.145	=	psi	x	6.895	=	kPa
Pa	x	.004	=	in. H <sub>2</sub> O	x	248.4	=	Pa
kPa	x	.33	=	ft. H <sub>2</sub> O	x	2.99	=	kPa
m H <sub>2</sub> O	x	.097	=	ATM	x	10.33	=	m H <sub>2</sub> O

**TABLE 34**  
**EQUIVALENT TEMPERATURE READINGS FOR FAHRENHEIT AND CELSIUS SCALES**

Formula: Temperature F° = 9/5 Temperature C° plus 32											
Temperature C° = 5/9 Temperature F° minus 32											
<i>Enter center column with given value and read to left or right.</i>											
TEMPERATURE			TEMPERATURE			TEMPERATURE			TEMPERATURE		
Celsius	C or F	Fahrenheit	Celsius	C or F	Fahrenheit	Celsius	C or F	Fahrenheit	Celsius	Cor F	Fahrenheit
-40.0	-40	-40.0	-6.7	+20	+68.0	+26.7	+80	+176.0	+60.0	+140	+284.0
-39.4	-39	-38.2	-6.1	+21	+69.8	+27.2	+81	+177.8	+60.6	+141	+285.8
-38.9	-38	-36.4	-5.5	+22	+71.6	+27.8	+82	+179.6	+61.1	+142	+287.6
-38.3	-37	-34.6	-5.0	+23	+73.4	+28.3	+83	+181.4	+61.7	+143	+289.4
-37.8	-36	-32.8	-4.4	+24	+75.2	+28.9	+84	+183.2	+62.2	+144	+291.2
-37.2	-35	-31.0	-3.9	+25	+77.0	+29.4	+85	+185.0	+62.8	+145	+293.0
-36.7	-34	-29.2	-3.3	+26	+78.8	+30.0	+86	+186.8	+63.3	+146	+294.8
-36.1	-33	-27.4	-2.8	+27	+80.6	+30.6	+87	+188.6	+63.9	+147	+296.6
-35.6	-32	-25.6	-2.2	+28	+82.4	+31.1	+88	+190.4	+64.4	+148	+298.4
-35.0	-31	-23.8	-1.7	+29	+84.2	+31.7	+89	+192.2	+65.0	+149	+300.2
-34.4	-30	-22.0	-1.1	+30	+86.0	+32.2	+90	+194.0	+65.6	+150	+302.0
-33.9	-29	-20.2	-0.6	+31	+87.8	+32.8	+91	+195.8	+66.1	+151	+303.8
-33.3	-28	-18.4	0	+32	+89.6	+33.3	+92	+197.6	+66.7	+152	+305.6
-32.8	-27	-16.6	+0.6	+33	+91.4	+33.9	+93	+199.4	+67.2	+153	+307.4
-32.2	-26	-14.8	+1.1	+34	+93.2	+34.4	+94	+201.2	+67.8	+154	+309.2
-31.7	-25	-13.0	+1.7	+35	+95.0	+35.0	+95	+203.0	+68.3	+155	+311.0
-31.1	-24	-11.2	+2.2	+36	+96.8	+35.6	+96	+204.8	+68.9	+156	+312.8
-30.6	-23	-9.4	+2.8	+37	+98.6	+36.1	+97	+206.6	+69.4	+157	+314.6
-30.0	-22	-7.6	+3.3	+38	+100.4	+36.7	+98	+208.4	+70.0	+158	+316.4
-29.4	-21	-5.8	+3.9	+39	+102.2	+37.2	+99	+210.2	+70.6	+159	+318.2
-28.9	-20	-4.0	+4.4	+40	+104.0	+37.8	+100	+212.0	+71.1	+160	+320.0
-28.3	-19	-2.2	+5.0	+41	+105.8	+38.3	+101	+213.8	+71.7	+161	+321.8
-27.8	-18	-0.4	+5.5	+42	+107.6	+38.9	+102	+215.6	+72.2	+162	+323.6
-27.2	-17	+1.4	+6.1	+43	+109.4	+39.4	+103	+217.4	+72.8	+163	+325.4
-26.7	-16	+3.2	+6.7	+44	+111.2	+40.0	+104	+219.2	+73.3	+164	+327.2
-26.1	-15	+5.0	+7.2	+45	+113.0	+40.6	+105	+221.0	+73.9	+165	+329.0
-25.6	-14	+6.8	+7.8	+46	+114.8	+41.1	+106	+222.8	+74.4	+166	+330.8
-25.0	-13	+8.6	+8.3	+47	+116.6	+41.7	+107	+224.6	+75.0	+167	+332.6
-24.4	-12	+10.4	+8.9	+48	+118.4	+42.2	+108	+226.4	+75.6	+168	+334.4
-23.9	-11	+12.2	+9.4	+49	+120.2	+42.8	+109	+228.2	+76.1	+169	+336.2
-23.3	-10	+14.0	+10.0	+50	+122.0	+43.3	+110	+230.0	+76.7	+170	+338.0
-22.8	-9	+15.8	+10.6	+51	+123.8	+43.9	+111	+231.8	+77.2	+171	+339.8
-22.2	-8	+17.6	+11.1	+52	+125.6	+44.4	+112	+233.6	+77.8	+172	+341.6
-21.7	-7	+19.4	+11.7	+53	+127.4	+45.0	+113	+235.4	+78.3	+173	+343.4
-21.1	-6	+21.2	+12.2	+54	+129.2	+45.6	+114	+237.2	+78.9	+174	+345.2
-20.6	-5	+23.0	+12.8	+55	+131.0	+46.1	+115	+239.0	+79.4	+175	+347.0
-20.0	-4	+24.8	+13.3	+56	+132.8	+46.7	+116	+240.8	+80.0	+176	+348.8
-19.4	-3	+26.6	+13.9	+57	+134.6	+47.2	+117	+242.6	+80.6	+177	+350.6
-18.9	-2	+28.4	+14.4	+58	+136.4	+47.8	+118	+244.4	+81.1	+178	+352.4
-18.3	-1	+30.2	+15.0	+59	+138.2	+48.3	+119	+246.2	+81.7	+179	+354.2
-17.8	0	+32.0	+15.6	+60	+140.0	+48.9	+120	+248.0	+82.2	+180	+356.0
-17.2	+1	+33.8	+16.1	+61	+141.8	+49.4	+121	+249.8	+82.8	+181	+357.8
-16.7	+2	+35.6	+16.7	+62	+143.6	+50.0	+122	+251.6	+83.3	+182	+359.6
-16.1	+3	+37.4	+17.2	+63	+145.4	+50.6	+123	+253.4	+83.9	+183	+361.4
-15.6	+4	+39.2	+17.8	+64	+147.2	+51.1	+124	+255.2	+84.4	+184	+363.3
-15.0	+5	+41.0	+18.3	+65	+149.0	+51.9	+125	+257.0	+85.0	+185	+365.0
-14.4	+6	+42.8	+18.9	+66	+150.8	+52.2	+129	+258.8	+85.6	+186	+366.8
-13.9	+7	+44.6	+19.4	+67	+152.6	+52.8	+127	+260.6	+86.1	+187	+368.6
-13.3	+8	+46.4	+20.0	+68	+154.4	+53.3	+128	+262.4	+86.7	+188	+370.4
-12.8	+9	+48.2	+20.6	+69	+156.2	+53.9	+129	+264.2	+87.2	+189	+372.2
-12.2	+10	+50.0	+21.1	+70	+158.0	+54.4	+130	+266.0	+87.8	+190	+374.0
-11.7	+11	+51.8	+21.7	+71	+159.8	+55.0	+131	+267.8	+88.3	+191	+375.8
-11.1	+12	+53.6	+22.2	+72	+161.6	+55.6	+132	+269.6	+88.9	+192	+377.6
-10.6	+13	+55.4	+22.8	+73	+163.4	+56.1	+133	+271.4	+89.4	+193	+379.4
-10.0	+14	+57.2	+23.3	+74	+165.2	+56.7	+134	+273.2	+90.0	+194	+381.2
-9.4	+15	+59.0	+23.9	+75	+167.0	+57.2	+135	+275.0	+90.6	+195	+383.0
-8.9	+16	+60.8	+24.4	+76	+168.8	+57.8	+136	+276.8	+91.1	+196	+384.8
-8.3	+17	+62.6	+25.0	+77	+170.6	+58.3	+137	+278.6	+91.7	+197	+386.6
-7.8	+18	+64.4	+25.6	+78	+172.4	+58.9	+138	+280.4	+92.2	+198	+388.4
-7.2	+19	+66.2	+26.1	+79	+174.2	+59.4	+139	+282.2	+92.8	+199	+390.2



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **FREON 22 (R22)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -50°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

Suva®  
refrigerants

## FREON 22 REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		50°F THROUGH 30°F (84 THROUGH 55 PSIG)					29°F THROUGH 10°F (54 THROUGH 33 PSIG)					9°F THROUGH -10°F (32 THROUGH 16 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		2.9 lb (2F°)					2.2 lb (2F°)					1.7 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	3/4	3/4	3/4	7/8	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	1 1/8	1 1/8	1 1/8	1.50	18000
24000	2.00	5/8	3/4	3/4	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	2.00	24000
30000	2.50	3/4	7/8	7/8	7/8	1 1/8	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	2.50	30000
36000	3.00	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	3.00	36000
42000	3.50	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	3.50	42000
48000	4.00	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	4.00	48000	
60000	5.00	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	5.00	60000	
92000	7.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	7.50	92000	
120000	10.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	10.00	120000	
150000	12.50	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	12.50	150000	
180000	15.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	15.00	180000	
240000	20.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	20.00	240000	
300000	25.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	25.00	300000	
360000	30.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 5/8	2 5/8	2 5/8	3 1/8	30.00	360000	
420000	35.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 5/8	35.00	420000	
480000	40.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	40.00	480000	
540000	45.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	45.00	540000	
600000	50.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	2 5/8	3 1/8	3 1/8	3 5/8	50.00	600000	

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

## FREON 22 REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		-11°F THROUGH 30°F (16 THROUGH 5 PSIG)					-31°F THROUGH -50°F (4 THROUGH 7" Hg)						
		1.1 lb (2F°)					0.8 lb (2F°)						
		Equivalent Suction Line Lengths (feet)											
System Capacity BTU/Hr	System Capacity Tons/Hr	25	50	75	100	150	25	50	75	100	150	System Capacity Tons/Hr	System Capacity BTU/Hr
18000	1.50	7/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1.50	18000
24000	2.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	2.00	24000
30000	2.50	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	2.50	30000
36000	3.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	3.00	36000
42000	3.50	1 3/8	1 3/8	1 5/8	2 1/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	3.50	42000
48000	4.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	4.00	48000
60000	5.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	5.00	60000
92000	7.50	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	7.50	92000
120000	10.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	10.00	120000
150000	12.50	2 1/8	2 1/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	12.50	150000
180000	15.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	15.00	180000
240000	20.00	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	2 5/8	3 1/8	3 5/8	3 5/8	4 1/8	20.00	240000
300000	25.00	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	3 1/8	3 5/8	3 5/8	3 5/8	4 1/8	25.00	300000
360000	30.00	2 5/8	3 1/8	3 5/8	3 5/8	4 1/8	3 1/8	3 5/8	3 5/8	4 1/8	5 1/8	30.00	360000
420000	35.00	3 1/8	3 5/8	3 5/8	3 5/8	4 1/8	3 5/8	4 1/8	4 1/8	5 1/8	5 1/8	35.00	420000
480000	40.00	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	3 5/8	4 1/8	5 1/8	5 1/8	5 1/8	40.00	480000
540000	45.00	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8	3 5/8	4 1/8	5 1/8	5 1/8	5 1/8	45.00	540000
600000	50.00	3 5/8	3 5/8	4 1/8	4 1/8	5 1/8	4 1/8	5 1/8	5 1/8	5 1/8	6 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

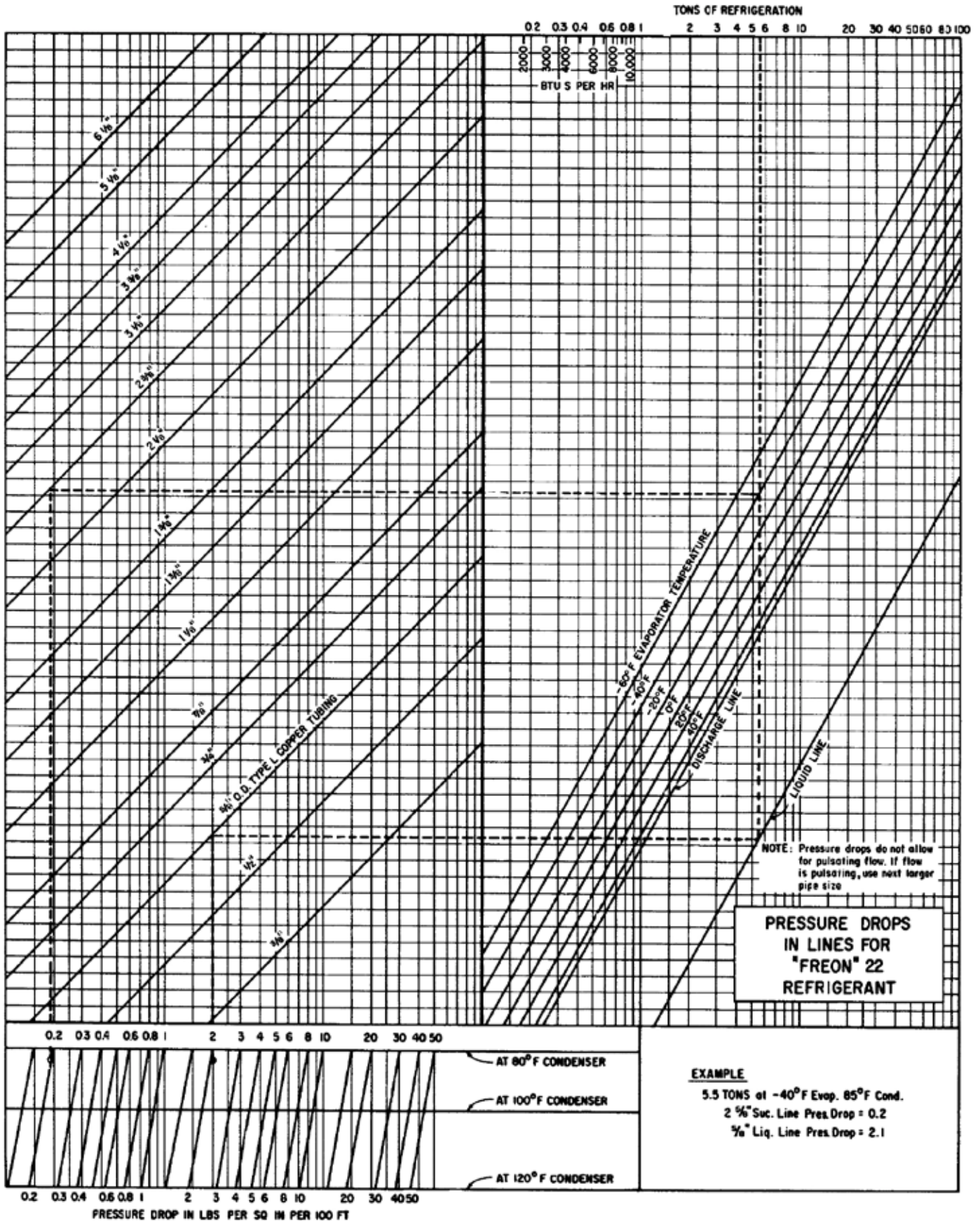
Suva®  
refrigerants

## FREON 22 REFRIGERANT PIPING GUIDE

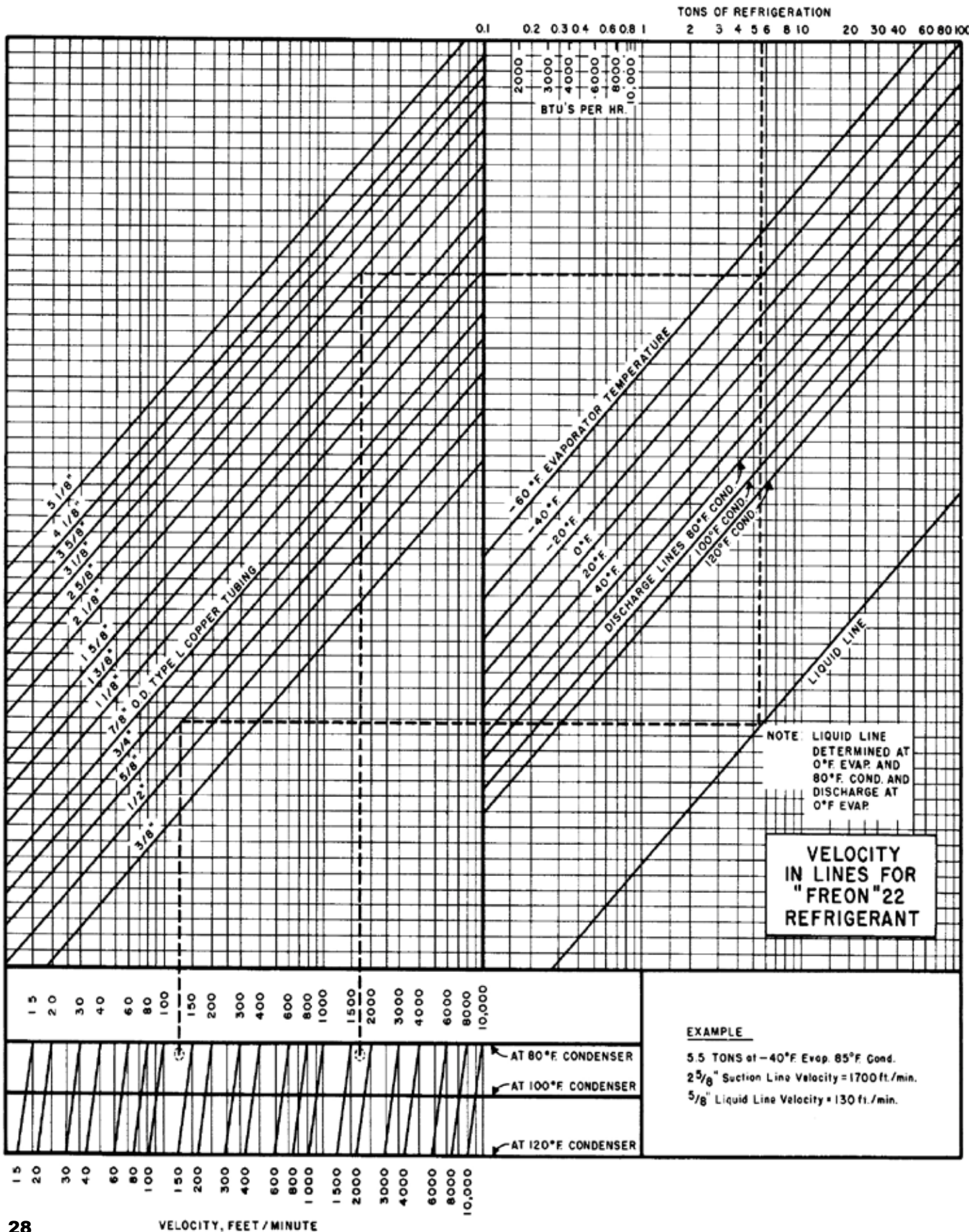
System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (3 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (3 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	5/8	3/8	3/8	3/8	3/8	1/2	1.50	18000
24000	2.00	5/8	5/8	3/4	3/4	3/4	1/2	1/2	1/2	5/8	5/8	3/8	3/8	3/8	1/2	1/2	2.00	24000
30000	2.50	5/8	3/4	3/4	3/4	7/8	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	2.50	30000
36000	3.00	3/4	3/4	3/4	7/8	7/8	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	1/2	3.00	36000
42000	3.50	3/4	3/4	7/8	7/8	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	5/8	3.50	42000
48000	4.00	3/4	3/4	7/8	7/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	4.00	48000
60000	5.00	3/4	7/8	7/8	1 1/8	1 1/8	5/8	5/8	3/4	3/4	3/4	1/2	1/2	5/8	5/8	5/8	5.00	60000
92000	7.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8	3/4	3/4	3/4	7/8	7/8	5/8	5/8	5/8	3/4	3/4	7.50	92000
120000	10.00	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	3/4	7/8	7/8	7/8	5/8	5/8	3/4	3/4	3/4	10.00	120000
150000	12.50	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	3/4	7/8	7/8	7/8	1 1/8	5/8	3/4	3/4	3/4	7/8	12.50	150000
180000	15.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 1/8	3/4	3/4	7/8	7/8	7/8	15.00	180000
240000	20.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	20.00	240000
300000	25.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	7/8	7/8	1 1/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	30.00	360000
420000	35.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	35.00	420000
480000	40.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	40.00	480000
540000	45.00	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	45.00	540000
600000	50.00	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.

# FREON 22 REFRIGERANT PRESSURE DROP IN LINES (65°F EVAPORATION OUTLET)



# FREON 22 REFRIGERANT VELOCITY IN LINES (65°F EVAPORATION OUTLET)







*The miracles of science™*

**Suva®**  
refrigerants

# HFC REFRIGERANT PIPING

## DESIGN GOALS

A common goal is to size the Suction, Hot Gas and Liquid lines for about 1F° pressure drop at design capacity.

### **A Suction Line must:**

- return oil from the evaporator to the compressor at minimum system capacity
- prevent oil draining from an active to an inactive evaporator when more than one evaporator is used in a single system
- dampen or eliminate line vibrations and noise caused by compressor vibration
- minimize line sweating from condensation
- prevent unnecessary heat gain into the refrigerant

### **The Hot Gas Discharge Line must:**

- avoid oil trapping at minimum system capacity
- prevent backflow of oil or liquid refrigerant to the compressor during low capacity or shutdown
- dampen or eliminate line vibration and noise caused by gas pulsations and compressor vibration

### **The Liquid Line must prevent:**

- formation of flash gas upstream of the metering device
- heat gain to the refrigerant

### **The Refrigerant Condensate Line must:**

- provide sewer-type flow; that is, free draining of liquid refrigerant in one direction, while refrigerant vapour flows adjacent to the liquid in the other direction.

### **The Hot Gas Defrost Line must:**

- maintain sufficient refrigerant flow rate. The velocity determined at saturated conditions will result in a conservative line size
- be properly sized to handle the calculated needed hot gas load, this is based on twice the evaporator flow rate
- prevent condensed liquid refrigerant from backflow to the compressor while on defrost or shutdown

Good refrigeration piping design requires that the refrigeration lines be pitched in the direction of flow at approximately 1/2 inch per 10 feet or 1 inch per 20 feet.

Refrigerant velocities in vertical lines should be at least 1500 feet per minute to ensure good oil return; velocities in horizontal lines should be at least 750 feet per minute.



*The miracles of science™*

**Suva®**  
refrigerants

## **HFC REFRIGERANT PIPING**

### **APPLICATION CONSIDERATIONS**

- System design for MINIMUM pressure drop.  
Pressure loss results in:
  - a. decrease in thermal capacity
  - b. increase in power requirements
- Refrigerant being piped DOES NOT change state.
- Lubricants are miscible with refrigerants.
  - a. minimize the accumulation of liquid refrigerant in compressor crankcase
  - b. oil returns to compressor at same rate at which it leaves

## **HFC REFRIGERANT PIPING**

### **CODE REGULATIONS**

- Design should conform to all codes, laws and regulations that apply at the “SITE” of the installation.

Examples:

Mechanical Refrigeration Code B52

Canadian Building Code

ASHRAE 15

Municipal / State / Provincial Codes

OEM's Recommended Installation Guide



The miracles of science™

Suva®  
refrigerants

# HFC REFRIGERANT PIPING

## GENERAL DESIGN PRINCIPLES

- Ensure proper feed to evaporators
- Practical line sizes without excessive pressure drop
- Protect compressor by:
  - a. prevent excessive oil from being trapped in a system
  - b. minimizing oil loss from the compressor
  - c. prevent liquid refrigerant or oil from entering the compressor while operating or while on the off cycle
  - d. maintain a clean and dry system

# HFC REFRIGERANT PIPING

## CAPACITY VERSUS LINE PRESSURE DROP

### VAPOUR LINES

### LIQUID LINES

	CAPACITY %	HP/TON %	
No line loss	100.0	100.0	Pressure drop not as critical as in vapour lines.
2F° suction line	95.7	103.5	Pressure drop should not cause: vapour formation in line insufficient liquid pressure at DX device
2F° hot gas discharge line	98.4	103.5	
4°F suction line	92.2	106.8	Typical liquid line pressure drop no greater than 1F° change in refrigerant temperature.
4°F hot gas discharge line	96.8	106.8	



The miracles of science™

Suva®  
refrigerants

# HFC REFRIGERANT PIPING

## “QUICK PICK” CRITERIA

Good piping design will result in a system having large enough discharge, liquid and suction lines to prevent excessive pressure drop, yet be small enough to maintain an adequate velocity of refrigerant flow to return the oil to the compressor crankcase.

1. Liquid condensate line from the condensers to receivers should be sized for a velocity of 100 fpm or less.
2. Liquid lines from the receiver to evaporators should be sized to maintain a velocity below 300 fpm to minimize liquid hammer.
3. Vapour line feasible design velocities (1) are:
4. A double riser gives the effect of a downsized riser at minimum load, while providing about the same pressure drop as a full-sized line at full load. The smaller riser is sized to ensure oil return at the minimum capacity step; the larger riser is sized so that the combined ‘flow areas’ of both of these risers is approximately equal to that of the main suction line.

Suction line - 900 to 4000 ft/min  
 Discharge line - 2000 to 3500 ft/min  
 Defrost line - 1000 to 2000 ft/min

(1) Velocities as recommended by ASHRAE Fundamentals handbook.

The following Refrigerant “Quick Pick” tables are based on a minimum refrigerant velocity of at least 1500 ft/min, while not exceeding the suggested allowable pressure drop in psig equaling 2F° in the suction lines. The discharge line and the liquid line are based on a pressure drop maximum equaling 1F°.



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 134A (R134A)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -30°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

Suva®  
refrigerants

## SUVA 134A REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		50°F THROUGH 30°F (48 THROUGH 26 PSIG)					29°F THROUGH 10°F (25 THROUGH 12 PSIG)					9°F THROUGH -10°F (11 THROUGH 2 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		2.2 lb (2F°)					1.4 lb (2F°)					1.0 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	3/4	3/4	7/8	7/8	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1.50	18000
24000	2.00	3/4	7/8	7/8	7/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	2.00	24000
30000	2.50	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	2.50	30000
36000	3.00	3/4	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	3.00	36000
42000	3.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	3.50	42000
48000	4.00	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	4.00	48000
60000	5.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	5.00	60000
92000	7.50	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	7.50	92000
120000	10.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 5/8	2 5/8	10.00	120000
150000	12.50	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	12.50	150000
180000	15.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	15.00	180000
240000	20.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	3 1/8	3 1/8	3 1/8	20.00	240000
300000	25.00	1 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	25.00	300000	
360000	30.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	30.00	360000
420000	35.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	2 5/8	3 1/8	3 5/8	3 5/8	4 1/8	35.00	420000
480000	40.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	3 1/8	3 5/8	3 5/8	3 5/8	4 1/8	40.00	480000
540000	45.00	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	45.00	540000
600000	50.00	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8	2 5/8	3 1/8	3 5/8	3 5/8	3 5/8	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

**Suva**  
refrigerants

**SUVA 134A  
REFRIGERANT PIPING GUIDE**

**Suction Line Size - Evaporator to Compressor**

		-11°F THROUGH -30°F (1 PSIG THROUGH 10" Hg)					-31°F THROUGH -50°F (11" THROUGH 19" Hg)						
		Suggested Allowable Pressure Drop in psig = 2°F											
		0.6 lb (2F°)					0.5 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)										System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150		
18000	1.50	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8						1.50	18000
24000	2.00	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8						2.00	24000
30000	2.50	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	N/A	N/A	N/A	N/A	N/A	2.50	30000
36000	3.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8						3.00	36000
42000	3.50	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8						3.50	42000
48000	4.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8						4.00	48000
60000	5.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8						5.00	60000
92000	7.50	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8						7.50	92000
120000	10.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	N/A	N/A	N/A	N/A	N/A	10.00	120000
150000	12.50	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8						12.50	150000
180000	15.00	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8						15.00	180000
240000	20.00	2 5/8	3 1/8	3 5/8	3 5/8	4 1/8						20.00	240000
300000	25.00	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8						25.00	300000
360000	30.00	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8						30.00	360000
420000	35.00	3 5/8	3 5/8	4 1/8	5 1/8	5 1/8	N/A	N/A	N/A	N/A	N/A	35.00	420000
480000	40.00	3 5/8	4 1/8	5 1/8	5 1/8	5 1/8						40.00	480000
540000	45.00	3 5/8	4 1/8	5 1/8	5 1/8	5 1/8						45.00	540000
600000	50.00	4 1/8	5 1/8	5 1/8	5 1/8	6 1/8						50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

## SUVA 134A REFRIGERANT PIPING GUIDE

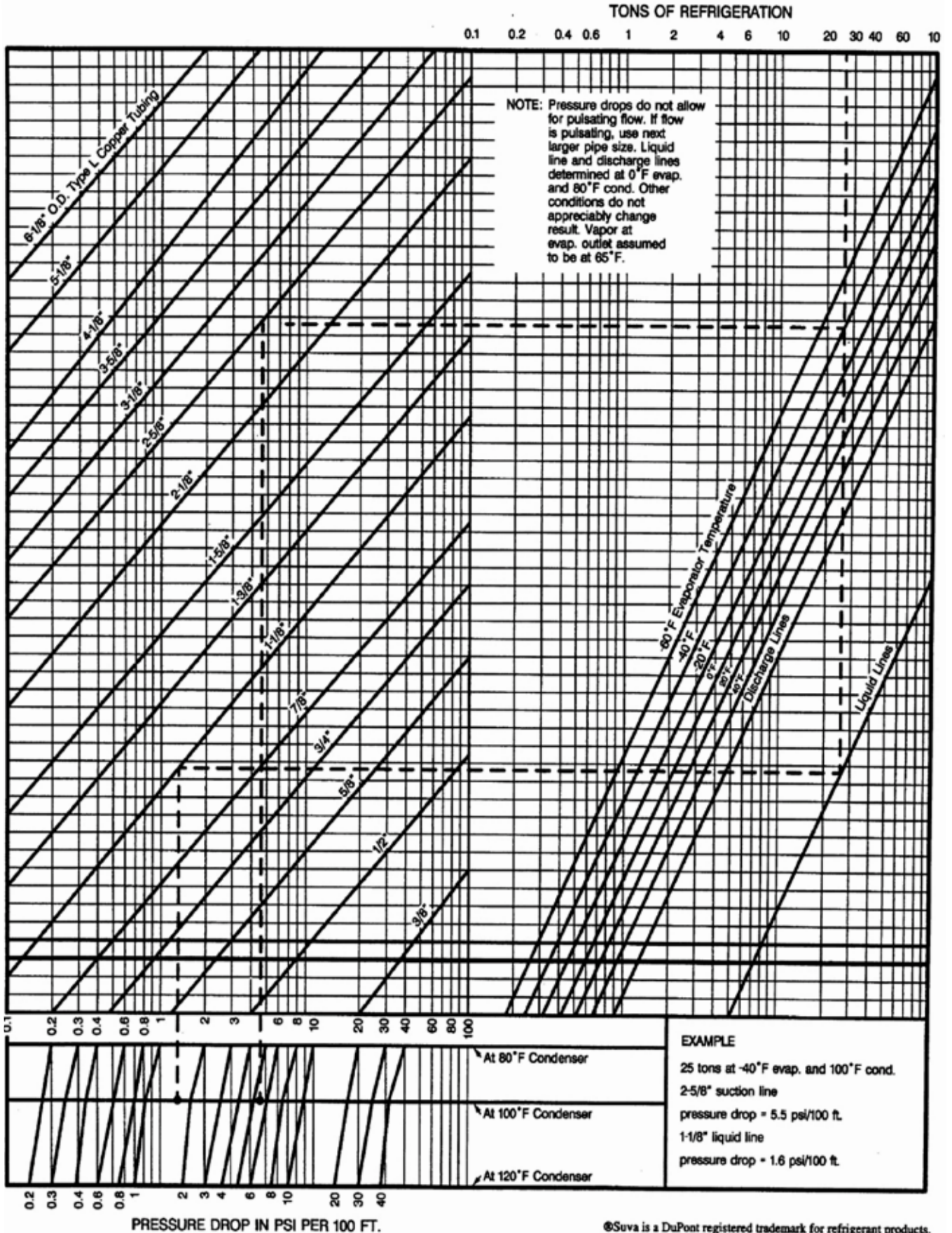
System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (2.2 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (2.2 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	5/8	3/4	3/4	3/4	1/2	1/2	1/2	5/8	5/8	3/8	3/8	3/8	1/2	1/2	1.50	18000
24000	2.00	5/8	5/8	3/4	3/4	7/8	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	2.00	24000
30000	2.50	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	1/2	2.50	30000
36000	3.00	3/4	3/4	7/8	7/8	7/8	1/2	5/8	5/8	5/8	3/4	3/8	1/2	1/2	1/2	5/8	3.00	36000
42000	3.50	3/4	7/8	7/8	7/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	3.50	42000
48000	4.00	3/4	7/8	7/8	1 1/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	4.00	48000
60000	5.00	3/4	7/8	1 1/8	1 1/8	1 1/8	5/8	5/8	3/4	3/4	3/4	1/2	1/2	5/8	5/8	5/8	5.00	60000
92000	7.50	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	3/4	3/4	7/8	7/8	5/8	5/8	5/8	3/4	3/4	7.50	92000
120000	10.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	3/4	7/8	7/8	7/8	1 1/8	5/8	3/4	3/4	3/4	7/8	10.00	120000
150000	12.50	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	3/4	7/8	7/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	12.50	150000
180000	15.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	15.00	180000
240000	20.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	20.00	240000
300000	25.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	7/8	7/8	1 1/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	30.00	360000
420000	35.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	35.00	420000
480000	40.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	40.00	480000
540000	45.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	45.00	540000
600000	50.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.

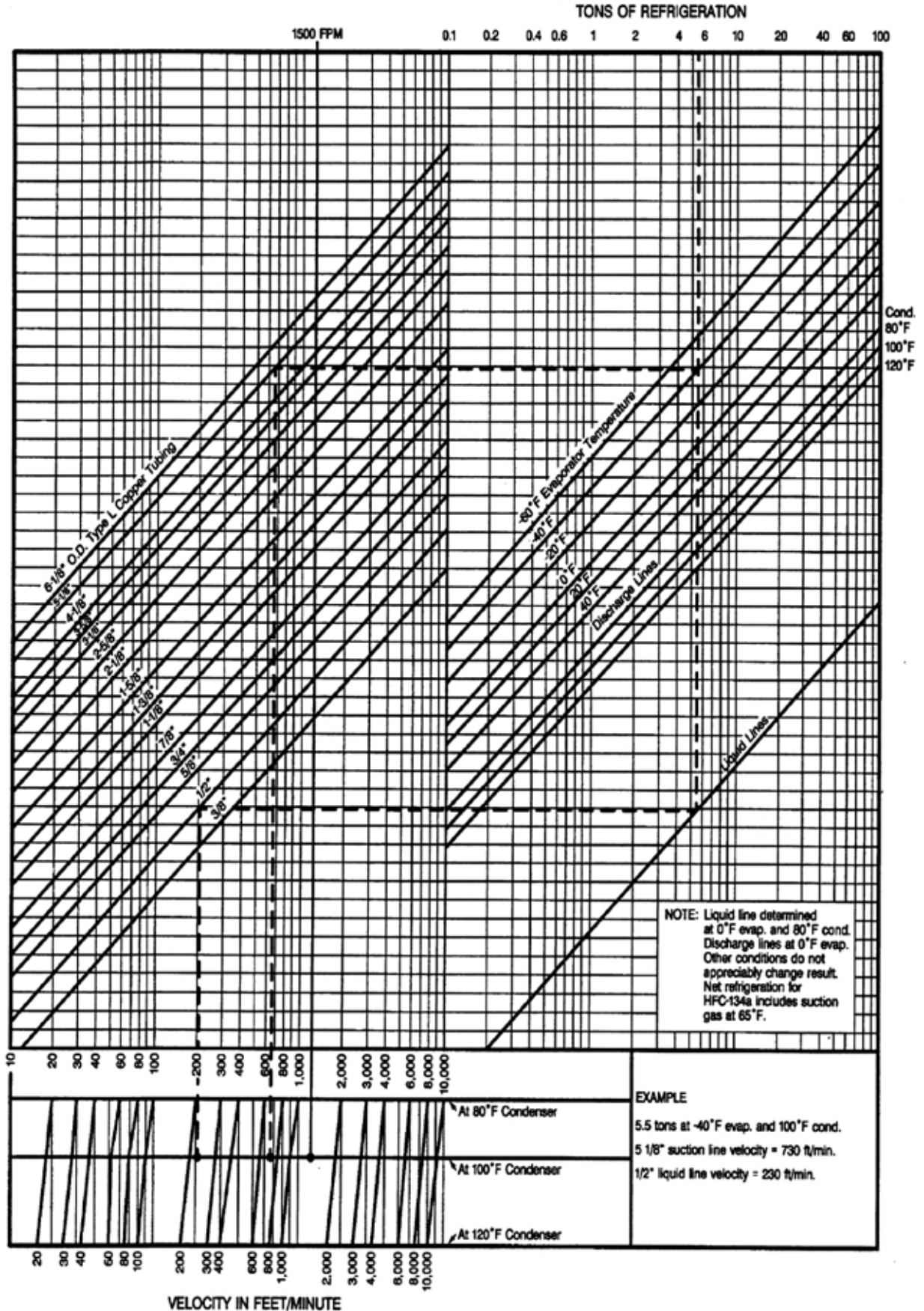


# SUVA 134A REFRIGERANT

## PRESSURE DROP IN LINES (65°F EVAPORATION OUTLET)



# FREON 22 REFRIGERANT VELOCITY IN LINES (65°F EVAPORATION OUTLET)





*The miracles of science™*

**Suva®**  
refrigerants

# **REFRIGERANT**

## **SUVA 404A (R404A)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -50°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

**Suva**  
refrigerants

**SUVA 404A  
REFRIGERANT PIPING GUIDE**

**Suction Line Size - Evaporator to Compressor**

		50°F THROUGH 30°F (104 THROUGH 70 PSIG)					29°F THROUGH 10°F (68 THROUGH 43 PSIG)					9°F THROUGH -10°F (42 THROUGH 24 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		3.4 lb (2F°)					2.6 lb (2F°)					1.9 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	5/8	3/4	3/4	3/4	5/8	3/4	3/4	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	1.50	18000
24000	2.00	5/8	3/4	7/8	7/8	7/8	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	1 1/8	1 1/8	2.00	24000	
30000	2.50	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	2.50	30000	
36000	3.00	3/4	7/8	7/8	7/8	1 1/8	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 3/8	3.00	36000	
42000	3.50	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 1/8	1 3/8	3.50	42000	
48000	4.00	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	4.00	48000	
60000	5.00	7/8	7/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	5.00	60000	
92000	7.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	7.50	92000	
120000	10.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	1 5/8	2 1/8	10.00	120000	
150000	12.50	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	12.50	150000	
180000	15.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 5/8	15.00	180000	
240000	20.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	20.00	240000	
300000	25.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	25.00	300000	
360000	30.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	30.00	360000	
420000	35.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	35.00	420000	
480000	40.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 5/8	40.00	480000	
540000	45.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	45.00	540000	
600000	50.00	2 1/8	2 1/8	2 5/8	2 5/8	3 1/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	50.00	600000	

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

**Suva**  
refrigerants

**SUVA 404A  
REFRIGERANT PIPING GUIDE**

**Suction Line Size - Evaporator to Compressor**

System Capacity BTU/Hr	System Capacity Tons/Hr	-11°F THROUGH -30°F (23 THROUGH 10 PSIG)					-31°F THROUGH -50°F (9 THROUGH 0 PSIG)					System Capacity Tons/Hr	System Capacity BTU/Hr
		Suggested Allowable Pressure Drop in psig = 2°F											
		1.4 lb (2F°)					1.0 lb (2F°)						
		Equivalent Suction Line Lengths (feet)											
		25	50	75	100	150	25	50	75	100	150		
18000	1.50	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1.50	18000
24000	2.00	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	2.00	24000
30000	2.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	2.50	30000
36000	3.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	3.00	36000
42000	3.50	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	3.50	42000
48000	4.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	4.00	48000
60000	5.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	1 5/8	2 1/8	2 1/8	5.00	60000
92000	7.50	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	7.50	92000
120000	10.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	10.00	120000
150000	12.50	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	12.50	150000
180000	15.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	15.00	180000
240000	20.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	20.00	240000
300000	25.00	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	25.00	300000
360000	30.00	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	30.00	360000
420000	35.00	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	35.00	420000
480000	40.00	2 5/8	3 1/8	3 5/8	3 5/8	3 5/8	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8	40.00	480000
540000	45.00	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	3 5/8	3 5/8	4 1/8	4 1/8	5 1/8	45.00	540000
600000	50.00	3 1/8	3 1/8	3 5/8	4 1/8	4 1/8	3 5/8	4 1/8	4 1/8	5 1/8	5 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

## SUVA 404A REFRIGERANT PIPING GUIDE

System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (3 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (3 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	5/8	5/8	5/8	5/8	1/2	1/2	1/2	1/2	5/8	3/8	3/8	3/8	1/2	1.50	18000	
24000	2.00	5/8	5/8	5/8	3/4	3/4	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	2.00	24000	
30000	2.50	5/8	5/8	3/4	3/4	3/4	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	2.50	30000	
36000	3.00	5/8	3/4	3/4	3/4	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	3.00	36000	
42000	3.50	5/8	3/4	3/4	7/8	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	3.50	42000	
48000	4.00	3/4	3/4	7/8	7/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	4.00	48000	
60000	5.00	3/4	7/8	7/8	1 1/8	1 1/8	5/8	5/8	3/4	3/4	3/4	1/2	1/2	5/8	5/8	5.00	60000	
92000	7.50	7/8	1 1/8	1 1/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	3/4	3/4	7.50	92000
120000	10.00	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	7/8	1 1/8	5/8	3/4	3/4	3/4	7/8	10.00	120000
150000	12.50	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	3/4	7/8	7/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	12.50	150000
180000	15.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	15.00	180000
240000	20.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	20.00	240000
300000	25.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	7/8	7/8	1 1/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	30.00	360000
420000	35.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	35.00	420000
480000	40.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	40.00	480000
540000	45.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	45.00	540000
600000	50.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	50.00	600000

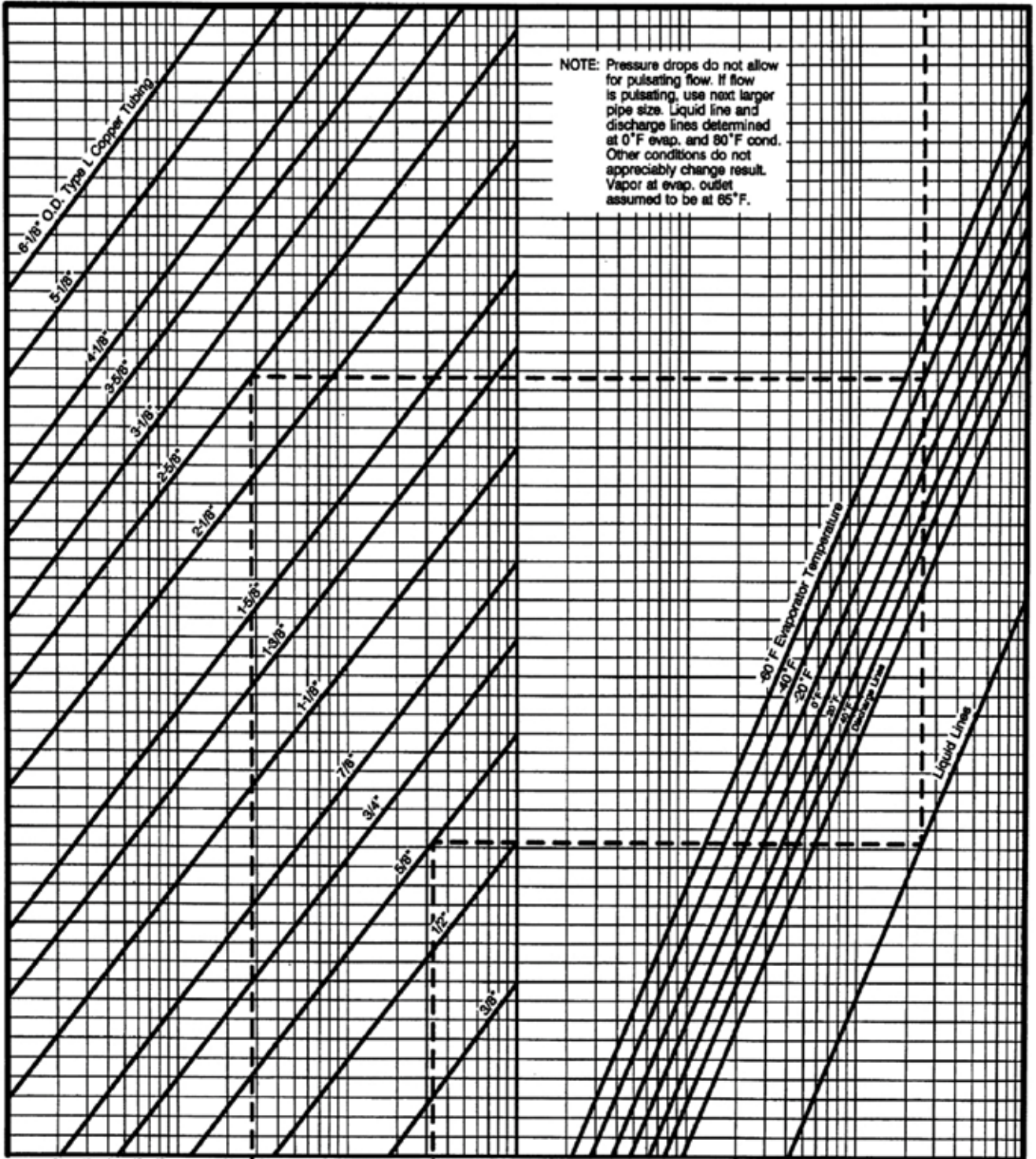
- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.

# SUVA 404A REFRIGERANT

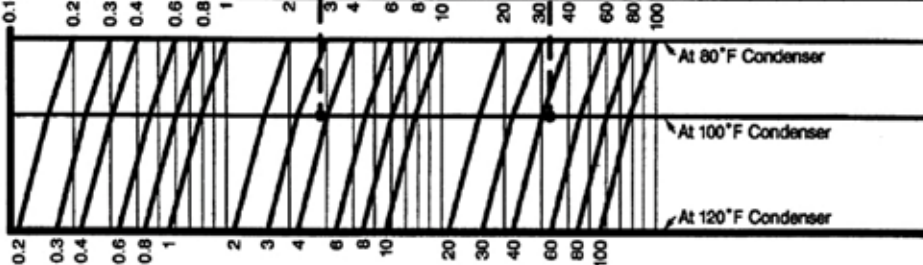
## PRESSURE DROP IN LINES (65°F EVAPORATION OUTLET)

TONS OF REFRIGERATION

0.1 0.2 0.4 0.6 1 2 4 6 10 20 40 60 100



NOTE: Pressure drops do not allow for pulsating flow. If flow is pulsating, use next larger pipe size. Liquid line and discharge lines determined at 0°F evap. and 80°F cond. Other conditions do not appreciably change result. Vapor at evap. outlet assumed to be at 65°F.

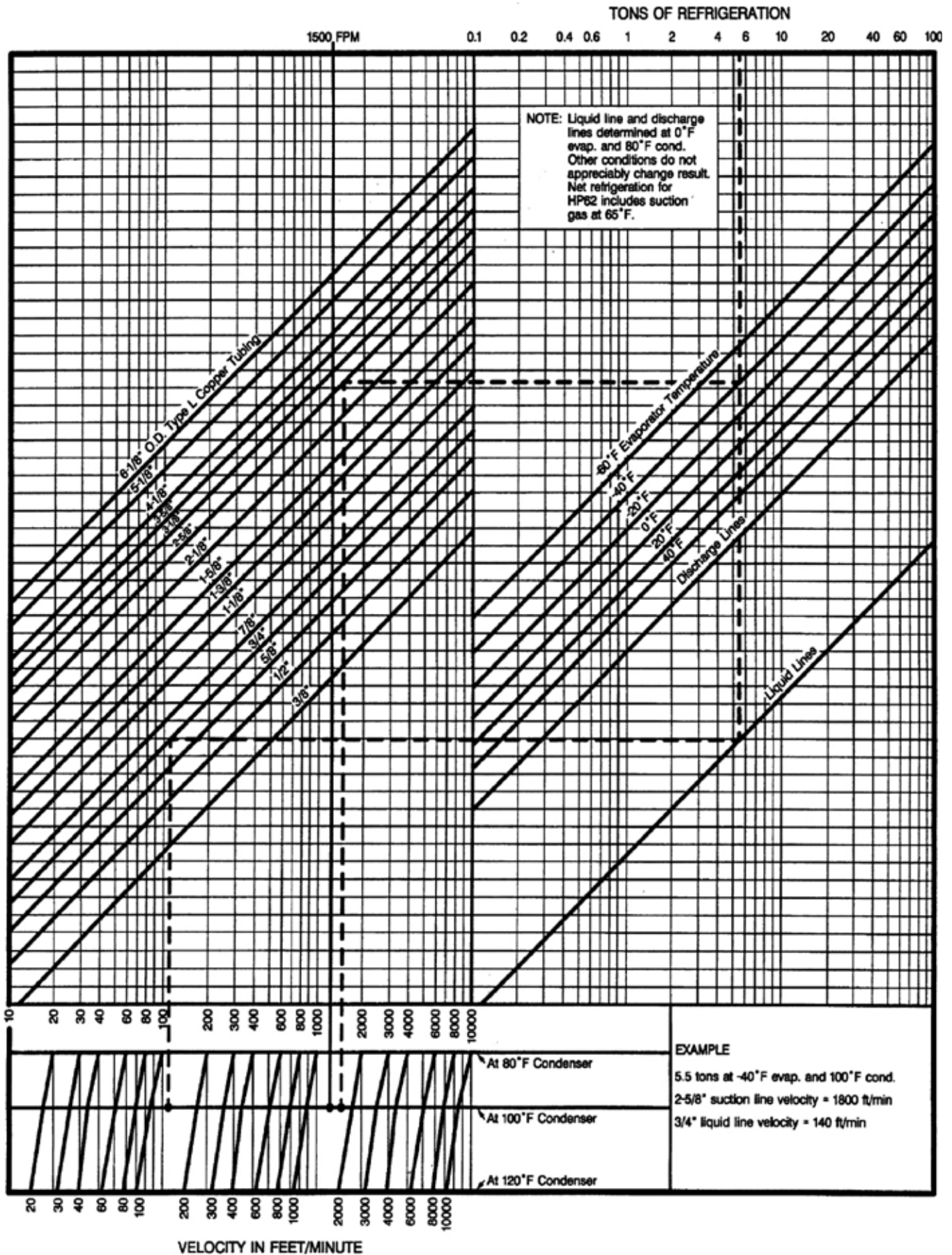


**EXAMPLE**  
 25 tons at -40°F evap. and 100°F cond.  
 2-5/8" suction line  
 pressure drop - 3.8 psi/100 ft.  
 5/8" liquid line pressure drop - 43 psi/100 ft.

PRESSURE DROP IN PSI PER 100 FT.

©Suva is a DuPont registered trademark for refrigerant products.

# SUVA 404A REFRIGERANT VELOCITY IN LINES (65°F EVAPORATION OUTLET)

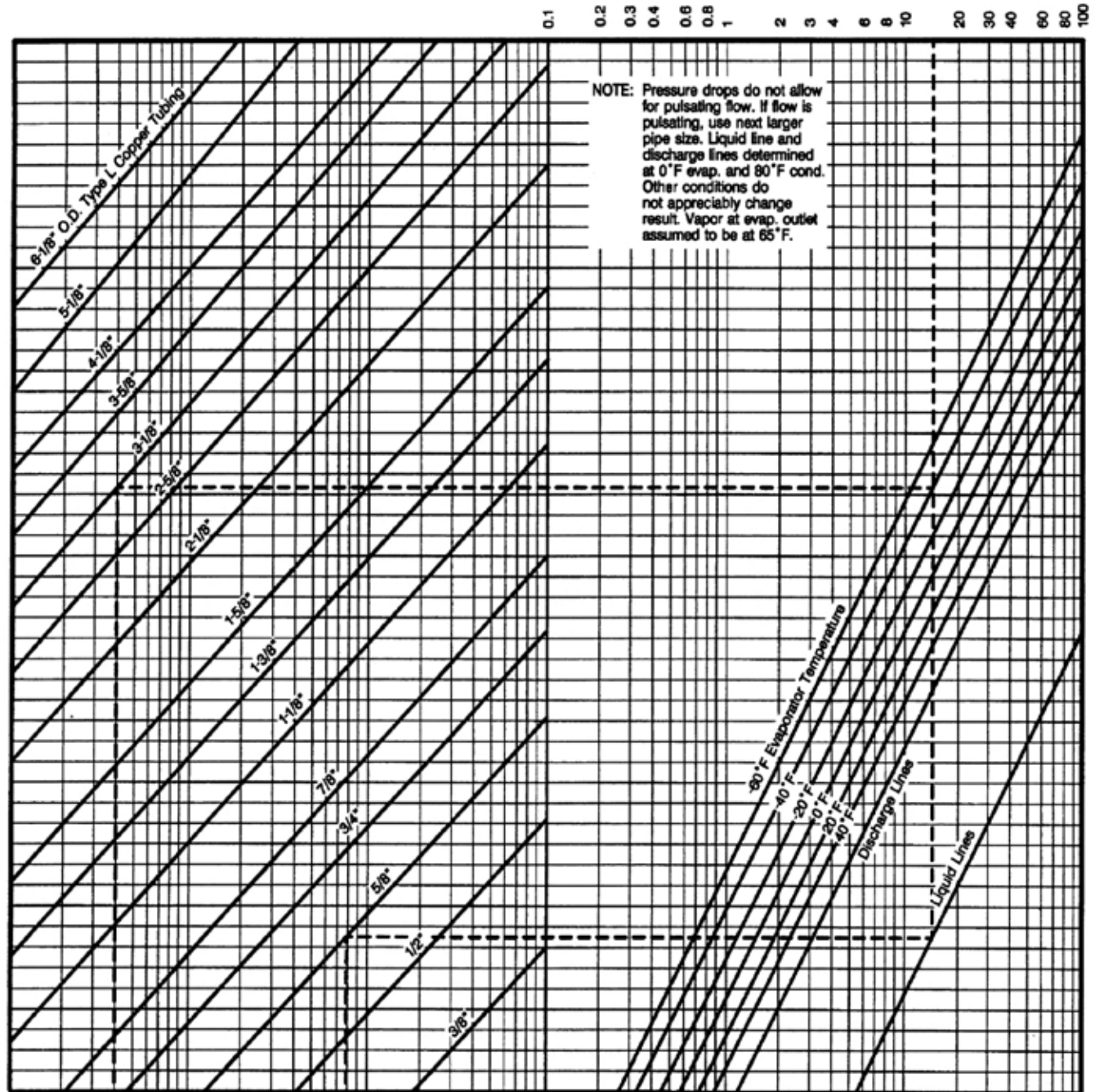




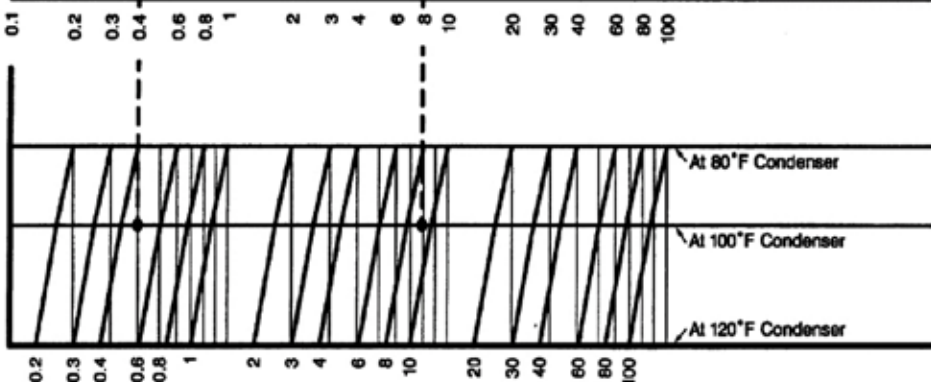
# SUVA 404A REFRIGERANT

## PRESSURE DROP IN LINES (65°F EVAPORATION OUTLET)

TONS OF REFRIGERATION



**NOTE:** Pressure drops do not allow for pulsating flow. If flow is pulsating, use next larger pipe size. Liquid line and discharge lines determined at 0°F evap. and 80°F cond. Other conditions do not appreciably change result. Vapor at evap. outlet assumed to be at 65°F.

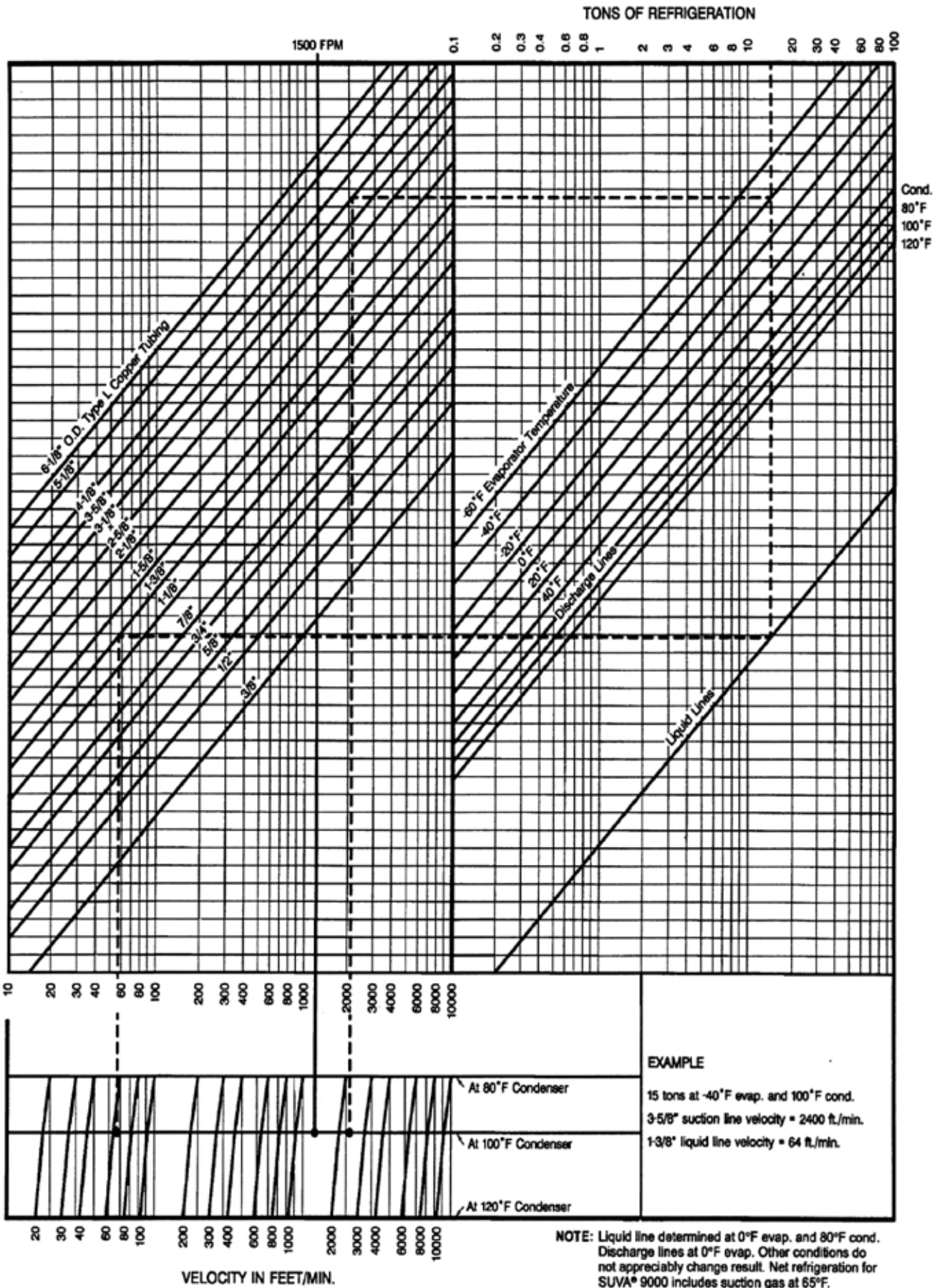


**EXAMPLE**  
 15 tons at -40°F evap. and 100°F cond.  
 3-1/8" suction line  
 pressure drop = 0.49 psi/100 ft.  
 5/8" liquid line pressure drop = 9.2 psi/100 ft.

PRESSURE DROP IN PSI PER 100 FT.

©Suva is a DuPont registered trademark for refrigerant products.

# SUVA 404A REFRIGERANT VELOCITY IN LINES (65°F EVAPORATION OUTLET)





*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 407C (R407C)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -30°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

Suva®  
refrigerants

## SUVA 407C REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		50°F THROUGH 30°F (77 THROUGH 48 PSIG)					29°F THROUGH 10°F (47 THROUGH 27 PSIG)					9°F THROUGH -10°F (26 THROUGH 12 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		2.5 lb (2F°)					1.8 lb (2F°)					1.3 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	3/4	3/4	3/4	7/8	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	1 1/8	1 1/8	1 1/8	1.50	18000
24000	2.00	3/4	3/4	7/8	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	2.00	24000
30000	2.50	3/4	7/8	7/8	7/8	1 1/8	7/8	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	2.50	30000
36000	3.00	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	3.00	36000
42000	3.50	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	3.50	42000
48000	4.00	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	4.00	48000
60000	5.00	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	5.00	60000
92000	7.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	7.50	92000
120000	10.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	10.00	120000
150000	12.50	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	12.50	150000
180000	15.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	15.00	180000
240000	20.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	20.00	240000
300000	25.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	25.00	300000
360000	30.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	30.00	360000
420000	35.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	35.00	420000
480000	40.00	2 1/8	2 1/8	2 5/8	2 5/8	3 1/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	40.00	480000
540000	45.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	45.00	540000
600000	50.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

**Suva**<sup>®</sup>  
refrigerants

## SUVA 407C REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		-11°F THROUGH -30°F (23 THROUGH 10 PSIG)					-31°F THROUGH -50°F (9 THROUGH 0 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F											
		0.9 lb (2F°)					0.6 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)										System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150		
18000	1.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8						1.50	18000
24000	2.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8						2.00	24000
30000	2.50	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	N/A	N/A	N/A	N/A	N/A	2.50	30000
36000	3.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8						3.00	36000
42000	3.50	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8						3.50	42000
48000	4.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8						4.00	48000
60000	5.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8						5.00	60000
92000	7.50	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8						7.50	92000
120000	10.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	N/A	N/A	N/A	N/A	N/A	10.00	120000
150000	12.50	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8						12.50	150000
180000	15.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8						15.00	180000
240000	20.00	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8						20.00	240000
300000	25.00	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8						25.00	300000
360000	30.00	2 5/8	3 1/8	3 5/8	3 5/8	3 5/8						30.00	360000
420000	35.00	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	N/A	N/A	N/A	N/A	N/A	35.00	420000
480000	40.00	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8						40.00	480000
540000	45.00	3 1/8	3 5/8	3 5/8	4 1/8	5 1/8						45.00	540000
600000	50.00	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8						50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

### SUVA 407C REFRIGERANT PIPING GUIDE

System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (3 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (3 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	1/2	5/8	5/8	5/8	1/2	1/2	3/4	1/2	1/2	3/8	3/8	3/8	3/8	3/8	1.50	18000
24000	2.00	1/2	5/8	5/8	5/8	3/4	1/2	1/2	3/4	1/2	5/8	3/8	3/8	3/8	3/8	1/2	2.00	24000
30000	2.50	5/8	5/8	5/8	3/4	3/4	1/2	1/2	3/4	5/8	5/8	3/8	3/8	3/8	1/2	1/2	2.50	30000
36000	3.00	5/8	5/8	3/4	3/4	3/4	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	3.00	36000
42000	3.50	5/8	3/4	3/4	3/4	7/8	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	1/2	3.50	42000
48000	4.00	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	5/8	3/4	3/8	1/2	1/2	1/2	5/8	4.00	48000
60000	5.00	3/4	3/4	7/8	7/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	5.00	60000
92000	7.50	3/4	7/8	1 1/8	1 1/8	1 1/8	5/8	3/4	3/4	3/4	7/8	1/2	5/8	5/8	5/8	3/4	7.50	92000
120000	10.00	7/8	1 1/8	1 1/8	1 1/8	1 3/8	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	3/4	3/4	10.00	120000
150000	12.50	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	3/4	7/8	7/8	7/8	5/8	5/8	3/4	3/4	3/4	12.50	150000
180000	15.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	3/4	7/8	7/8	7/8	1 1/8	5/8	3/4	3/4	3/4	7/8	15.00	180000
240000	20.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	20.00	240000
300000	25.00	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	7/8	1 1/8	1 3/8	1 3/8	1 3/8	3/4	7/8	1 1/8	1 1/8	1 1/8	30.00	360000
420000	35.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	7/8	7/8	1 1/8	1 1/8	1 1/8	35.00	420000
480000	40.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	40.00	480000
540000	45.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	45.00	540000
600000	50.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 410A (R410A)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -50°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

Suva®  
refrigerants

## SUVA 410A REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		50°F THROUGH 30°F (145 THROUGH 99 PSIG)					29°F THROUGH 10°F (97 THROUGH 64 PSIG)					9°F THROUGH -10°F (62 THROUGH 38 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		4.6 lb (2F°)					3.5 lb (2F°)					2.5 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	5/8	5/8	5/8	3/4	5/8	5/8	3/4	3/4	3/4	5/8	3/4	3/4	7/8	7/8	1.50	18000
24000	2.00	1/2	5/8	3/4	3/4	3/4	5/8	3/4	3/4	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	2.00	24000
30000	2.50	5/8	3/4	3/4	3/4	7/8	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	1 1/8	1 1/8	1 1/8	2.50	30000
36000	3.00	5/8	3/4	3/4	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	3.00	36000
42000	3.50	3/4	3/4	7/8	7/8	1 1/8	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	3.50	42000
48000	4.00	3/4	7/8	7/8	7/8	1 1/8	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	4.00	48000
60000	5.00	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	5.00	60000
92000	7.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7.50	92000
120000	10.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	10.00	120000
150000	12.50	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	12.50	150000
180000	15.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	15.00	180000
240000	20.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	20.00	240000
300000	25.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	25.00	300000
360000	30.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	30.00	360000
420000	35.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	35.00	420000
480000	40.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	40.00	480000
540000	45.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	45.00	540000
600000	50.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.





The miracles of science™

**Suva**  
refrigerants

## SUVA 410A REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		-11°F THROUGH -30°F (37 THROUGH 19 PSIG)					-31°F THROUGH -50°F (18 THROUGH 6 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F											
		1.9 lb (2F°)					1.3 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)										System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150		
18000	1.50	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1.50	18000
24000	2.00	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	2.00	24000
30000	2.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	2.50	30000
36000	3.00	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	3.00	36000
42000	3.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	3.50	42000
48000	4.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	4.00	48000
60000	5.00	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	5.00	60000
92000	7.50	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	1 5/8	2 1/8	2 1/8	2 5/8	7.50	92000
120000	10.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	10.00	120000
150000	12.50	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	12.50	150000
180000	15.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	15.00	180000
240000	20.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	20.00	240000
300000	25.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	25.00	300000
360000	30.00	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 5/8	3 5/8	3 5/8	30.00	360000
420000	35.00	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	3 1/8	3 5/8	3 5/8	3 5/8	4 1/8	35.00	420000
480000	40.00	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	40.00	480000
540000	45.00	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	3 1/8	3 5/8	3 5/8	4 1/8	5 1/8	45.00	540000
600000	50.00	2 5/8	3 1/8	3 5/8	3 5/8	4 1/8	3 5/8	3 5/8	4 1/8	4 1/8	5 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

## SUVA 410A REFRIGERANT PIPING GUIDE

System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (5 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (5 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	1/2	1/2	5/8	5/8	1/2	1/2	1/2	1/2	1/2	3/8	3/8	3/8	3/8	3/8	1.50	18000
24000	2.00	1/2	5/8	5/8	5/8	5/8	1/2	1/2	1/2	5/8	5/8	3/8	3/8	3/8	1/2	1/2	2.00	24000
30000	2.50	1/2	5/8	5/8	5/8	3/4	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	2.50	30000
36000	3.00	5/8	5/8	5/8	3/4	3/4	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	3.00	36000
42000	3.50	5/8	5/8	3/4	3/4	3/4	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	1/2	3.50	42000
48000	4.00	5/8	3/4	3/4	3/4	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	5/8	4.00	48000
60000	5.00	3/4	3/4	7/8	7/8	7/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	5.00	60000
92000	7.50	3/4	7/8	7/8	1 1/8	1 1/8	5/8	3/4	3/4	3/4	7/8	1/2	5/8	5/8	5/8	3/4	7.50	92000
120000	10.00	7/8	1 1/8	1 1/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	3/4	3/4	10.00	120000
150000	12.50	7/8	1 1/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	5/8	5/8	3/4	3/4	7/8	12.50	150000
180000	15.00	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	15.00	180000
240000	20.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	20.00	240000
300000	25.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	7/8	1 1/8	1 3/8	1 3/8	1 3/8	3/4	7/8	1 1/8	1 1/8	1 1/8	30.00	360000
420000	35.00	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	35.00	420000
480000	40.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	40.00	480000
540000	45.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	45.00	540000
600000	50.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 507 (R507)**

### **PIPING GUIDE**

From 18,000 BTU through 600,000 BTU per hour at -50°F through +50°F saturated suction temperature (1.5 ton through 50.0 tons).

**“QUICK PICK”**



The miracles of science™

Suva®  
refrigerants

## SUVA 507 REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		50°F THROUGH 30°F (104 THROUGH 70 PSIG)					29°F THROUGH 10°F (68 THROUGH 43 PSIG)					9°F THROUGH -10°F (42 THROUGH 24 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F																
		3.4 lb (2F°)					2.6 lb (2F°)					1.9 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)															System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	5/8	5/8	3/4	3/4	3/4	5/8	3/4	3/4	7/8	7/8	3/4	7/8	7/8	1 1/8	1 1/8	1.50	18000
24000	2.00	5/8	3/4	7/8	7/8	7/8	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	1 1/8	1 1/8	1 1/8	2.00	24000
30000	2.50	3/4	3/4	7/8	7/8	1 1/8	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	2.50	30000
36000	3.00	3/4	7/8	7/8	7/8	1 1/8	7/8	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	3.00	36000
42000	3.50	3/4	7/8	7/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	3.50	42000
48000	4.00	3/4	7/8	1 1/8	1 1/8	1 1/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	4.00	48000
60000	5.00	7/8	7/8	1 1/8	1 1/8	1 3/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	5.00	60000
92000	7.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	7.50	92000
120000	10.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	10.00	120000
150000	12.50	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	12.50	150000
180000	15.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	15.00	180000
240000	20.00	1 3/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	20.00	240000
300000	25.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	25.00	300000
360000	30.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	30.00	360000
420000	35.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	35.00	420000
480000	40.00	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	40.00	480000
540000	45.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	45.00	540000
600000	50.00	2 1/8	2 1/8	2 5/8	2 5/8	3 1/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 Suva 404A (R404A) for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

**Suva**  
refrigerants

## SUVA 507 REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

		-11°F THROUGH -30°F (23 THROUGH 10 PSIG)					-31°F THROUGH -50°F (9 THROUGH 0 PSIG)						
		Suggested Allowable Pressure Drop in psig = 2°F											
		1.4 lb (2F°)					1.0 lb (2F°)						
System Capacity BTU/Hr	System Capacity Tons/Hr	Equivalent Suction Line Lengths (feet)										System Capacity Tons/Hr	System Capacity BTU/Hr
		25	50	75	100	150	25	50	75	100	150		
18000	1.50	7/8	7/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1.50	18000
24000	2.00	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	2.00	24000
30000	2.50	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	2.50	30000
36000	3.00	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	3.00	36000
42000	3.50	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 3/8	1 5/8	1 5/8	1 5/8	2 1/8	3.50	42000
48000	4.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	4.00	48000
60000	5.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 5/8	1 5/8	1 5/8	2 1/8	2 1/8	5.00	60000
92000	7.50	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	7.50	92000
120000	10.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	10.00	120000
150000	12.50	2 1/8	2 1/8	2 1/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	12.50	150000
180000	15.00	2 1/8	2 1/8	2 5/8	2 5/8	2 5/8	2 1/8	2 5/8	2 5/8	3 1/8	3 1/8	15.00	180000
240000	20.00	2 1/8	2 5/8	2 5/8	2 5/8	3 1/8	2 5/8	3 1/8	3 1/8	3 1/8	3 5/8	20.00	240000
300000	25.00	2 5/8	2 5/8	3 1/8	3 1/8	3 1/8	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	25.00	300000
360000	30.00	2 5/8	2 5/8	3 1/8	3 1/8	3 5/8	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	30.00	360000
420000	35.00	2 5/8	3 1/8	3 1/8	3 5/8	3 5/8	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	35.00	420000
480000	40.00	2 5/8	3 1/8	3 5/8	3 5/8	3 5/8	3 1/8	3 5/8	4 1/8	4 1/8	5 1/8	40.00	480000
540000	45.00	3 1/8	3 1/8	3 5/8	3 5/8	4 1/8	3 5/8	3 5/8	4 1/8	4 1/8	5 1/8	45.00	540000
600000	50.00	3 1/8	3 5/8	3 5/8	4 1/8	4 1/8	3 5/8	4 1/8	4 1/8	5 1/8	5 1/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 Suva 404A (R404A) for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



The miracles of science™

Suva®  
refrigerants

## SUVA 507 REFRIGERANT PIPING GUIDE

System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (3 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (3 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	5/8	5/8	5/8	5/6	1/2	1/2	1/2	1/2	5/8	3/8	3/8	3/8	3/8	1/2	1.50	18000
24000	2.00	5/8	5/8	5/8	3/4	3/4	1/2	1/2	5/8	5/8	5/8	3/8	3/8	1/2	1/2	1/2	2.00	24000
30000	2.50	5/8	5/8	3/4	3/4	3/4	1/2	5/8	5/8	5/8	5/8	3/8	1/2	1/2	1/2	1/2	2.50	30000
36000	3.00	5/8	3/4	3/4	3/4	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	5/8	3.00	36000
42000	3.50	5/8	3/4	3/4	7/8	7/8	5/8	5/8	5/8	5/8	3/4	1/2	1/2	1/2	1/2	5/8	3.50	42000
48000	4.00	3/4	3/4	7/8	7/8	1 1/8	5/8	5/8	5/8	3/4	3/4	1/2	1/2	1/2	5/8	5/8	4.00	48000
60000	5.00	3/4	7/8	7/8	1 1/8	1 1/8	5/8	5/8	3/4	3/4	3/4	1/2	1/2	5/8	5/8	5/8	5.00	60000
92000	7.50	7/8	1 1/8	1 1/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	1/2	5/8	5/8	3/4	3/4	7.50	92000
120000	10.00	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	7/8	1 1/8	5/8	3/4	3/4	3/4	7/8	10.00	120000
150000	12.50	1 1/8	1 1/8	1 3/8	1 3/8	1 5/8	3/4	7/8	7/8	1 1/8	1 1/8	5/8	3/4	3/4	7/8	7/8	12.50	150000
180000	15.00	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	7/8	1 1/8	1 1/8	1 3/8	3/4	3/4	7/8	7/8	1 1/8	15.00	180000
240000	20.00	1 1/8	1 3/8	1 3/8	1 5/8	1 5/8	7/8	1 1/8	1 1/8	1 3/8	1 3/8	3/4	7/8	7/8	1 1/8	1 1/8	20.00	240000
300000	25.00	1 3/8	1 3/8	1 5/8	1 5/8	2 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	7/8	7/8	1 1/8	1 1/8	1 1/8	25.00	300000
360000	30.00	1 3/8	1 5/8	1 5/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	30.00	360000
420000	35.00	1 5/8	1 5/8	2 1/8	2 1/8	2 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 5/8	7/8	1 1/8	1 1/8	1 1/8	1 3/8	35.00	420000
480000	40.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	40.00	480000
540000	45.00	1 5/8	2 1/8	2 1/8	2 1/8	2 1/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	45.00	540000
600000	50.00	1 5/8	2 1/8	2 1/8	2 1/8	2 5/8	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 Suva 404A (R404A) for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of 65°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of 105°F.



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 507 (R507)**

### **REFRIGERANT PIPING GUIDE**

#### **SUVA 507 PRESSURE DROP IN LINES**

**REFER TO SUVA 404A**

## **SUVA 507 (R507)**

### **REFRIGERANT PIPING GUIDE**

#### **SUVA 507 VELOCITY IN LINES**

**REFER TO SUVA 404A**



*The miracles of science™*

**Suva**<sup>®</sup>  
refrigerants

# **REFRIGERANT**

## **SUVA 95 (R508B)**

### **PIPING GUIDE**

From 12,000 BTU through 240,000 BTU per hour at -130°F through -60°F saturated suction temperature (1.0 ton through 20.0 tons).

### **“QUICK PICK”**

Note: This data is for the selection of the second stage refrigeration piping of a typical cascade refrigeration system ONLY. In the first stage use Suva 404A (R404A) refrigerant and select the suggested pipe size from the Suva 404A (R404A) refrigerant piping guide.





The miracles of science™

Suva®  
refrigerants

## SUVA 95 REFRIGERANT PIPING GUIDE

### Suction Line Size - Evaporator to Compressor

System Capacity BTU/Hr	System Capacity Tons/Hr	-60°F THROUGH -100°F (68 THROUGH 17 PSIG)					-101°F THROUGH -115°F (16 THROUGH 6 PSIG)					-116°F THROUGH -130°F (5 PSIG THROUGH 4" Hg)					System Capacity Tons/Hr	System Capacity BTU/Hr
		Suggested Allowable Pressure Drop in psig = 2°F																
		2.6 lb (2F°)					1.4 lb (2F°)					1.0 lb (2F°)						
		Equivalent Suction Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	3/4	3/4	7/8	7/8		3/4	7/8	1 1/8	1 1/8		1 1/8	1 1/8	1 1/8	1 3/8		1.50	18000
24000	2.00	7/8	7/8	7/8	1 1/8		7/8	1 1/8	1 1/8	1 1/8		1 1/8	1 3/8	1 3/8	1 3/8		2.00	24000
30000	2.50	7/8	1 1/8	1 1/8	1 1/8	N/A	1 1/8	1 1/8	1 3/8	1 3/8	N/A	1 1/8	1 3/8	1 5/8	1 5/8	N/A	2.50	30000
36000	3.00	7/8	1 1/8	1 1/8	1 1/8		1 1/8	1 3/8	1 3/8	1 3/8		1 3/8	1 5/8	1 5/8	1 5/8		3.00	36000
42000	3.50	1 1/8	1 1/8	1 1/8	1 3/8		1 1/8	1 3/8	1 5/8	1 5/8		1 3/8	1 5/8	2 1/8	2 1/8		3.50	42000
48000	4.00	1 1/8	1 1/8	1 3/8	1 3/8		1 3/8	1 3/8	1 5/8	1 5/8		1 3/8	1 5/8	2 1/8	2 1/8		4.00	48000
60000	5.00	1 1/8	1 3/8	1 3/8	1 3/8		1 3/8	1 5/8	1 5/8	1 5/8		1 5/8	2 1/8	2 1/8	2 1/8		5.00	60000
92000	7.50	1 1/8	1 3/8	1 3/8	1 5/8		1 3/8	1 5/8	2 1/8	2 1/8		1 5/8	2 1/8	2 1/8	2 1/8		7.50	92000
120000	10.00	1 3/8	1 5/8	1 5/8	1 5/8	N/A	1 5/8	2 1/8	2 1/8	2 1/8	N/A	2 1/8	2 1/8	2 5/8	2 5/8	N/A	10.00	120000
150000	12.50	1 5/8	1 5/8	2 1/8	2 1/8		2 1/8	2 1/8	2 5/8	2 5/8		2 1/8	2 5/8	2 5/8	2 5/8		12.50	150000
180000	15.00	1 5/8	2 1/8	2 1/8	2 1/8		2 1/8	2 5/8	2 5/8	2 5/8		2 5/8	3 1/8	3 1/8	3 1/8		15.00	180000
240000	20.00	2 1/8	2 1/8	2 5/8	2 5/8		2 5/8	2 5/8	3 1/8	3 1/8		2 5/8	3 1/8	3 5/8	3 5/8		20.00	240000
300000	25.00																25.00	300000
360000	30.00																30.00	360000
420000	35.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	35.00	420000
480000	40.00																40.00	480000
540000	45.00																45.00	540000
600000	50.00																50.00	600000

- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of -60°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of -20°F.



The miracles of science™

Suva®  
refrigerants

## SUVA 95 REFRIGERANT PIPING GUIDE

System Capacity BTU/Hr	System Capacity Tons/Hr	DISCHARGE LINE SIZE COMPRESSOR TO CONDENSER 1F° (3.2 psi) pressure drop maximum					LIQUID CONDENSATE LINE CONDENSER TO RECEIVER Condensate drain / vent					LIQUID LINE SIZE RECEIVER TO TXV 1F° (3.4 psi) pressure drop maximum					System Capacity Tons/Hr	System Capacity BTU/Hr
		Equivalent Line Lengths (feet)																
		25	50	75	100	150	25	50	75	100	150	25	50	75	100	150		
18000	1.50	1/2	5/8	5/8	5/8		1/2	1/2	1/2	1/2		3/8	3/8	3/8	3/8		1.50	18000
24000	2.00	5/8	3/4	3/4	3/4		1/2	1/2	5/8	5/8		3/8	3/8	1/2	1/2		2.00	24000
30000	2.50	5/8	3/4	7/8	7/8	N/A	5/8	5/8	5/8	5/8	N/A	1/2	1/2	1/2	1/2	N/A	2.50	30000
36000	3.00	3/4	3/4	7/8	7/8		5/8	5/8	5/8	3/4		1/2	1/2	1/2	5/8		3.00	36000
42000	3.50	3/4	7/8	7/8	1 1/8		5/8	5/8	3/4	3/4		1/2	1/2	5/8	5/8		3.50	42000
48000	4.00	3/4	7/8	1 1/8	1 1/8		5/8	5/8	3/4	3/4		1/2	1/2	5/8	5/8		4.00	48000
60000	5.00	7/8	1 1/8	1 1/8	1 1/8		5/8	3/4	3/4	3/4		1/2	5/8	5/8	5/8		5.00	60000
92000	7.50	7/8	1 1/8	1 1/8	1 1/8		5/8	3/4	3/4	7/8		1/2	5/8	5/8	3/4		7.50	92000
120000	10.00	1 1/8	1 1/8	1 3/8	1 3/8	N/A	3/4	7/8	7/8	7/8	N/A	5/8	3/4	3/4	3/4	N/A	10.00	120000
150000	12.50	1 1/8	1 3/8	1 3/8	1 5/8		7/8	7/8	1 1/8	1 1/8		3/4	3/4	7/8	7/8		12.50	150000
180000	15.00	1 3/8	1 5/8	1 5/8	2 1/8		7/8	1 1/8	1 3/8	1 3/8		3/4	7/8	1 1/8	1 1/8		15.00	180000
240000	20.00	1 5/8	2 1/8	2 1/8	2 1/8		1 1/8	1 3/8	1 3/8	1 3/8		7/8	1 1/8	1 1/8	1 1/8		20.00	240000
300000	25.00																25.00	300000
360000	30.00																30.00	360000
420000	35.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	35.00	420000
480000	40.00																40.00	480000
540000	45.00																45.00	540000
600000	50.00																50.00	600000

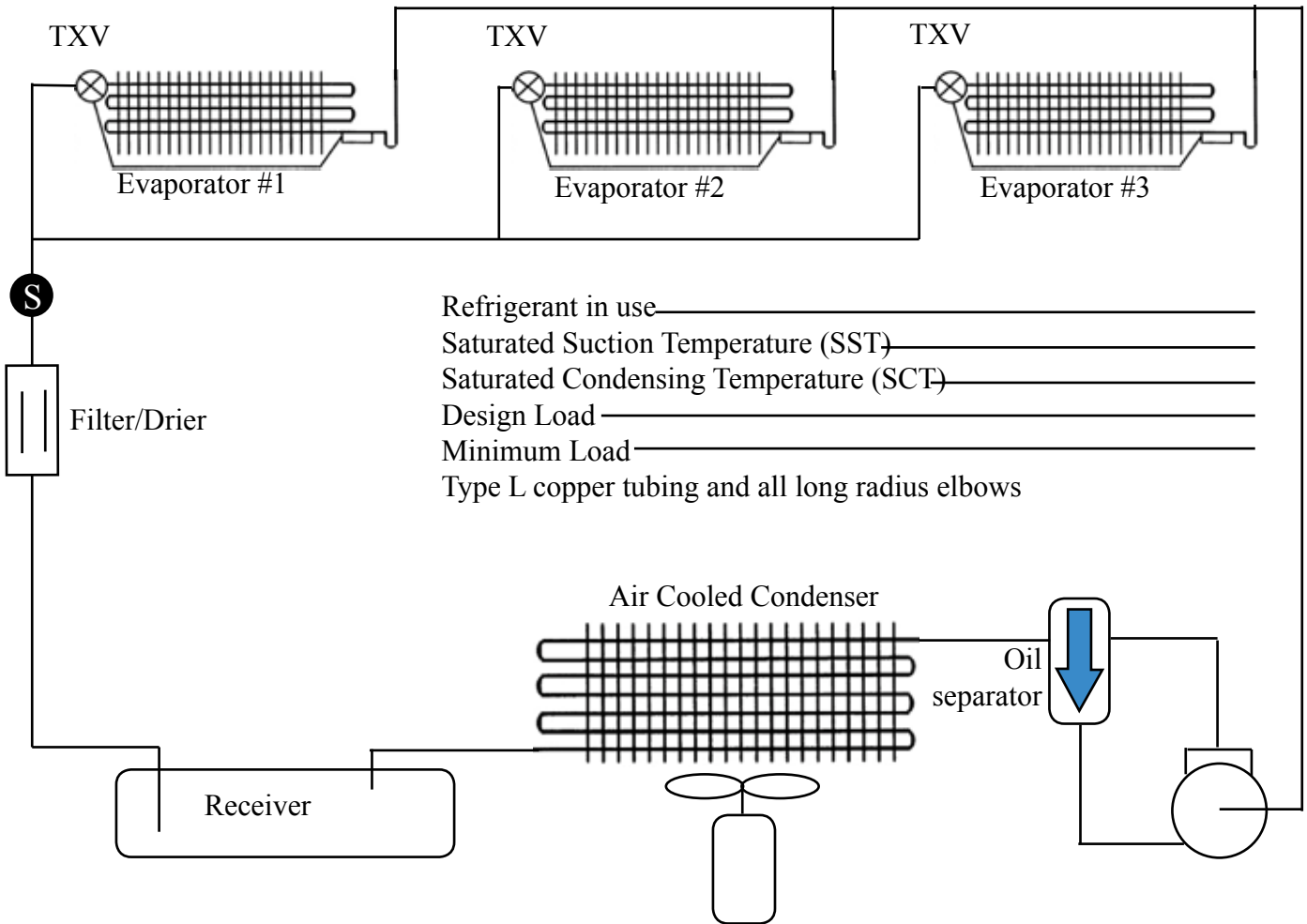
- \* Refer to DuPont Refrigerant Expert, Version 2.0 for actual velocities and pressure drops.
- \* Equivalent length is actual length plus friction losses caused by fittings and accessories.
- \* Line sizes are expressed in outside diameter of type "L" copper tubing.
- \* Line sizes are calculated at rated full load system capacity.
- \* All selections are based on a maximum of -60°F return gas entering the compressor and a refrigerant condensing and liquid line temperature of -20°F.



The miracles of science™

Suva®  
refrigerants

# TYPICAL REFRIGERATION PIPING SCHEMATIC



Vapour Lines equivalent lengths;  
 Suction line: H \_\_\_\_, V \_\_\_\_, R \_\_\_\_ / \_\_\_\_  
 Discharge line: H \_\_\_\_, V \_\_\_\_, R \_\_\_\_ / \_\_\_\_  
 Hot Gas Defrost line: H \_\_\_\_, V \_\_\_\_

Liquid Line equivalent lengths;  
 Liquid line: H \_\_\_\_, V \_\_\_\_, R \_\_\_\_ / \_\_\_\_

Note: H is horizontal, V is vertical, R is riser



The miracles of science™

Suva®  
refrigerants

# EQUIVALENT LENGTHS OF NONFERROUS VALVES AND FITTINGS

## EQUIVALENT LENGTH IS EXPRESSED IN FEET OF PIPE

Line Size OD	Glove / Solenoid Valve	Angle / Check Valve	90° SR Elbow	90° LR Elbow	45° Elbow	Tee Line / Sight Glass	Tee Branch
1/2	9	5	1.4	0.9	0.4	0.6	2.0
5/8	12	6	1.5	1.0	0.5	0.8	2.5
3/4	14	7	1.9	1.3	0.6	0.9	3.0
7/8	15	8	2.3	1.5	0.7	1.0	3.5
1 1/8	22	12	2.7	1.8	0.9	1.5	4.5
1 3/8	28	15	3.6	2.4	1.2	1.8	6.0
1 5/8	35	17	4.2	2.8	1.4	2.0	7.0
2 1/8	45	22	5.9	3.9	1.8	3.0	10.0
2 5/8	51	26	6.9	4.6	2.2	3.5	12.0
3 1/8	65	34	7.7	5.5	2.7	4.5	15.0
3 5/8	80	40	9.8	6.5	3.0	5.0	17.0

Mueller Brass Co. Data

## MAXIMUM SPACING BETWEEN PIPE SUPPORTS FOR COPPER TUBING

3 5/8 Nominal (OD) Diameter	Maximum Span in Feet
5/8	5
7/8	6
1 1/8	7
1 3/8	8
1 5/8	9
2 1/8	10
2 5/8	11
3 1/8	12
3 5/8	13
4 1/8	14

1967 ASHRAE Guide and Data Book

① Maximum allowable hanger distance as per CSA B52 code.

Note: Generally accepted industry practice for determining the equivalent lengths for both P traps and U bends is to add two 90° LR elbows of the specific OD tubing size for each component used.



The miracles of science™

Suva®  
refrigerants

## REFRIGERANT PIPING COPPER TUBING SPECIFICATIONS

NOMINAL (OD) DIAMETER	TYPE	DIAMETER		FLOW AREA SQUARE INCHES	WEIGHT LB/LINEAR FOOT
		OD INCHES	ID INCHES		
3/8	K	0.375	0.305	0.073	0.145
	L	0.375	0.315	0.078	0.126
1/2	K	0.500	0.402	0.127	0.269
	L	0.500	0.430	0.145	0.198
5/8	K	0.625	0.527	0.218	0.344
	L	0.625	0.545	0.233	0.285
3/4	K	0.750	0.652	0.334	0.418
	L	0.750	0.666	0.348	0.362
7/8	K	0.875	0.745	0.436	0.641
	L	0.875	0.785	0.484	0.455
1 1/8	K	1.125	0.995	0.778	0.839
	L	1.125	1.025	0.825	0.655
1 3/8	K	1.375	1.245	1.22	1.040
	L	1.375	1.265	1.26	0.884
1 5/8	K	1.625	1.481	1.72	1.36
	L	1.625	1.505	1.78	1.14
2 1/8	K	2.125	1.959	3.01	2.06
	L	2.125	1.985	3.10	1.75
2 5/8	K	2.625	2.435	4.66	2.93
	L	2.625	2.465	4.77	2.48
3 1/8	K	3.125	2.907	6.64	4.00
	L	3.125	2.945	6.81	3.33
3 5/8	K	3.625	3.385	9.00	5.12
	L	3.625	3.425	9.21	4.29
4 1/8	K	4.125	3.557	11.7	6.51
	L	4.125	3.905	12.0	5.38

Based on ASTM B-88 standard



*The miracles of science™*

**Suva®**  
refrigerants

## REFRIGERANT PIPING EXPANSION AND CONTRACTION

All refrigeration piping materials are subject to changes in temperature, and will expand and contract with temperature change. Installation techniques must allow for expansion and contraction changes. This will prevent stresses which may buckle and rupture the copper tube or joints.

The average coefficient of expansion of copper is 0.0000104 inch/per inch/per °F. Copper tubing will expand about 1¼ inches per 100 feet per 100F° change in temperature. For example, a copper line 75 feet long is used to carry hot discharge refrigerant vapour at 225°F to the systems condenser. The change in temperature could be 155°F, that is 225 - 70 (room ambient). The expected expansion on this application could very well be **75 x 12 x 0.0000104 x 155 = 1.451** or 1.5 inches.

There are two common methods of taking care of expansion and contraction in copper lines used in the refrigeration industry. These are the use of “expansion loops” or “pipe offsets”. See **Figures 1** and **2** for specifics on these two methods.

In the installation of expansion loops, the expansion member should be “cold sprung” approximately half the estimated travel expected. In this manner the bend is subject to only about half of the stress when the line is at the highest temperature than it would be if the loop were installed in its natural position.

Care must be taken during installation of lines to maintain perfect alignment; if not, there will be a tendency for lines to bow, and possibly buckle or rupture, particularly on the smaller sizes.

It is often possible to provide for expansion by offsetting the pipe line rather than to continue in a straight line. This method can be used only where there is plenty of space available. A single offset using two 90° elbows should have a minimum length of not less than three times the radius required in an expansion loop. The legs of the offset should not be spaced less than two times the radius from each other. See **Figure 2**. This method is just as effective as expansion loops, and can be made on the job. See **Table 1** for fabrication details. Offsetting by means of long radius allows the installer to vary the length to suit the job. Due to the amount of labour involved in the fabrication of expansion loops, they are considered more expensive than offsets made up on the job.

So far, we have referred only to main lines in general; these are usually thought of as horizontal. Vertical lines or risers must also be considered in the same manner. Risers should have adequate support at or near the bottom. Where branch lines to fixtures are taken off, they should be sufficiently long to take care of any movement in the main.

Rigid fixtures should never be directly connected to risers. One or two turns or elbows in the line will take care of the short branches. Copper tubing may not break as readily, but if continually subjected to strain and bending, it will ultimately fail. Designers and contractors must always keep the matter of expansion and contraction in mind.

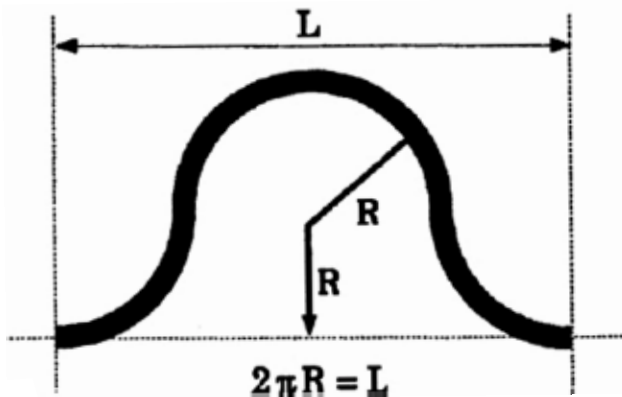


The miracles of science™

**Suva**  
refrigerants

## REFRIGERANT PIPING EXPANSION AND CONTRACTION

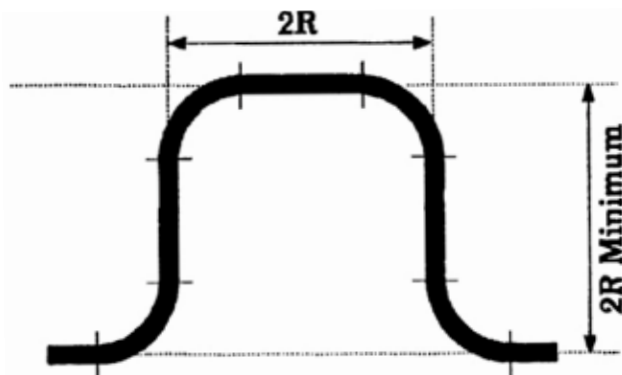
**FIGURE 1  
EXPANSION LOOP (U-BEND)**



Note:

1. All radii are referenced to the centre line of pipe
2. "L" length of pipe is referenced to the total length measured along the centre line of the bent pipe

**FIGURE 2  
OFFSET AND RETURN**



Offset with four (4) 90° LR elbows

**Note:** bracket supports should be within six inches of a change of direction and opposite the source of vibration.

A freezer operating at a SST of -30°F and 100 feet from the mechanical room which is 70°F, the compressor discharge temperature is 225°F and the condenser is 75 feet away.

Suction "shrinkage" is:

$$0.0000104 \times 12 \times 100 \times 100 = 1.248 \text{ or } 1\frac{1}{4} \text{ inches}$$

Discharge expansion is:

$$0.000104 \times 12 \times 75 \times 155 = 1.451 \text{ or } 1\frac{1}{2} \text{ inches}$$

Total expansion and contraction movement in this freezer application would be:

$$1\frac{1}{4} + 1\frac{1}{2} = 2\frac{3}{4} \text{ inches}$$

The installation and servicing contractor must be aware of the potential problems that could arise if these factors are not taken into consideration in the original installation.

Note example:

$$\text{Suction} = 0.0000104/\text{inch} \times 12" \times 100 \text{ feet} \times \Delta 100^\circ\text{F} = 1.248 \text{ inches}$$

**TABLE 1**

TUBE OD	RADIUS - R - INCH				For travel of...		
	1/2"	1"	1 1/2"	2"	2 1/2"	3"	4"
7/8	10	15	19	22	25	27	30
1 1/8	11	16	20	24	27	29	33
1 3/8	11	17	21	26	29	32	36
1 5/8	12	18	23	28	31	35	-
2 1/8	14	20	25	31	34	-	-
2 5/8	16	22	27	32	-	-	-
3 1/8	18	24	30	34	-	-	-
4 1/8	20	28	34	-	-	-	-

Bends can be made from 20 feet or less of tubing.



The miracles of science™

Suva®  
refrigerants

## WEIGHT OF REFRIGERANT IN COPPER TUBING POUNDS PER 100 FEET OF TYPE K AND L TUBING

Weight at 77°F / 25°C

TUBE OD (2)	FLOW AREA SQ IN	CUBIC FEET PER 100 FEET	R12		R22		R500		R502		R134A		R401A		R402A		R404A		R407C		R410A		
			81.84	2.32	74.53	2.76	72.16	2.29	75.95	4.16	75.28	2.02	74.52	1.81	71.86	4.32	65.45	4.00	70.81	2.62	66.32	4.12	
			L(1)	V	L	V	L	V	L	V	L	V	L	V	L	V	L	V	L(3)	V	L	V	L
1/2	K	0.127	0.088	7.2	0.20	6.6	0.24	6.4	0.20	6.7	0.37	6.6	0.18	6.6	0.16	6.3	0.38	5.8	0.35	6.2	0.23	5.8	0.36
	L	0.145	0.101	8.3	0.23	7.5	0.28	7.3	0.23	7.7	0.42	7.6	0.20	7.5	0.18	7.3	0.44	6.6	0.40	7.2	0.26	6.7	0.42
5/8	K	0.218	0.151	12.4	0.35	11.3	0.42	10.9	0.35	11.5	0.63	11.4	0.31	11.3	0.27	10.9	0.65	9.9	0.60	10.7	0.40	10.0	0.62
	L	0.233	0.162	13.3	0.38	12.1	0.45	11.7	0.37	11.7	0.67	12.2	0.37	12.1	0.29	11.6	0.70	10.6	0.65	11.5	0.42	10.7	0.67
3/4	K	0.334	0.232	19.0	0.54	17.3	0.64	16.7	0.53	17.6	0.97	17.5	0.47	17.3	0.42	16.7	1.00	15.2	0.93	16.4	0.61	15.4	0.96
	L	0.348	0.242	19.8	0.56	18.0	0.67	17.5	0.55	18.4	1.01	18.2	0.49	18.0	0.44	17.4	1.05	15.8	0.97	17.1	0.63	16.0	1.00
7/8	K	0.436	0.303	24.8	0.70	22.6	0.84	21.9	0.69	23.0	1.26	22.8	0.61	22.6	0.55	21.8	1.31	19.8	1.21	21.5	0.79	20.1	1.25
	L	0.484	0.336	27.5	0.78	25.0	0.93	24.2	0.77	25.5	1.40	25.3	0.68	25.0	0.61	24.1	1.45	22.0	1.34	23.8	0.88	22.3	1.38
1 1/8	K	0.778	0.540	44.2	1.25	40.2	1.49	39.0	1.24	41.0	2.25	40.7	1.09	40.2	0.98	38.8	2.33	35.3	2.16	38.2	1.41	35.8	2.22
	L	0.825	0.573	46.9	1.33	42.7	1.58	41.3	1.31	43.5	2.38	43.1	1.16	42.7	1.04	41.2	2.48	37.5	2.29	40.7	1.50	38.0	2.36
1 3/8	K	1.217	0.845	69.2	1.96	63.0	2.33	61.0	1.94	64.2	3.52	63.6	1.71	63.0	1.53	60.7	3.65	55.3	3.38	59.8	2.21	56.0	3.48
	L	1.257	0.873	71.4	2.03	65.1	2.41	63.0	2.00	66.3	3.63	65.7	1.76	65.1	1.58	62.7	3.77	57.1	3.49	61.8	2.29	57.8	3.60
1 5/8	K	1.723	1.197	97.9	2.78	89.2	3.30	86.4	2.74	90.9	5.00	90.1	2.42	89.2	2.17	86.0	5.17	78.3	4.79	84.7	3.14	79.4	4.93
	L	1.779	1.235	100.1	2.87	92.0	3.41	89.1	2.82	93.8	5.14	93.0	2.49	92.0	2.24	88.7	5.33	80.8	4.94	87.4	3.24	81.9	5.09
2 1/8	K	3.014	2.093	171.3	4.86	156.0	5.78	151.0	4.79	159.0	8.71	157.6	4.23	156.0	3.79	150.4	9.04	137.0	8.37	148.2	5.48	138.8	8.62
	L	3.095	2.149	175.9	4.99	160.2	5.93	155.1	5.93	163.2	8.94	161.8	4.34	160.1	3.89	154.4	9.28	140.7	8.60	152.1	5.63	142.5	8.85
2 5/8	K	4.657	3.234	264.7	7.50	241.0	8.93	233.4	7.41	245.6	13.45	243.5	6.53	241.0	5.85	232.4	13.97	211.7	12.94	229.0	8.47	214.4	13.32
	L	4.772	3.314	271.2	7.69	247.0	9.15	239.1	7.59	251.7	13.79	249.5	6.69	247.0	6.00	238.0	14.32	216.9	13.26	234.6	8.68	219.8	13.65
3 1/8	K	6.637	4.609	377.2	10.70	343.5	12.72	332.6	10.55	350.1	19.17	347.0	9.31	343.5	8.34	331.2	19.90	301.7	18.43	326.3	12.10	305.7	18.99
	L	6.812	4.731	387.2	10.98	352.6	13.06	341.4	13.06	359.3	19.68	356.1	9.56	352.6	8.56	340.0	20.43	309.6	18.92	345.0	12.40	313.8	19.49
3 5/8	K	8.999	6.249	511.4	14.50	465.7	17.25	450.9	14.31	474.6	25.99	470.4	12.62	465.7	11.31	449.1	26.99	409.0	25.00	442.4	16.37	414.4	25.75
	L	9.213	6.398	523.6	14.84	476.8	17.66	461.7	14.65	485.9	26.62	481.6	12.92	476.8	11.58	459.8	27.64	418.7	25.59	453.0	16.76	424.3	26.36
4 1/8	K	11.684	8.114	664.0	18.82	604.7	22.39	585.5	18.58	616.3	33.75	610.8	16.39	604.7	14.68	583.1	35.10	531.1	32.46	547.5	21.26	538.1	33.43
	L	11.977	8.317	680.7	19.30	619.9	22.95	600.2	19.05	631.7	34.60	626.1	16.80	619.8	15.05	597.7	35.93	544.3	33.27	588.8	21.79	551.6	34.27

Notes: (1) L = saturated liquid and density, V = saturated vapour and density.  
 (2) Copper tubing as per ASTM - B88.  
 (3) For R507 use R404A values.





The miracles of science™

Suva®  
refrigerants

**REFRIGERANT RECEIVERS**  
**R22 CAPACITIES AT 90°F AND 90% FULL**

Density of R22 at 90°F is 72.71 lb per cubic foot.

**VERTICAL RECEIVERS**  
**R22 CAPACITY IN POUNDS**

DIAMETER		LENGTH	=	POUNDS
3.5	x	7.5	=	2
3.5	x	10	=	3
4	x	10	=	4
5	x	10	=	6
5	x	20	=	13
6	x	12	=	10
6	x	18	=	16
6	x	24	=	22
6	x	30	=	28

Note: Diameter and length are in inches.

**HORIZONTAL RECEIVERS**  
**R22 CAPACITY IN POUNDS**

DIAMETER		LENGTH	=	POUNDS
5	x	28	=	18
6	x	30	=	28
6	x	36	=	34
6 5/8	x	38	=	43
7 5/8	x	28	=	41
8 5/8	x	28	=	53
8 5/8	x	36	=	69
8 5/8	x	42	=	81
8 5/8	x	48	=	93
8 5/8	x	60	=	117
9 3/4	x	22	=	51
10 3/4	x	36	=	105
10 3/4	x	48	=	142
10 3/4	x	60	=	179
10 3/4	x	72	=	216
10 3/4	x	96	=	290
12 3/4	x	48	=	196
12 3/4	x	60	=	248
12 3/4	x	72	=	299
12 3/4	x	96	=	404
14	x	72	=	363
14	x	96	=	489
16	x	60	=	388
16	x	72	=	470
16	x	96	=	633
18	x	72	=	597
20	x	72	=	736
20	x	84	=	866
20	x	96	=	996

Note: Diameter and length are in inches.

For alternate refrigerant storage capacities in pounds for R22 rated receivers, multiply rated capacity by the following conversion factors:

REFRIGERANT	FACTOR	REFRIGERANT	FACTOR
R22	1.0000	R402B	0.9433
R123	1.2405	R404A	0.8682
R124	1.1425	R407C	0.9473
R134A	1.0114	R408A	0.8853
R401A	0.9927	R409A	1.0278
R401B	0.9920	R410A	0.8794
R402A	0.9293	R507	0.8674

Example: A receiver measuring 12<sup>3</sup>/<sub>4</sub>" x 72" has a R22 rated capacity of 299 lb. What is its revised capacity if this receiver is used with R407C?

$$299 \text{ lb} \times 0.9473 = 283 \text{ lb}$$

Notes: Receivers capacities source - Standard Refrigeration Company.  
All dimensions are expressed in inches and all weights are expressed in pounds.  
Densities sourced from E.I. DuPont Thermodynamic Tables.  
R507 - AlliedSignal Inc. computer program.  
R408A and R409A - Elf Atochem computer program.



The miracles of science™

Suva®  
refrigerants

# TEMPERATURE / PRESSURE CHART COMPLETE RANGE OF TEMPERATURE APPLICATIONS

## HIGH, MEDIUM AND LOW TEMPERATURE APPLICATIONS

## VERY LOW TEMPERATURE APPLICATIONS

°F	R12	R22	R502	R134A	R404A		R407C		R410A	R507	°C
-50	16"	7"	0	19"	1	0	3"	11"	6	1	-46
-45	14"	3"	2	17"	4	3	1	8"	9	3	-43
-40	11"	0	9	15"	5	5	3	5"	12	6	-40
-35	9"	2	4	13"	8	7	5	1"	15	8	-37
-30	6"	5	7	10"	11	10	8	1	19	11	-34
-25	2"	7	12	7"	14	13	10	4	23	15	-32
-20	1	10	15	4"	17	16	14	6	28	18	-29
-15	2	13	19	0	21	20	17	9	32	22	-26
-10	5	16	22	2	25	24	21	12	38	26	-23
-5	5	20	27	4	29	28	25	15	44	31	-21
0	9	24	31	7	34	33	29	19	50	35	-18
5	12	28	36	9	39	38	34	23	57	41	-15
10	15	33	41	12	45	44	39	27	64	46	-12
15	18	38	46	15	51	49	44	32	72	52	-9
20	21	43	52	19	57	56	50	37	80	59	-7
25	25	49	59	22	64	63	57	43	89	66	-4
30	29	55	66	26	71	70	64	48	99	73	-1
35	33	62	73	31	79	78	71	55	109	81	2
40	37	69	81	35	87	86	79	62	121	90	4
45	42	76	89	40	96	95	87	69	132	99	7
50	47	84	98	46	106	104	96	77	145	108	10
55	52	93	107	52	116	114	106	86	158	119	13
60	57	102	117	58	126	125	116	95	173	129	16
65	64	111	127	64	138	136	127	104	188	141	18
70	70	122	138	71	150	148	139	115	204	153	21
75	77	132	149	79	162	160	151	126	221	166	24
80	84	144	161	87	176	177	163	138	238	180	27
85	92	156	174	95	190	188	177	150	257	194	29
90	100	168	187	104	205	203	191	164	277	210	32
95	108	182	201	114	220	218	206	178	298	226	35
100	117	196	216	124	237	235	222	193	320	243	38
105	127	210	232	135	254	252	239	209	344	261	41
110	136	226	248	146	273	271	257	225	368	280	43
115	147	242	265	158	292	290	275	243	394	300	46
120	158	260	282	171	312	310	294	262	421	322	49
125	169	278	301	184	333	331	315	282	445	344	52
130	181	296	321	199	355	353	336	302	479	368	54
135	193	316	341	213	378	377	358	324	510	392	57
140	207	337	363	229	403	401	381	347	543	418	60
145	220	359	385	246	428	422	405	372	577	446	63

°F	R13	R503	R508B	°C
-200	-	-	-	-129
-195	-	-	-	-126
-190	-	-	-	-123
-185	-	-	-	-121
-180	-	-	-	-118
-175	-	-	-	-115
-170	-	-	-	-112
-165	-	-	-	-109
-160	-	-	-	-107
-155	-	-	-	-104
-150	-	16"	18"	-101
-145	-	13"	15"	-98
-140	-	10"	12"	-96
-135	-	6"	8"	-93
-130	-	2"	4"	-90
-125	9"	1	0	-87
-120	5"	4	3	-87
-115	1"	7	6	-82
-110	2	10	9	-79
-105	5	13	13	-76
-100	7	17	17	-73
-95	11	22	21	-71
-90	14	26	26	-68
-85	18	32	32	-66
-80	23	38	38	-62
-75	27	44	45	-59
-70	32	51	52	-57
-65	38	58	60	-54
-60	44	67	68	-51
-55	51	75	77	-48
-50	58	85	87	-46
-45	65	95	98	-43
-40	74	107	110	-40
-35	82	119	122	-37
-30	92	132	135	-34
-25	102	146	150	-32
-20	113	160	165	-29
-15	124	176	181	-26
-10	136	193	198	-23
-5	149	211	217	-21

Note: Pressure / °C temperature values are rounded off to the nearest whole number, and the values are expressed in PSIG or inches Hg.

**ESTIMATED COOLING  
REQUIREMENTS  
SQUARE FEET PER TON**

APPLICATION	AVERAGE LOAD
Residential	600
Banks	240
Barber	250
Bars and Taverns	9*
Beauty	180
Churches	20*
Department Stores	
Basement	350
Main Floor	300
Upper Floor	400
Dress	280
Drug	150
Groceries / Supermarket	250
Hospital Room	280
Hotels / Public Spaces	220
Jewelry	220
Office Building	340
Office - Small Suite	280
Restaurant	200
Shoe	220
Theatres and Auditoriums	20*
Variety	220
*Person per Ton	

1 ton = 12,000 BTU per hour  
 1 gallon water = 10 pounds  
 1 pound = 7,000 grains  
 1 watt = 3.42 BTU per hour  
 1 kilowatt = 1,000 watts  
 1 HP = 746 watts  
 1 hp = 2,545 BTU per hour  
 $C^{\circ} = 5/9 \times (F^{\circ} - 32^{\circ})$   
 $F^{\circ} = 9/5 \times (C^{\circ} + 32^{\circ})$   
 No air changes (N) =  $\frac{60 \times \text{CFM}}{\text{cubic feet}}$

$$\text{CFM} = \frac{N \times \text{cubic feet}}{60}$$

$$\text{Motor efficiency} = \frac{\text{HP} \times 746 \times 100\%}{\text{KW input} \times 1000}$$

$$\text{SHR} = \frac{\text{sensible heat (BTU/hour)}}{\text{CFM} \times 1.08 \text{ (BTU/hour)}}$$

$$\Delta\text{TD} = \frac{\text{sensible heat}}{\text{CFM} \times 1.08}$$

$$\text{SH BTU/hour} = \text{CFM} \times 1.08 \times \Delta\text{TD}$$

$$\text{LH BTU/hour} = \text{CFM} \times 0.68 \times \text{GR/\#AIR}$$

$$\text{BTU} = \text{GPM} \times 500 \times \text{TD}$$

$$\text{Converter area} = \left( \frac{\text{BTU/hour}}{U \times \text{LMTD}} \right)$$

$$\text{Foot head} = 2.31 \times \text{pounds}$$

$$1 \text{ EDR} = 240 \text{ BTU}$$

$$\text{One boiler HP} = 33,479 \text{ BTU per hour}$$

$$\text{Pump efficiency \%} = \frac{\text{GPM} \times 8.3 \times \text{foot head}}{\text{BHP} \times 33,000}$$

$$\text{Tons R22} = \text{tons R12} \times 1.61$$

$$\text{BHP R22} = \text{BHP R12} \times 1.48$$

**WATER REQUIREMENTS FOR  
CONDENSING UNITS**

**CITY WATER  
TONS REFRIGERATION X 1.5 = GPM**

**COOLING TOWER  
TONS REFRIGERATION X 3.0 = GPM**

**AIR REQUIREMENTS FOR AIR COOLED  
CONDENSER REFRIGERATION:**

**750 CFM PER HP, 1000 CFM PER TON**

**AIR CONDITIONING:**

**1000 CFM PER HP, 1000 CFM PER TON**

DIRECT CURRENT	SINGLE PHASE ALTERNATING CURRENT	THREE PHASE ALTERNATING CURRENT
$E = IR$	$E = IR$	$E = IR$
$I = \frac{E}{R}$	$I = \frac{E}{R}$	$I = \frac{E}{R}$
$P = EI$	$P = EI \times \text{PF}$	$P = EI \times \text{PF} \times 1.732$
	$\text{PF} = \frac{P}{EI}$	$\text{PF} = \frac{P}{EI \times 1.732}$
<b>E = Volts</b>	<b>I = Current (Amps)</b>	<b>R = Resistance (Ohms)</b>
	<b>P = Power (Watts)</b>	<b>PF = Power Factor</b>

# DETERMINING SIZE AND SPEED OF PULLEYS OR GEARS AND BELT LENGTHS

## DRIVING PULLEY - DRIVER

## DRIVEN PULLEY - DRIVEN

- To determine the diameter of the DRIVER, the revolutions and diameter of the DRIVEN, and revolutions of the DRIVER:

$$\frac{\text{diameter of DRIVEN} \times \text{revolutions of DRIVEN}}{\text{revolutions of DRIVER}} = \text{diameter of DRIVER}$$

- To determine the diameter of the DRIVEN, the revolutions and diameter of the DRIVER, and revolutions of the DRIVER:

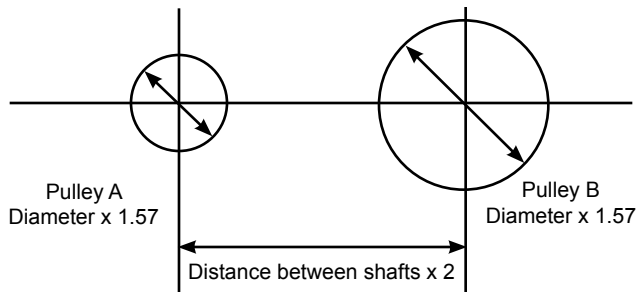
$$\frac{\text{diameter of DRIVER} \times \text{revolutions of DRIVER}}{\text{revolutions of DRIVEN}} = \text{diameter of DRIVEN}$$

- To determine the revolutions of the DRIVER, the revolutions and diameter of the DRIVEN, and diameter of the DRIVER:

$$\frac{\text{diameter of DRIVEN} \times \text{revolutions of DRIVEN}}{\text{diameter of DRIVER}} = \text{revolutions of DRIVER}$$

- To determine the revolutions of the DRIVEN, the revolutions and diameter of the DRIVER, and diameter of the DRIVEN:

$$\frac{\text{diameter of DRIVER} \times \text{revolutions of DRIVER}}{\text{diameter of DRIVEN}} = \text{revolutions of DRIVEN}$$



### BELT LENGTH FORMULA

$$\begin{aligned} & \text{Pulley A} \times 1.57 \\ & + \text{Pulley B} \times 1.57 \\ & + \text{distance between shafts} \times 2 \\ \hline & = \text{OD BELT LENGTH} \end{aligned}$$

### BLOWER TIPS

### BLOWER SPEED FORMULA

$$\text{Blower RPM} = \frac{\text{Motor Pulley P.D.}}{\text{Blower Pulley P.D.}} \times \text{Motor RPM}$$

- Do not bench test a blower at free air, as it will overload the motor
- If you double the RPM of a fan or blower, you would get twice the CFM, four times the SP and require 8 times the HP
- When giving dimensions of a wheel, the first dimension is the diameter, and the second is the width
- To specify rotation: double inlet wheel is viewing hub side, and single inlet wheel is viewing back plate







## EMERGENCY SERVICE CONTACT INFORMATION

ISC Partner	Email	ISC Partner	Email
-------------	-------	-------------	-------

### Calgary: 403.214.2134

<b>Dene Flahr</b>	<b>dflahr@isc.tv</b>	Vince Larsen	vlarsen@isc.tv
Anthony Cegielnik	acegielnik@isc.tv	Joe McIntyre	jmcintyre@isc.tv
Robert Grieve	rgrieve@isc.tv	Jeff Weber	jweber@isc.tv
Kent Iwaskiw	kiwaskiw@isc.tv		

### Edmonton: 780.451.4744

<b>Brian Pampu</b>	<b>bpampu@isc.tv</b>	Miles Nelson	mnelson@isc.tv
Doug Ade	dade@isc.tv	Cliff Osadchuk	cosadchuk@isc.tv
Jordan Arts	jarts@isc.tv	Dale Werner	dwerner@isc.tv
Joline Kuhn	jkuhn@isc.tv	Mike Wieschorster	mwieschorster@isc.tv

### Burnaby: 604.298.4472

<b>Glenn McCullough</b>	<b>gmccullough@isc.tv</b>	Tom Newmark	tnewmark@isc.tv
Ademar Andres	aandres@isc.tv	Jerry Schaab	jschaab@isc.tv
Rabin Kishore	rkishore@isc.tv	Marcel Silberman	msilberman@isc.tv
Wayne McCollum	wmccollum@isc.tv	Brian Yi	byi@isc.tv
Gary Monts	gmonts@isc.tv		

### Saskatchewan: 306.373.9227

Don Faris	dfaris@isc.tv		
-----------	---------------	--	--

### Kitchener: 519.748.0961

<b>Ken Desrosier</b>	<b>kdesrosier@isc.tv</b>	Tom Grant	tgrant@isc.tv
Phil Antunes	pantunes@isc.tv	Terri-Lynn McNeil	tmcneil@isc.tv
Dave Cushing	dcushing@isc.tv	Sam Otaki	sotaki@isc.tv

### St. Catharines: 905.988.1724

<b>Dave Sevcik</b>	<b>dsevcik@isc.tv</b>	Brandon Keel	bkeel@isc.tv
Jeff Dougall	jdougall@isc.tv	Jeff Zimmerman	jzimmerman@isc.tv
Aaron Garrett	agarrett@isc.tv		

### Windsor: 519.251.9925

<b>Tim Reid</b>	<b>treid@isc.tv</b>	Bill Pratt	bpratt@isc.tv
Ray Copeman	rcopeman@isc.tv		

### Ottawa: 613.742.0083

<b>Alain Brunet</b>	<b>abrunet@isc.tv</b>	Robert Lantaigne	rlantaigne@isc.tv
Louis Aivaliotis	laivaliotis@isc.tv	Jonathan Ritchot	jritchot@isc.tv

### North Bay: 705.476.0800

<b>Ray Spencer</b>	<b>rspencer@isc.tv</b>	Mark Spencer	mspencer@isc.tv
Yves Audette	yaudette@isc.tv		

### Headquarters: 604.298.4463

<b>Keith Werner</b>	<b>kwerner@isc.tv</b>	Johann Russell	jrussell@isc.tv
Mike Feedham	mfeedham@isc.tv	Rudy Wieschorster	rwieschorster@isc.tv
Ray Newstead	rnewstead@isc.tv		



**BURNABY, BC**

3030 Beta Avenue  
Burnaby, BC V5G 4K4  
24 HR Ph: (604) 298.4472  
BC Toll Free: 1.877.778.1818  
YVR Island Toll: 1.866.886.8858  
Interior BC Toll: 1.866.950.4853  
Fax: (604) 298.4288

**CALGARY, AB**

2280 Portland Street SE  
Calgary, AB T2G 4M6  
24 HR Ph: (403) 214.2134  
Toll Free: 1.877.212.2822  
Fax: (403) 214.2139

**EDMONTON, AB**

11418 - 120 Street  
Edmonton, AB T5G 2Y2  
24 HR Ph: (780) 451.4744  
Toll Free: 1.877.969.9979  
Fax: (780) 454.1072

**SASKATCHEWAN**

24 HR Ph: (306) 373.9227  
Toll Free: 1.877.969.9979  
Fax: (306) 374.7911

**HEADQUARTERS**

Ph: (604) 298.4463  
Fax: (604) 205.7162

[www.isc.tv](http://www.isc.tv)

**KITCHENER, ON**

186 Shoemaker Street  
Kitchener, ON N2E 3E1  
24 HR Ph: (519) 748.0961  
Toll Free: 1.866.300.4300  
Fax: (519) 748.2068

**ST. CATHARINES, ON**

Units 4, 5 & 6, 27 Seapark Drive  
St. Catharines, ON L2M 6S5  
24 HR Ph: (905) 988.1724  
Fax: (905) 988.5722

**WINDSOR, ON**

Unit 200, 3215 Jefferson Blvd  
Windsor, ON N8T 2W7  
24 HR Ph: (519) 251.9925  
Toll Free: 1.866.282.4472  
Fax: (519) 251.9930

**OTTAWA, ON**

Units 1-4, 1550 Liverpool Court  
Ottawa, ON K1B 4L2  
24 HR Ph: (613) 742.0083  
Toll Free: 1.866.896.4439  
Fax: (613) 742.0084

**NORTH BAY, ON**

Unit N, 600 Gormanville Road  
North Bay, ON P1B 9S7  
24 HR Ph: (705) 476.0800  
Toll Free: 1.888.266.1955  
Fax: (705) 476.2210