Klea® 134a Engineers Tables – British Units

1. Introduction

This is the first edition of Mexichem's Engineers' Tables for Klea® 134a. In these tables you'll find practical information to help you design or set up refrigeration systems using Klea®134a. We've tried to make the layout as easy as possible to use; where possible we've followed the existing conventions used in standard reference works. These tables are supplementary to the Physical Property Data Sheet for Klea® 134a and the booklets of Thermodynamic Property Data for Klea® 134a.

2. Temperature-Pressure Tables For Klea® 134a

The following simple guidelines explain which tables to use to obtain the relationships between the saturated liquid and vapor pressure and temperatures. We have tabulated the following data for you:

Table 1: Saturation pressure from temperature
Table 2: Saturation temperature from pressure
Tables 3-5: Maximum recommended suction line capacities for varying suction gas conditions
Table 6: Discharge line capacities
Table 7: Liquid line capacities
Table 8: Recommended minimum capacities for oil entrainment in suction lines
Table 9: Correction factors for use with the capacity tables at other conditions
Refrigerant Flowrate: A graphical correlation of refrigerant flowrate per unit capacity

3. Refrigerant Line Capacity Tables

3.1 Methods Used to Generate the Tables

The tables presented here have been developed using the methodology described in the ASHRAE Handbook: Refrigeration Systems and Applications (1994). The physical property data used to generate these tables are correlated in the Mexichem data sheets, thermodynamic tables, and date of issue January 1994. Pressure drop has been estimated using the Colebrook equation to obtain friction factors and the DarcyWeisbach equation for pressure drop.

Gas Compressibility Effects

In calculating the maximum capacity (flowrate) is has been assumed that the gas is incompressible. This is in line with the tables published in the ASHRAE handbook and for most systems this is perfectly adequate.

The assumption of incompressibility may, however, over-predict capacity if the total pressure drop is appreciable compared to the static pressure. The likely over-prediction will be in the region of 5-10% depending on the evaporator pressure and total line loss (including fittings loss).

Mexichem recommends that the pressure drop obtained for a line using these tables should be compared to the total pressure available; if it is greater than 5% of the static pressure then the compressibility may have some effect, and sizing should be made on that basis.

3.2 Suction Line Capacity Tables

These tables give capacities for cycles operating under the following conditions:
Condenser mean temperature 110°F.
Zero sub-cooling (i.e. liquid at bubble point).

Vapor leaving evaporator (i) saturated i.e. at dew point or (ii) superheated (superheat quoted in the table).
Evaporator temperatures quoted are true mean values.

The capacity for other liquid temperatures may be found using the tabulated correction factors given in Table 11. Note that the tables are referenced to a mean condenser of 110°F; the liquid temperature (bubble point) corresponding to this condition is quoted in the tables.

The tables quote capacity for pressure drops in the mean evaporating pressure equivalent to a drop in saturation temperature of 0.5°, 1° and 2°F in 100 feet pipe length. Data are presented for copper tubing, Type L, and Schedule 40 steel pipe with dimensions as given in the ASHRAE Handbook HVAC Systems and Equipment (1992).

The mass flowrate of refrigerant is also presented graphically as the flow in lb/hr required for a duty of 1 ton refrigeration over a range of evaporating temperatures and liquid temperatures.

3.3 Discharge Line Capacity Tables

These have been calculated on the following basis:
Condenser mean temperature of 110°F.
Zero sub-cooling i.e. liquid at bubble point.

Vapor leaves evaporator at dew point i.e. zero useful superheat.
Superheat at compressor discharge is (i) 80 or (ii) 110°F.
Evaporator temperatures are true mean values.

3.4 Liquid Line Capacity Tables

These are quoted for conditions of (i) 1.5 fps maximum velocity or (ii) 1 Fahrenheit drop in saturation temperature in 100 feet of pipe run. Use the velocity criterion for sizing self-venting lines.

3.5 Correcting for Other Temperature Drops Or Line Lengths

The suction capacity tables reference according to saturation temperature losses of 0.5°, 1° and 2°F in 100 feet pipe length. In order to correct the capacities for different values of temperature drop or line length, use the following equation:

$$\text{Capacity} = \text{Table Capacity} \times \left(\frac{\text{Required } \Delta T_e \times \text{Table } L_e}{\text{Table } \Delta T_e \text{ Required } L_e}\right)^{0.54}$$

where:
ΔT_e is the change in evaporating temperature
ΔL_e is the length of suction line

To evaluate the change in saturation temperature for differing capacities or line lengths, use the equation :

$$\text{Actual } \Delta T_e = \text{Table } \Delta T_e \times \left(\frac{\text{Actual } L_e}{\text{Table } L_e} \times \left[\frac{\text{Actual Capacity}}{\text{Table Capacity}}\right]\right)^{1.8}$$

Table 1: Saturation Pressure from Temperature – Klea® 134a

Temperature °F	Pressure psia	Temperature °F	Pressure psia	Temperature °F	Pressure psia
-40	7.43	22	34.53	84	107.73
-38	7.87	24	36.01	86	111.12
-36	8.34	26	37.53	88	114.82
-34	8.82	28	39.11	90	118.49
-32	9.33	30	40.73	92	122.25
-30	9.87	32	42.41	94	126.10
-28	10.42	34	44.13	96	130.04
-26	11.00	36	45.92	98	134.08
-24	11.61	38	47.75	100	138.21
-22	12.24	40	49.65	102	142.43
-20	12.90	42	51.59	104	146.75
-18	13.59	44	53.60	106	151.17
-16	14.31	46	55.67	108	155.69
-14	15.05	48	57.79	110	160.30
-12	15.83	50	59.98	112	165.03
-10	16.64	52	62.23	114	169.85
-8	17.48	54	64.55	116	174.78
-6	18.35	56	66.92	118	179.82
-4	19.26	58	69.37	120	184.97
-2	20.20	60	71.88	122	190.23
0	21.17	62	74.46	124	195.60
2	22.19	64	77.11	126	201.08
4	23.24	66	79.83	128	206.68
6	24.33	68	82.63	130	212.40
8	25.45	70	85.49	132	218.24
10	26.62	72	88.44	134	224.20
12	27.83	74	91.45	136	230.28
14	29.08	76	94.55	138	236.48
16	30.38	78	97.72	140	242.81
18	31.72	80	100.98		
20	33.10	82	104.31		

Table 2: Saturation Temperature from Pressure – Klea® 134a

Temperature °F	Pressure psia	Temperature °F	Pressure psia	Temperature °F	Pressure psia	Temperature °F	Pressure psia
14	-16.79	62	51.77	179	117.77	304	157.51
17	-9.11	65	54.37	182	118.95	311	159.33
20	-2.43	68	56.88	185	120.11	318	161.12
23	3.52	71	59.30	188	121.25	325	162.88
26	8.89	74	61.65	191	122.38	332	164.61
29	13.81	77	63.93	194	123.50	339	166.31
32	18.35	80	66.14	197	124.60	346	167.99
35	22.57	83	68.29	200	125.69	353	169.64
38	26.53	86	70.38	203	126.77	360	171.26
41	30.26	89	72.42	206	127.84	367	172.86
44	33.78	92	74.40	209	128.89	374	174.44
47	37.13	95	76.34	212	129.94	381	175.99
50	40.32	98	78.23	215	130.97	388	177.53
53	43.36	101	80.07	218	131.99	395	179.04
56	46.28	104	81.88	221	133.00	402	180.53
59	49.08	107	83.65	224	134.00	409	182.00
62	51.77	110	85.37	227	134.99	416	183.45
65	54.37	113	87.07	230	135.97	423	184.88
68	56.88	116	88.73	233	136.94	430	186.30
71	59.30	119	90.36	236	137.90	437	187.69
74	61.65	122	91.95	239	138.85	444	189.07
77	63.93	125	93.52	242	139.79	451	190.44
80	66.14	128	95.06	245	140.73		
14	-16.79	131	96.57	248	141.65		
17	-9.11	134	98.06	251	142.57		
20	-2.43	137	99.52	254	143.48		
23	3.52	140	100.95	257	144.38		
26	8.89	143	102.36	260	145.27		
29	13.81	146	103.76	263	146.15		
32	18.35	149	105.12	266	147.03		
35	22.57	152	106.47	269	147.89		
38	26.53	155	107.80	272	148.76		
41	30.26	158	109.11	275	149.61		
44	33.78	161	110.40	278	150.46		
47	37.13	164	111.67	281	151.30		
50	40.32	167	112.92	284	152.13		
53	43.36	170	114.16	287	152.95		
56	46.28	173	115.38	290	153.77		
59	49.08	176	116.58	297	155.66		

Table 3a: Suction Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Saturation temperature change 0.5°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	0.30	0.35	0.41	0.48	0.55
Type L Copper						
1/4		0.034	0.043	0.054	0.067	0.082
3/8		0.079	0.100	0.125	0.154	0.189
1/2		0.149	0.189	0.236	0.292	0.357
5/8		0.256	0.324	0.405	0.500	0.612
3/4		0.399	0.503	0.628	0.776	0.949
1		0.815	1.03	1.28	1.58	1.93
1-1/4		1.43	1.80	2.24	2.76	3.38
1-1/2		2.27	2.86	3.56	4.39	5.35
2		4.74	5.96	7.42	9.13	11.1
2-1/2		8.42	10.6	13.2	16.2	19.7
3		13.5	16.9	21.0	25.9	31.5
3-1/2		20.1	25.2	31.3	38.5	46.9
4		28.4	35.7	44.3	54.4	66.3
Schedule 40 Steel						
3/8		0.100	0.125	0.154	0.189	0.229
1/2		0.187	0.233	0.288	0.351	0.426
3/4		0.395	0.493	0.608	0.742	0.898
1		0.751	0.936	1.15	1.41	1.70
1-1/4		1.56	1.94	2.38	2.91	3.52
1-1/2		2.34	2.91	3.58	4.37	5.28
2		4.53	5.63	6.93	8.44	10.2
2-1/2		7.23	8.99	11.1	13.5	16.3
3		12.8	15.9	19.6	23.8	28.8
4		26.1	32.5	39.9	48.6	58.6

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 3b: Suction Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Saturation temperature change 1.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	0.59	0.7	0.82	0.96	1.11
Type L Copper						
1/4		0.050	0.064	0.080	0.098	0.121
3/8		0.116	0.147	0.184	0.227	0.278
1/2		0.220	0.278	0.347	0.429	0.525
5/8		0.378	0.477	0.594	0.734	0.897
3/4		0.586	0.739	0.922	1.14	1.39
1		1.20	1.51	1.88	2.31	2.82
1-1/4		2.09	2.63	3.28	4.04	4.93
1-1/2		3.32	4.18	5.20	6.40	7.80
2		6.92	8.70	10.8	13.3	16.2
2-1/2		12.3	15.4	19.1	23.5	28.7
3		19.6	24.6	30.6	37.6	45.7
3-1/2		29.3	36.7	45.5	55.9	68.0
4		41.3	51.8	64.3	78.9	96.0
Schedule 40 Steel						
3/8		0.144	0.18	0.222	0.271	0.327
1/2		0.268	0.334	0.412	0.503	0.608
3/4		0.567	0.706	0.869	1.06	1.28
1		1.08	1.34	1.65	2.01	2.43
1-1/4		2.22	2.76	3.40	4.14	5.00
1-1/2		3.34	4.15	5.11	6.22	7.51
2		6.46	8.02	9.86	12.0	14.5
2-1/2		10.3	12.8	15.7	19.1	23.1
3		18.2	22.6	27.8	33.9	40.9
4		37.2	46.2	56.7	69.0	83.2

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 3c: Suction Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Saturation temperature change 2.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	1.19	1.41	1.65	1.92	2.22
Type L Copper						
1/4		0.074	0.094	0.117	0.145	0.178
3/8		0.172	0.217	0.270	0.334	0.408
1/2		0.324	0.409	0.510	0.629	0.768
5/8		0.555	0.699	0.871	1.07	1.31
3/4		0.86	1.08	1.35	1.66	2.03
1		1.75	2.20	2.74	3.37	4.11
1-1/4		3.06	3.85	4.78	5.88	7.17
1-1/2		4.85	6.09	7.57	9.31	11.3
2		10.1	12.7	15.7	19.3	23.5
2-1/2		17.9	22.4	27.8	34.1	41.5
3		28.5	35.8	44.4	54.4	66.2
3-1/2		42.5	53.2	66.0	80.9	98.3
4		60.0	75.1	93.0	114	139
Schedule 40 Steel						
3/8		0.207	0.257	0.317	0.386	0.467
1/2		0.384	0.478	0.588	0.717	0.866
3/4		0.811	1.01	1.24	1.51	1.82
1		1.54	1.91	2.35	2.86	3.45
1-1/4		3.17	3.94	4.84	5.89	7.11
1-1/2		4.76	5.91	7.26	8.84	10.7
2		9.19	11.4	14.0	17.1	20.6
2-1/2		14.7	18.2	22.3	27.2	32.8
3		25.9	32.2	39.5	48.0	58.0
4		52.8	65.5	80.4	97.8	118

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 4: Suction Line Capacities in Tons Refrigeration for Klea® 134a Suction Line Vapor with 10.0°F of Superheat

Nominal line size inch	Saturation temperature change 0.5°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	0.30	0.35	0.41	0.48	0.55
Type L Copper						
1/4		0.034	0.044	0.055	0.068	0.083
3/8		0.080	0.101	0.127	0.157	0.192
1/2		0.152	0.192	0.240	0.297	0.364
5/8		0.261	0.330	0.412	0.509	0.623
3/4		0.406	0.512	0.639	0.790	0.966
1		0.830	1.05	1.30	1.61	1.97
1-1/4		1.45	1.83	2.28	2.82	3.44
1-1/2		2.31	2.91	3.63	4.47	5.45
2		4.83	6.07	7.55	9.30	11.3
2-1/2		8.57	10.8	13.4	16.5	20.1
3		13.7	17.3	21.4	26.4	32.1
3-1/2		20.5	25.7	31.9	39.3	47.8
4		28.9	36.3	45.1	55.5	67.5
Schedule 40 Steel						
3/8		0.102	0.127	0.158	0.193	0.234
1/2		0.190	0.238	0.293	0.359	0.434
3/4		0.403	0.503	0.620	0.758	0.917
1		0.766	0.955	1.18	1.44	1.74
1-1/4		1.59	1.98	2.43	2.97	3.59
1-1/2		2.39	2.97	3.66	4.46	5.39
2		4.62	5.75	7.07	8.62	10.4
2-1/2		7.38	9.18	11.3	13.8	16.6
3		13.1	16.2	20.0	24.3	29.4
4		26.7	33.2	40.8	49.6	59.9

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 4b: Suction line Capacities in Tons Refrigeration for Klea® 134a Suction Line Vapor with 10.0°F of Superheat

Nominal fine size inch	Saturation temperature change 1.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	0.59	0.7	0.82	0.96	1.11
Type L Copper						
1/4		0.051	0.065	0.081	0.100	0.123
3/8		0.118	0.150	0.187	0.231	0.283
1/2		0.224	0.283	0.353	0.437	0.534
5/8		0.385	0.485	0.605	0.747	0.913
3/4		0.597	0.753	0.938	1.16	1.41
1		1.22	1.53	1.91	2.35	2.87
1-1/4		2.13	2.68	3.34	4.11	5.02
1-1/2		3.38	4.26	5.29	6.52	7.95
2		7.05	8.86	11.0	13.5	16.5
2-1/2		12.5	15.7	19.5	24.0	29.2
3		20.0	25.1	31.2	38.3	46.6
3-1/2		29.8	37.4	46.4	57.0	69.3
4		42.1	52.8	65.5	80.4	97.8
Schedule 40 Steel						
3/8		0.147	0.183	0.226	0.276	0.334
1/2		0.274	0.341	0.420	0.513	0.621
3/4		0.579	0.721	0.888	1.08	1.31
1		1.10	1.37	1.68	2.05	2.48
1-1/4		2.27	2.82	3.47	4.23	5.11
1-1/2		3.41	4.24	5.21	6.35	7.67
2		6.59	8.19	10.1	12.3	14.8
2-1/2		10.5	13.1	16.1	19.6	23.6
3		18.6	23.1	28.4	34.6	41.7
4		38.0	47.1	57.9	70.5	85.0

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 4c: Suction Line Capacities in Tons Refrigeration for Klea® 134a Suction Line Vapor with 10.0T of Superheat

Nominal line size inch	Saturation temperature change 2.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft					
	T	10	20	30	40	50
	dP/dL	1.19	1.41	1.65	1.92	2.22
Type L Copper						
1/4		0.076	0.096	0.119	0.148	0.181
3/8		0.175	0.221	0.275	0.340	0.416
1/2		0.330	0.416	0.519	0.640	0.782
5/8		0.565	0.712	0.887	1.09	1.34
3/4		0.876	1.10	1.37	1.69	2.07
1		1.78	2.24	2.79	3.44	4.19
1-1/4		3.12	3.92	4.87	5.99	7.30
1-1/2		4.94	6.21	7.71	9.48	11.6
2		10.3	12.9	16.0	19.7	23.9
2-1/2		18.2	22.8	28.3	34.8	42.3
3		29.1	36.5	45.2	55.5	67.5
3-1/2		43.3	54.3	67.2	82.5	100.0
4		61.1	76.6	94.9	116	141
Schedule 40 Steel						
3/8		0.211	0.263	0.323	0.395	0.477
1/2		0.392	0.488	0.601	0.732	0.885
3/4		0.828	1.03	1.27	1.54	1.86
1		1.57	1.95	2.40	2.92	3.52
1-1/4		3.24	4.02	4.94	6.02	7.26
1-1/2		4.86	6.04	7.42	9.03	10.9
2		9.39	11.7	14.3	17.4	21.0
2-1/2		15.0	18.6	22.8	27.8	33.5
3		26.5	32.9	40.3	49.1	59.2
4		54.0	66.9	82.2	99.9	121

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 5a: Suction Line Capacities in Tons Refrigeration for Klea® 134a Suction line Vapor at 65.0 °F

Nominal line size inch	Saturation temperature change 0.5°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft				
T	10	20	30	40	50
dP/dL	0.30	0.35	0.41	0.48	0.55
Type L Copper					
1/4	0.031	0.040	0.050	0.064	0.079
3/8	0.072	0.092	0.117	0.147	0.184
1/2	0.136	0.175	0.222	0.279	0.347
5/8	0.234	0.301	0.381	0.478	0.595
3/4	0.365	0.467	0.592	0.742	0.923
1	0.746	0.955	1.21	1.51	1.88
1-1/4	1.31	1.67	2.12	2.65	3.29
1-1/2	2.08	2.66	3.36	4.20	5.21
2	4.35	5.55	7.00	8.75	10.80
2-1/2	7.73	9.86	12.4	15.5	19.2
3	12.4	15.8	19.9	24.8	30.7
3-1/2	18.5	23.5	29.6	37.0	45.7
4	26.1	33.3	41.9	52.2	64.6
Schedule 40 Steel					
3/8	0.092	0.117	0.147	0.182	0.223
1/2	0.172	0.218	0.273	0.338	0.416
3/4	0.366	0.462	0.578	0.715	0.878
1	0.696	0.879	1.10	1.36	1.66
1-1/4	1.44	1.82	2.27	2.80	3.44
1-1/2	2.17	2.74	3.41	4.21	5.16
2	4.20	5.29	6.59	8.14	9.96
2-1/2	6.72	8.45	10.5	13.0	15.9
3	11.9	15.0	18.6	23.0	28.1
4	24.3	30.6	38.0	46.9	57.3

Note:

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 5b: Suction line Capacities in Tons Refrigeration for Klea® 134a Suction line Vapor at 65.0°F

Nominal line size inch	Saturation temperature change 1.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft				
T	10	20	30	40	50
dP/dL	0.59	0.70	0.82	0.96	1.11
Type L Copper					
1/4	0.046	0.059	0.075	0.094	0.117
3/8	0.106	0.136	0.173	0.217	0.271
1/2	0.201	0.258	0.327	0.410	0.510
5/8	0.346	0.443	0.560	0.702	0.873
3/4	0.537	0.687	0.869	1.09	1.35
1	1.10	1.40	1.77	2.22	2.75
1-1/4	1.92	2.45	3.10	3.87	4.80
1-1/2	3.05	3.89	4.91	6.13	7.60
2	6.36	8.11	10.2	12.8	15.8
2-1/2	11.3	14.4	18.1	22.6	27.9
3	18.1	23.0	28.9	36.1	44.6
3-1/2	26.9	34.2	43.1	53.7	66.3
4	38.1	48.4	60.8	75.8	93.6
Schedule 40 Steel					
3/8	0.133	0.169	0.211	0.261	0.32
1/2	0.249	0.314	0.392	0.484	0.594
3/4	0.526	0.663	0.827	1.02	1.25
1	0.999	1.26	1.57	1.94	2.37
1-1/4	2.07	2.60	3.24	4.00	4.89
1-1/2	3.11	3.91	4.86	6.00	7.34
2	6.01	7.55	9.39	11.6	14.2
2-1/2	9.59	12.1	15.0	18.5	22.6
3	17.0	21.3	26.5	32.7	39.9
4	34.6	43.5	54.0	66.6	81.4

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 5c: Suction Line Capacities in Tons Refrigeration for Klea® 134a Suction line Vapor at 65.0°F

Nominal line size inch	Saturation temperature change 2.0°F in 100 ft Mean evaporating temperature °F at corresponding dP psi/100ft				
	T	10	20	30	40	50
	dP/dL	1.19	1.41	1.65	1.92	2.22
Type L Copper						
1/4		0.068	0.087	0.110	0.139	0.173
3/8		0.157	0.201	0.255	0.320	0.397
1/2		0.297	0.380	0.481	0.602	0.748
5/8		0.509	0.650	0.822	1.03	1.28
3/4		0.789	1.01	1.27	1.59	1.97
1		1.61	2.05	2.59	3.23	4.01
1-1/4		2.81	3.58	4.52	5.64	6.98
1-1/2		4.46	5.68	7.16	8.93	11.0
2		9.28	11.8	14.9	18.5	22.9
2-1/2		16.4	20.9	26.3	32.8	40.5
3		26.3	33.4	42.0	52.3	64.5
3-1/2		39.2	49.7	62.5	77.7	95.9
4		55.3	70.2	88.1	110	135
Schedule 40 Steel						
3/8		0.192	0.242	0.301	0.372	0.456
1/2		0.357	0.449	0.560	0.691	0.847
3/4		0.753	0.948	1.18	1.46	1.78
1		1.43	1.80	2.24	2.76	3.37
1-1/4		2.95	3.71	4.61	5.68	6.95
1-1/2		4.43	5.57	6.92	8.53	10.4
2		8.56	10.7	13.4	16.5	20.1
2-1/2		13.7	17.1	21.3	26.2	32.1
3		24.2	30.3	37.7	46.4	56.7
4		49.3	61.8	76.7	94.4	115

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 6a: Discharge Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Condenser saturation temperature change 1.0°F in 100ft Pressure gradient of 2.33 psi/100 ft Discharge line superheat of 80.0°F Mean evaporating temperature °F				
	T	10.0	20.0	30.0	40.0	50.0
Type L Copper						
1/4		0.241	0.247	0.254	0.259	0.265
3/8		0.555	0.569	0.583	0.597	0.610
1/2		1.04	1.07	1.10	1.12	1.15
5/8		1.78	1.83	1.87	1.92	1.96
3/4		2.75	2.82	2.89	2.96	3.03
1		5.59	5.73	5.87	6.01	6.14
1-1/4		9.73	9.98	10.2	10.5	10.7
1-1/2		15.4	15.8	16.2	16.6	16.9
2		31.9	32.7	33.5	34.3	35.1
2-1/2		56.4	57.8	59.2	60.6	62.0
3		89.9	92.2	94.4	96.6	98.8
3-1/2		134	137	140	144	147
4		188	193	198	202	207
Schedule 40 steel						
3/8		0.634	0.650	0.666	0.682	0.697
1/2		1.18	1.21	1.24	1.26	1.29
3/4		2.48	2.54	2.60	2.66	2.72
1		4.68	4.80	4.92	5.03	5.15
1-1/4		9.65	9.89	10.1	10.4	10.6
1-1/2		14.5	14.8	15.2	15.6	15.9
2		27.9	28.6	29.3	30.0	30.7
2-1/2		44.5	45.6	46.7	47.8	48.9
3		78.6	80.6	82.6	84.5	86.4
4		160	164	168	172	176

Note:

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 6b: Discharge Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Condenser saturation temperature change 1.0°F in 100ft Pressure gradient of 2.33 psi/100 ft Discharge line superheat of 110.0°F Mean evaporating temperature °F				
	T	10.0	20.0	30.0	40.0	50.0
Type L Copper						
1/4		0.229	0.235	0.241	0.247	0.252
3/8		0.528	0.542	0.555	0.568	0.581
1/2		0.994	1.02	1.04	1.07	1.09
5/8		1.70	1.74	1.78	1.83	1.87
3/4		2.63	2.69	2.76	2.83	2.89
1		5.33	5.47	5.60	5.74	5.86
1-1/4		9.30	9.54	9.77	10.0	10.2
1-1/2		14.7	15.1	15.5	15.8	16.2
2		30.5	31.3	32.1	32.8	33.6
2-1/2		53.9	55.3	56.7	58.0	59.3
3		86.1	88.3	90.4	92.6	94.6
3-1/2		128	131	134	138	141
4		180	185	190	194	198
Schedule 40 steel						
3/8		0.611	0.626	0.642	0.657	0.671
1/2		1.13	1.16	1.19	1.22	1.25
3/4		2.39	2.45	2.51	2.57	2.62
1		4.52	4.63	4.74	4.86	4.97
1-1/4		9.31	9.55	9.78	10.0	10.2
1-1/2		14.0	14.3	14.7	15.0	15.4
2		26.9	27.6	28.3	29.0	29.6
2-1/2		43.0	44.1	45.1	46.2	47.2
3		75.9	77.9	79.8	81.6	83.5
4		155	159	162	166	170

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 7a: Liquid line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Liquid line velocity 1.5 fps Mean evaporating temperature °F				
T	10.0	20.0	30.0	40.0	50.0
Type L Copper					
1/4	0.959	0.984	1.01	1.03	1.05
3/8	1.79	1.83	1.88	1.92	1.96
1/2	2.87	2.94	3.02	3.09	3.16
5/8	4.29	4.40	4.51	4.61	4.72
3/4	5.96	6.11	6.26	6.41	6.55
1	10.2	10.4	10.7	10.9	11.2
1-1/4	15.5	15.9	16.3	16.6	17.0
1-1/2	21.9	22.5	23.0	23.6	24.1
2	38.1	39.1	40.0	41.0	41.9
2-1/2	58.7	60.2	61.7	63.2	64.6
3	83.8	86.0	88.1	90.2	92.2
3-1/2	113	116	119	122	125
4	147	151	155	159	162
Schedule 40 Steel					
3/8	2.35	2.41	2.47	2.53	2.58
1/2	3.74	3.84	3.93	4.02	4.11
3/4	6.56	6.73	6.90	7.06	7.22
1	10.6	10.9	11.2	11.4	11.7
1-1/4	18.4	18.9	19.3	19.8	20.2
1-1/2	25.1	25.7	26.3	26.9	27.5
2	41.3	42.4	43.4	44.4	45.4
2-1/2	58.9	60.4	61.9	63.4	64.8
3	91.0	93.3	95.6	97.9	100
4	157	161	165	169	172

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 7b: Liquid Line Capacities in Tons Refrigeration for Klea® 134a Saturated Vapor Leaving Evaporator

Nominal line size inch	Condenser saturation temperature change 1.0°F in 100m Pressure gradient of 2.33 psi/100 ft Mean evaporating temperature °F				
T	10.0	20.0	30.0	40.0	50.0
Type L Copper					
1/4	1.18	1.21	1.24	1.27	1.30
3/8	2.72	2.79	2.86	2.93	2.99
1/2	5.14	5.27	5.40	5.52	5.65
5/8	8.79	9.01	9.23	9.45	9.66
3/4	13.6	14.0	14.3	14.6	15.0
1	27.7	28.4	29.1	29.8	30.4
1-1/4	48.3	49.5	50.8	52.0	53.1
1-1/2	76.5	78.5	80.4	82.3	84.2
2	159	163	167	171	175
2-1/2	281	289	296	303	309
3	449	461	472	483	494
3-1/2	668	685	702	719	735
4	943	967	991	1014	1037
Schedule 40 Steel					
3/8	3.23	3.31	3.39	3.47	3.55
1/2	6.00	6.15	6.30	6.45	6.59
3/4	12.6	13.0	13.3	13.6	13.9
1	23.9	24.5	25.1	25.7	26.3
1-1/4	49.4	50.6	51.9	53.1	54.3
1-1/2	74.1	76.0	77.9	79.7	81.5
2	143	147	150	154	157
2-1/2	228	234	240	245	251
3	403	414	424	434	444
4	822	843	863	884	904

Note:
(i) Capacity based on saturated vapor (no useful superheat)
(ii) Mean condenser temperature 110°F (no subcooling)

Table 8a: Minimum Refrigeration Capacities in Tons Refrigeration for Klea® 134a Lubricant Is 32 cSt Polyolester

Type L Copper Tubing		Nominal line size, inch												
Evap Temp °F	Suction Temp °F	1/4	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4
50	60	0.062	0.134	0.243	0.401	0.605	1.18	1.99	3.08	6.15	10.6	16.5	24.0	33.4
	70	0.060	0.131	0.237	0.392	0.591	1.15	1.95	3.01	6.01	10.3	16.1	23.5	32.6
	80	0.059	0.129	0.233	0.384	0.579	1.13	1.91	2.95	5.89	10.1	15.8	23.0	32.0
40	50	0.055	0.120	0.218	0.359	0.542	1.06	1.79	2.76	5.51	9.47	14.8	21.6	29.9
	60	0.054	0.118	0.213	0.352	0.530	1.03	1.75	2.70	5.39	9.26	14.5	21.1	29.3
	70	0.053	0.115	0.209	0.345	0.520	1.01	1.71	2.64	5.28	9.08	14.2	20.7	28.7
30	40	0.049	0.107	0.194	0.321	0.484	0.942	1.59	2.46	4.92	8.45	13.2	19.2	26.7
	50	0.048	0.105	0.190	0.314	0.473	0.922	1.56	2.41	4.81	8.26	12.9	18.8	26.1
	60	0.047	0.103	0.186	0.308	0.464	0.904	1.53	2.36	4.72	8.10	12.6	18.4	25.6
20	30	0.044	0.095	0.172	0.285	0.429	0.836	1.41	2.18	4.36	7.49	11.7	17.1	23.7
	40	0.043	0.093	0.169	0.278	0.420	0.818	1.38	2.14	4.27	7.33	11.4	16.7	23.2
	50	0.042	0.091	0.165	0.273	0.412	0.802	1.36	2.09	4.18	7.19	11.2	16.4	22.7
10	20	0.039	0.084	0.152	0.251	0.379	0.738	1.25	1.93	3.85	6.61	10.3	15.1	20.9
	30	0.038	0.082	0.149	0.246	0.371	0.722	1.22	1.89	3.77	6.47	10.1	14.7	20.5
	40	0.037	0.081	0.146	0.241	0.363	0.708	1.20	1.85	3.69	6.35	9.9	14.4	20.1

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Condenser temperature 110°F (no subcooling)
(iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 8b: Minimum Refrigeration Capacities in Tons Refrigeration for Klea® 134a Lubricant Is 32 cSt Polyolester

Schedule 40 Steel Pipe		Nominal line size, inch									
Evap Temp °F	Suction Temp °F	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
50	60	0.189	0.338	0.683	1.25	2.48	3.64	6.80	10.6	18.3	36.0
	70	0.185	0.331	0.668	1.22	2.42	3.56	6.65	10.4	17.9	35.2
	80	0.181	0.324	0.654	1.20	2.37	3.49	6.52	10.2	17.5	34.5
40	50	0.169	0.303	0.612	1.12	2.22	3.26	6.10	9.51	16.4	32.3
	60	0.166	0.296	0.599	1.09	2.17	3.19	5.96	9.30	16.0	31.6
	70	0.162	0.290	0.587	1.07	2.13	3.13	5.84	9.11	15.7	30.9
30	40	0.151	0.270	0.546	0.998	1.98	2.91	5.44	8.48	14.6	28.8
	50	0.148	0.264	0.534	0.976	1.94	2.85	5.32	8.30	14.3	28.2
	60	0.145	0.259	0.524	0.957	1.90	2.79	5.22	8.13	14.0	27.6
20	30	0.134	0.240	0.484	0.885	1.76	2.58	4.83	7.52	13.0	25.6
	40	0.131	0.235	0.474	0.866	1.72	2.53	4.72	7.36	12.7	25.0
	50	0.129	0.230	0.465	0.849	1.69	2.48	4.63	7.22	12.4	24.5
10	20	0.118	0.212	0.427	0.781	1.55	2.28	4.26	6.64	11.4	22.5
	30	0.116	0.207	0.418	0.765	1.52	2.23	4.17	6.50	11.2	22.1
	40	0.114	0.203	0.410	0.750	1.49	2.19	4.09	6.37	11.0	21.6

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Condenser temperature 110°F (no subcooling)
(iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 8c: Minimum Refrigeration Capacities in Tons Refrigeration for Klea® 134a Lubricant Is 68 cSt Polyolester

Type L Copper Tubing		Nominal line size, inch												
Evap Temp °F	Suction Temp °F	1/4	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4
50	60	0.071	0.155	0.280	0.462	0.696	1.36	2.30	3.54	7.08	12.2	19.0	27.7	38.4
	70	0.068	0.149	0.269	0.445	0.671	1.31	2.21	3.42	6.83	11.7	18.3	26.7	37.1
	80	0.066	0.144	0.261	0.432	0.651	1.27	2.14	3.31	6.62	11.4	17.7	25.9	35.9
40	50	0.063	0.138	0.250	0.412	0.622	1.21	2.05	3.16	6.32	10.9	16.9	24.7	34.3
	60	0.061	0.133	0.241	0.398	0.599	1.17	1.98	3.05	6.09	10.5	16.3	23.8	33.1
	70	0.059	0.129	0.233	0.386	0.581	1.13	1.92	2.96	5.91	10.2	15.8	23.1	32.1
30	40	0.056	0.123	0.222	0.366	0.552	1.08	1.82	2.81	5.62	9.7	15.1	22.0	30.5
	50	0.054	0.118	0.214	0.353	0.533	1.04	1.76	2.71	5.42	9.3	14.5	21.2	29.4
	60	0.053	0.115	0.207	0.343	0.517	1.01	1.70	2.63	5.25	9.03	14.1	20.5	28.5
20	30	0.050	0.108	0.196	0.324	0.488	0.951	1.6	2.5	5.0	8.52	13.3	19.4	26.9
	40	0.048	0.104	0.189	0.312	0.471	0.917	1.6	2.4	4.8	8.22	12.8	18.7	26.0
	50	0.047	0.101	0.183	0.303	0.457	0.890	1.5	2.3	4.6	7.98	12.4	18.2	25.2
10	20	0.044	0.095	0.172	0.284	0.429	0.835	1.4	2.2	4.4	7.49	11.7	17.0	23.7
	30	0.042	0.092	0.166	0.274	0.414	0.806	1.4	2.1	4.2	7.23	11.3	16.4	22.8
	40	0.041	0.089	0.161	0.266	0.401	0.782	1.3	2.0	4.1	7.01	10.9	16.0	22.2

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Condenser temperature 110°F (no subcooling)
(iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 8d: Minimum Refrigeration Capacities in Tons Refrigeration for Klea® 134a Lubricant Is 32 cSt Polyolester

Schedule 40 Steel Pipe		Nominal line size, inch									
Evap Temp	Suction Temp										
°F	°F	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4
50	60	0.218	0.389	0.786	1.44	2.85	4.19	7.83	12.2	21.0	41.5
	70	0.210	0.375	0.758	1.39	2.75	4.04	7.55	11.8	20.3	40.0
	80	0.203	0.364	0.735	1.34	2.67	3.92	7.32	11.4	19.7	38.8
40	50	0.194	0.347	0.702	1.28	2.55	3.74	6.99	10.9	18.8	37.0
	60	0.187	0.335	0.677	1.24	2.46	3.61	6.74	10.5	18.1	35.7
	70	0.182	0.325	0.656	1.20	2.38	3.50	6.54	10.2	17.6	34.6
30	40	0.173	0.309	0.623	1.14	2.26	3.33	6.21	9.69	16.7	32.9
	50	0.166	0.298	0.601	1.10	2.18	3.21	5.99	9.34	16.1	31.7
	60	0.161	0.289	0.583	1.07	2.12	3.11	5.81	9.06	15.6	30.8
20	30	0.152	0.273	0.551	1.01	2.00	2.94	5.49	8.56	14.7	29.1
	40	0.147	0.263	0.531	0.971	1.93	2.83	5.29	8.26	14.2	28.0
	50	0.143	0.255	0.515	0.942	1.87	2.75	5.14	8.01	13.8	27.2
10	20	0.134	0.240	0.484	0.884	1.76	2.58	4.82	7.52	12.9	25.5
	30	0.129	0.231	0.467	0.853	1.69	2.49	4.65	7.25	12.5	24.6

(i) Capacity based on saturated vapor (no useful superheat)
(ii) Condenser temperature 110°F (no subcooling)
(iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 9a: Suction line Correction Factors for Klea® 134a

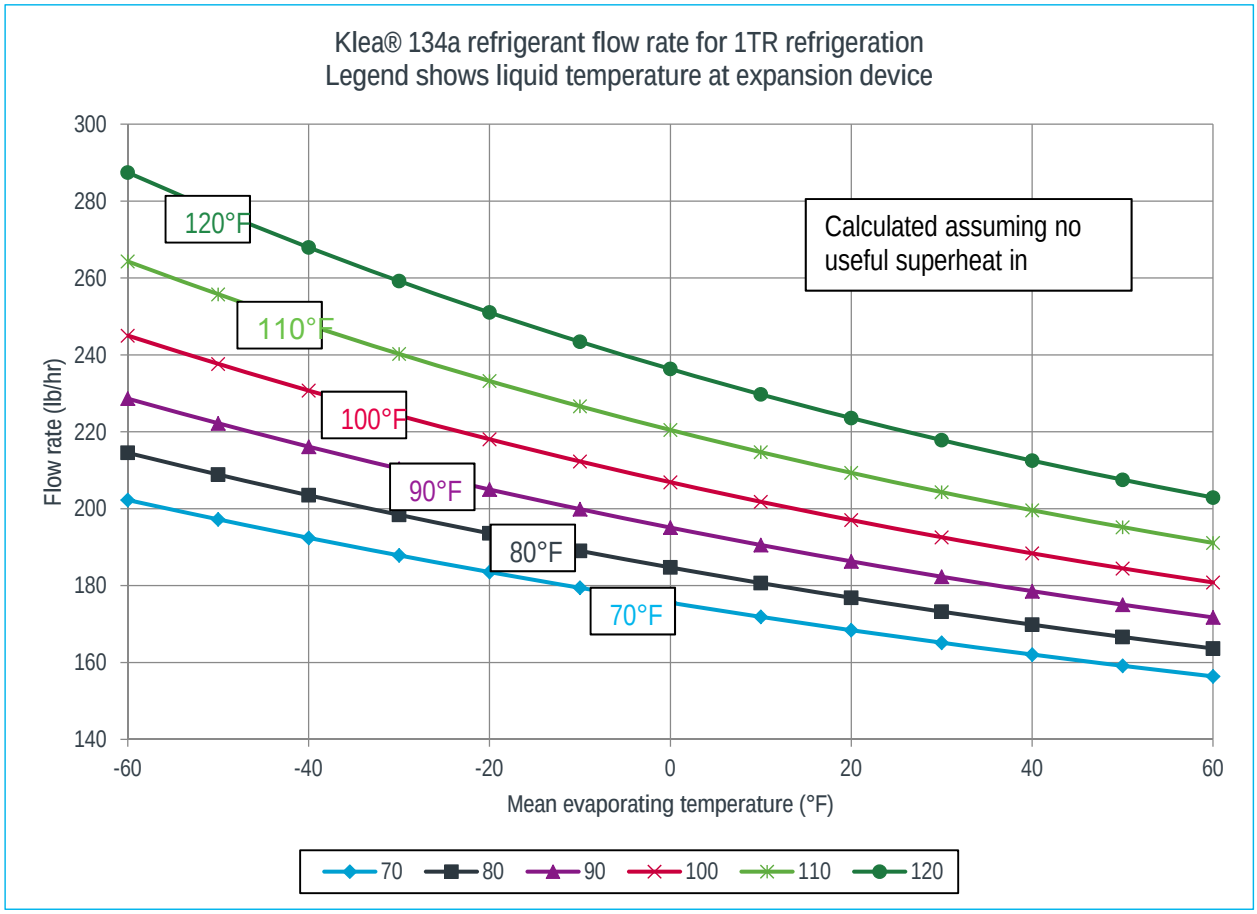
To convert from tabulated values at a condenser temperature of 110°F to the desired value, multiply by the appropriate factor.

T evap °F	T Condenser °F					
	70	80	90	100	110	120
50	1.195	1.147	1.099	1.05	1.000	0.949
40	1.199	1.15	1.101	1,051	1.000	0.947
30	1.204	1.154	1.103	1,052	1.000	0.947
20	1.208	1.157	1.106	1.053	1.000	0.947
10	1.214	1.161	1.108	1.055	1.000	0.945

Table 9b: Discharge line Capacity Correction Factors for Klea® 134a

To calculate capacities at other condenser temperatures, multiply tabulated capacities by the factors given below.

Evaporator temperature °F	Condenser temperature 85 °F	110 °F	130 °F
50	0.812	1.000	1.135
40	0.814	1.000	1.131
30	0.817	1.000	1.128
20	0.819	1.000	1.124
10	0.822	1.000	1.120



Mexichem Refrigerants

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