

Klea® 410A Engineers Tables – SI Units

1. Introduction

The following tables provide practical information to help you design or set up refrigeration systems using Klea® 410A. 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 Datasheet for Klea® 410A and the booklets of Thermodynamic Property Data for Klea® 410A.

2. Temperature-Pressure Tables for Klea® 410A

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

Table 1-3: Maximum recommended suction line capacities for varying suction gas conditions.

Table 4: Discharge line capacities.

Table 5: Liquid line capacities.

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 Klea® datasheets, thermodynamic tables. Pressure drop has been estimated using the Colebrook equation to obtain friction factors and the Darcy-Weisbach equation for pressure drop.

Gas Compressibility Effects

In calculating the maximum capacity (flowrate) it 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 overpredict capacity if the total pressure drop is appreciable compared to the static pressure. The likely overprediction 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 temperature 40 °C.

Zero subcooling.

Vapour leaving evaporator (i) saturated or (ii) superheated (superheat quoted in the table).

The capacity for other liquid temperatures may be found using the tabulated correction factors given in Table 9. Note that the tables are referenced to a condenser of 40 °C; the liquid temperature corresponding to this condition is quoted in the tables.

The tables quote capacity for pressure drops in the evaporating pressure equivalent to a drop in saturation temperature of 0.01, 0.02 and 0.04 Kelvin for every metre of suction line. 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 kg/hr required for a duty of 1 kW 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 temperature of 40 °C.

Zero subcooling.

Vapour leaves evaporator at zero useful superheat

Superheat at compressor discharge is (i) 45 or (ii) 60 °C.

3.4 Liquid Line Capacity Tables

These are quoted for conditions of (i) 0.5 m/s maximum velocity or (ii) 0.02 K/m drop in saturation temperature. 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 0.01, 0.02 and 0.04 K in one metre length. In order to correct the capacities for different values of temperature drop or line length, use the following equation:

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

where:

ΔT_e is the change in evaporating temperature

L_e is the length of suction line

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

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

Table 1a: Suction line capacities in kW for Klea® 410A - Saturated vapour leaving evaporator

Nominal line size mm	Saturation temperature change 1.0 K in 100 m									
	Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL	80	95	112	130	151	174	199	226	256	288
Type L Copper										
10	0.126	0.159	0.198	0.243	0.296	0.358	0.428	0.509	0.6	0.703
12	0.293	0.369	0.458	0.562	0.684	0.825	0.986	1.17	1.38	1.62
15	0.556	0.697	0.865	1.06	1.29	1.55	1.86	2.2	2.6	3.04
19	0.954	1.2	1.48	1.82	2.21	2.66	3.17	3.76	4.43	5.18
22	1.48	1.86	2.3	2.82	3.42	4.12	4.91	5.82	6.85	8.01
28	3.02	3.78	4.68	5.73	6.95	8.36	9.98	11.8	13.9	16.2
35	5.29	6.62	8.18	10	12.1	14.6	17.4	20.6	24.2	28.3
42	8.41	10.5	13	15.9	19.2	23.1	27.5	32.6	38.3	44.7
54	17.5	21.9	27	33	40	48	57.2	67.6	79.3	92.6
67	31.1	38.8	47.9	58.5	70.8	84.9	101	119	140	163
79	49.8	62	76.5	93.4	113	136	161	190	223	261
92	74.1	92.4	114	139	168	202	240	283	332	387
105	105	131	161	196	237	284	338	399	468	545
Schedule 40 steel										
10	0.367	0.454	0.557	0.676	0.813	0.969	1.15	1.35	1.58	1.83
15	0.683	0.846	1.04	1.26	1.51	1.8	2.13	2.5	2.92	3.39
20	1.45	1.79	2.19	2.65	3.18	3.79	4.49	5.27	6.15	7.14
25	2.74	3.39	4.15	5.02	6.03	7.18	8.49	9.97	11.6	13.5
32	5.67	7.01	8.56	10.4	12.4	14.8	17.5	20.6	24	27.8
40	8.53	10.5	12.9	15.6	18.7	22.2	26.3	30.8	36	41.7
50	16.5	20.3	24.8	30.1	36	42.9	50.7	59.5	69.4	80.5
65	26.3	32.5	39.6	47.9	57.5	68.4	80.8	94.8	111	128
80	46.6	57.5	70.1	84.8	102	121	143	168	195	227
100	95.1	117	143	173	207	246	291	341	398	461

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 1b: Suction line capacities in kW for klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Saturation temperature change 2.0 K in 100 m									
	Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T dP/dL	-40	-35	-30	-25	-20	-15	-10	-5	0	5
Type L Copper										
10	0.187	0.235	0.292	0.359	0.436	0.526	0.629	0.747	0.88	1.03
12	0.433	0.543	0.674	0.827	1	1.21	1.45	1.71	2.02	2.36
15	0.819	1.03	1.27	1.56	1.89	2.28	2.72	3.22	3.79	4.43
19	1.4	1.76	2.17	2.66	3.23	3.89	4.63	5.49	6.45	7.54
22	2.17	2.72	3.37	4.12	5	6.01	7.16	8.48	9.97	11.6
28	4.43	5.54	6.84	8.37	10.1	12.2	14.5	17.2	20.2	23.5
35	7.75	9.67	11.9	14.6	17.7	21.2	25.3	29.9	35.1	41
42	12.3	15.3	18.9	23.1	28	33.6	40	47.2	55.5	64.7
54	25.6	31.9	39.3	48	58	69.6	82.8	97.8	115	134
67	45.3	56.4	69.6	84.9	103	123	146	173	202	236
79	72.4	90.2	111	135	164	196	233	275	322	375
92	108	134	165	201	243	291	346	408	478	557
105	152	189	233	284	343	411	488	575	674	785
Schedule 40 steel										
10	0.527	0.651	0.797	0.966	1.16	1.38	1.64	1.92	2.24	2.6
15	0.98	1.21	1.48	1.79	2.15	2.56	3.03	3.56	4.16	4.82
20	2.07	2.55	3.12	3.78	4.54	5.4	6.38	7.49	8.74	10.1
25	3.92	4.84	5.91	7.15	8.58	10.2	12.1	14.2	16.5	19.2
32	8.1	9.99	12.2	14.8	17.7	21	24.9	29.2	34	39.5
40	12.2	15	18.3	22.1	26.5	31.6	37.3	43.8	51	59.2
50	23.5	28.9	35.3	42.7	51.2	60.9	71.9	84.4	98.4	114
65	37.5	46.2	56.3	68.1	81.6	97.1	115	134	157	182
80	66.3	81.7	99.6	120	144	172	203	238	277	321
100	135	166	203	245	294	349	412	484	564	653

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 1c: Suction line capacities in kW for Klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Saturation temperature change 4.0 K in 100 m Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T dP/dL	-40	-35	-30	-25	-20	-15	-10	-5	0	5
Type L Copper										
10	0.276	0.347	0.43	0.527	0.641	0.772	0.922	1.09	1.29	1.5
12	0.638	0.799	0.989	1.21	1.47	1.77	2.11	2.5	2.94	3.44
15	1.2	1.5	1.86	2.28	2.76	3.32	3.96	4.69	5.51	6.44
19	2.06	2.57	3.18	3.89	4.71	5.66	6.75	7.98	9.37	10.9
22	3.19	3.98	4.92	6.01	7.28	8.74	10.4	12.3	14.5	16.9
28	6.48	8.08	9.98	12.2	14.8	17.7	21.1	24.9	29.2	34.1
35	11.3	14.1	17.4	21.2	25.7	30.8	36.6	43.3	50.7	59.2
42	17.9	22.3	27.5	33.6	40.6	48.7	57.9	68.3	80.1	93.3
54	37.2	46.3	57	69.6	84	101	120	141	165	193
67	65.8	81.9	101	123	148	178	211	249	291	339
79	105	131	161	196	236	283	336	396	464	540
92	156	194	239	291	351	420	498	587	688	800
105	220	274	337	410	494	591	702	827	968	1126
Schedule 40 steel										
10	0.754	0.931	1.14	1.38	1.65	1.97	2.33	2.73	3.19	3.7
15	1.4	1.73	2.11	2.55	3.06	3.65	4.31	5.06	5.9	6.84
20	2.95	3.64	4.45	5.38	6.45	7.67	9.06	10.6	12.4	14.4
25	5.59	6.89	8.41	10.2	12.2	14.5	17.1	20.1	23.4	27.2
32	11.5	14.2	17.3	21	25.1	29.9	35.3	41.4	48.2	55.9
40	17.3	21.3	26	31.4	37.7	44.8	52.9	62	72.3	83.9
50	33.4	41.1	50.2	60.6	72.6	86.4	102	120	139	162
65	53.3	65.6	80	96.6	116	138	162	191	222	257
80	94.2	116	141	171	204	243	287	337	392	455
100	192	236	288	347	416	495	584	685	798	925

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 2a: Suction line capacities in kW for Klea® 410A Suction line vapour with 5.0 °C of superheat

Nominal line size mm	Saturation temperature change 1.0 K in 100 m									
	Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL	80	95	112	130	151	174	199	226	256	288
Type L Copper										
10	0.108	0.136	0.17	0.21	0.256	0.311	0.373	0.444	0.526	0.618
12	0.25	0.315	0.393	0.485	0.592	0.717	0.86	1.02	1.21	1.42
15	0.473	0.597	0.743	0.916	1.12	1.35	1.62	1.93	2.28	2.67
19	0.812	1.02	1.27	1.57	1.91	2.31	2.77	3.29	3.88	4.55
22	1.26	1.59	1.98	2.43	2.96	3.58	4.28	5.09	6.01	7.04
28	2.58	3.24	4.03	4.95	6.03	7.27	8.7	10.3	12.2	14.3
35	4.51	5.67	7.04	8.65	10.5	12.7	15.2	18	21.2	24.9
42	7.17	9	11.2	13.7	16.7	20.1	24	28.5	33.6	39.3
54	14.9	18.7	23.2	28.5	34.7	41.8	49.9	59.1	69.6	81.5
67	26.5	33.2	41.2	50.5	61.4	73.9	88.2	105	123	144
79	42.4	53.2	65.8	80.7	98	118	141	167	196	229
92	63.2	79.2	98	120	146	175	209	248	292	341
105	89.4	112	138	170	206	247	295	350	411	480
Schedule 40 steel										
10	0.313	0.39	0.48	0.585	0.706	0.845	1	1.18	1.39	1.61
15	0.583	0.726	0.893	1.09	1.31	1.57	1.86	2.2	2.57	2.99
20	1.23	1.53	1.89	2.29	2.77	3.31	3.93	4.63	5.42	6.3
25	2.34	2.91	3.57	4.35	5.24	6.26	7.43	8.75	10.2	11.9
32	4.85	6.01	7.38	8.98	10.8	12.9	15.3	18	21.1	24.6
40	7.28	9.04	11.1	13.5	16.2	19.4	23	27.1	31.7	36.8
50	14.1	17.5	21.4	26	31.3	37.4	44.4	52.2	61.1	71
65	22.5	27.9	34.2	41.5	50	59.7	70.7	83.3	97.4	113
80	39.8	49.3	60.5	73.4	88.4	106	125	147	172	200
100	81.2	101	123	150	180	215	255	300	350	407

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 2b: Suction line capacities in kW for Klea® 410A Suction line vapour with 5.0 °C of superheat

Nominal line size mm	Saturation temperature change 2.0 K in 100 m									
	Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL	160	190	223	260	302	348	398	453	512	577
Type L Copper										
10	0.159	0.201	0.251	0.309	0.378	0.457	0.548	0.653	0.771	0.905
12	0.369	0.465	0.579	0.713	0.87	1.05	1.26	1.5	1.77	2.07
15	0.698	0.878	1.09	1.34	1.64	1.98	2.37	2.82	3.32	3.89
19	1.19	1.5	1.87	2.3	2.8	3.38	4.04	4.8	5.66	6.63
22	1.85	2.33	2.89	3.56	4.33	5.22	6.25	7.42	8.75	10.2
28	3.78	4.74	5.89	7.23	8.79	10.6	12.7	15	17.7	20.7
35	6.6	8.28	10.3	12.6	15.3	18.5	22.1	26.2	30.8	36
42	10.5	13.1	16.3	20	24.3	29.2	34.9	41.4	48.7	56.9
54	21.8	27.3	33.8	41.5	50.3	60.6	72.3	85.6	101	118
67	38.6	48.4	59.9	73.3	89	107	128	151	178	208
79	61.8	77.3	95.6	117	142	171	204	241	283	331
92	91.9	115	142	174	211	254	302	358	420	491
105	130	162	201	245	298	357	426	504	592	691
Schedule 40 steel										
10	0.45	0.559	0.687	0.836	1.01	1.21	1.43	1.69	1.97	2.3
15	0.837	1.04	1.28	1.55	1.87	2.24	2.65	3.13	3.66	4.26
20	1.77	2.19	2.69	3.27	3.94	4.71	5.59	6.58	7.7	8.95
25	3.35	4.15	5.1	6.19	7.46	8.91	10.6	12.4	14.5	16.9
32	6.92	8.57	10.5	12.8	15.4	18.4	21.8	25.6	30	34.8
40	10.4	12.9	15.8	19.2	23.1	27.6	32.7	38.4	44.9	52.3
50	20.1	24.9	30.5	37	44.5	53.1	63	74.1	86.6	101
65	32	39.6	48.6	59	71	84.7	100	118	138	160
80	56.7	70.1	85.9	104	125	150	177	209	244	284
100	115	143	175	212	255	305	361	425	497	577

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 2c: Suction line capacities in kW for Klea® 410A Suction line vapour with 5.0 °C of superheat

Nominal line size mm	Saturation temperature change 4.0 K in 100 m									
	Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T dP/dL	-40	-35	-30	-25	-20	-15	-10	-5	0	5
Type L Copper										
10	0.235	0.297	0.369	0.455	0.555	0.671	0.804	0.955	1.13	1.32
12	0.543	0.684	0.85	1.05	1.27	1.54	1.84	2.19	2.58	3.02
15	1.02	1.29	1.6	1.97	2.4	2.89	3.46	4.1	4.84	5.66
19	1.75	2.2	2.73	3.36	4.08	4.92	5.89	6.98	8.23	9.63
22	2.72	3.41	4.23	5.19	6.31	7.61	9.09	10.8	12.7	14.9
28	5.52	6.92	8.58	10.5	12.8	15.4	18.4	21.8	25.6	30
35	9.64	12.1	15	18.3	22.3	26.8	32	37.9	44.6	52.1
42	15.3	19.1	23.7	29	35.2	42.3	50.5	59.8	70.4	82.2
54	31.7	39.7	49.1	60.1	72.9	87.6	104	124	145	170
67	56.1	70.2	86.8	106	129	155	184	218	256	299
79	89.6	112	138	169	205	246	293	347	407	476
92	133	167	206	251	305	366	435	515	604	705
105	188	235	290	354	429	515	613	725	851	992
Schedule 40 steel										
10	0.644	0.799	0.981	1.19	1.44	1.72	2.04	2.4	2.8	3.26
15	1.2	1.48	1.82	2.21	2.66	3.18	3.77	4.44	5.2	6.04
20	2.52	3.13	3.83	4.66	5.61	6.69	7.93	9.34	10.9	12.7
25	4.78	5.92	7.25	8.81	10.6	12.7	15	17.6	20.6	24
32	9.85	12.2	15	18.1	21.8	26.1	30.9	36.3	42.5	49.4
40	14.8	18.3	22.4	27.2	32.8	39.1	46.3	54.5	63.7	74.1
50	28.5	35.3	43.3	52.5	63.1	75.4	89.3	105	123	143
65	45.5	56.3	69	83.7	101	120	142	167	196	227
80	80.5	99.6	122	148	178	212	251	296	346	402
100	164	203	248	301	362	432	511	602	703	817

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 3a: Suction line capacities in kW for Klea® 410A Suction line vapour at 20.0 °C

Nominal line size mm	Saturation temperature change 1.0 K in 100 m Mean evaporating temperature °C at corresponding pressure drop, Pa/m										
	T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL											
Type	L	Copper									
10	0.103	0.131	0.166	0.207	0.256	0.313	0.381	0.459	0.551	0.657	
12	0.24	0.306	0.385	0.48	0.592	0.724	0.879	1.06	1.27	1.51	
15	0.457	0.581	0.73	0.909	1.12	1.37	1.66	2	2.39	2.84	
19	0.786	0.998	1.25	1.56	1.92	2.34	2.84	3.41	4.08	4.85	
22	1.22	1.55	1.95	2.42	2.98	3.63	4.4	5.28	6.31	7.5	
28	2.5	3.17	3.98	4.94	6.07	7.39	8.94	10.7	12.8	15.2	
35	4.39	5.56	6.97	8.64	10.6	12.9	15.6	18.7	22.4	26.5	
42	6.99	8.85	11.1	13.7	16.8	20.5	24.7	29.7	35.4	42	
54	14.6	18.5	23.1	28.6	35	42.6	51.4	61.6	73.4	87	
67	26	32.8	41	50.7	62.1	75.5	91	109	130	154	
79	41.6	52.6	65.6	81.1	99.3	121	145	174	207	245	
92	62.1	78.4	97.8	121	148	179	216	259	308	364	
105	87.8	111	138	171	209	253	305	365	434	514	
Type	Schedule 40 steel										
10	0.311	0.39	0.485	0.595	0.725	0.874	1.05	1.25	1.47	1.73	
15	0.581	0.729	0.904	1.11	1.35	1.63	1.94	2.31	2.73	3.21	
20	1.23	1.54	1.91	2.34	2.85	3.43	4.1	4.87	5.76	6.77	
25	2.35	2.94	3.63	4.45	5.4	6.5	7.77	9.22	10.9	12.8	
32	4.87	6.08	7.52	9.2	11.2	13.4	16	19	22.5	26.4	
40	7.32	9.15	11.3	13.8	16.8	20.2	24.1	28.6	33.7	39.6	
50	14.2	17.7	21.9	26.7	32.4	38.9	46.4	55.1	65	76.3	
65	22.7	28.3	34.9	42.6	51.7	62.1	74.1	87.9	104	122	
80	40.2	50.1	61.8	75.5	91.4	110	131	155	183	215	
100	82.2	102	126	154	186	224	267	316	373	438	

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 3b: Suction line capacities in kW for Klea® 410A Suction line vapour at 20.0 °C

Nominal line size mm	Saturation temperature change 2.0 K in 100 m Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL	160	190	223	260	302	348	398	453	512	577
Type L Copper										
10	0.153	0.195	0.246	0.306	0.378	0.462	0.561	0.676	0.809	0.963
12	0.356	0.453	0.569	0.708	0.872	1.07	1.29	1.55	1.86	2.21
15	0.675	0.857	1.08	1.34	1.65	2.01	2.43	2.92	3.49	4.15
19	1.16	1.47	1.84	2.29	2.82	3.43	4.15	4.99	5.95	7.07
22	1.8	2.28	2.86	3.55	4.36	5.31	6.42	7.71	9.2	10.9
28	3.68	4.66	5.83	7.23	8.87	10.8	13	15.6	18.6	22.1
35	6.45	8.16	10.2	12.6	15.5	18.8	22.7	27.3	32.5	38.5
42	10.2	13	16.2	20	24.6	29.8	36	43.1	51.3	60.8
54	21.4	27	33.7	41.7	51	61.9	74.7	89.4	106	126
67	37.9	47.9	59.7	73.8	90.3	110	132	158	188	222
79	60.7	76.6	95.5	118	144	175	211	252	299	354
92	90.6	114	142	175	215	260	313	374	444	525
105	128	161	201	248	303	367	441	527	626	740
Schedule 40 steel										
10	0.449	0.563	0.697	0.855	1.04	1.25	1.49	1.78	2.1	2.47
15	0.838	1.05	1.3	1.59	1.93	2.32	2.77	3.29	3.89	4.57
20	1.77	2.22	2.74	3.35	4.07	4.89	5.84	6.94	8.19	9.62
25	3.37	4.21	5.2	6.35	7.7	9.26	11.1	13.1	15.5	18.2
32	6.98	8.7	10.7	13.1	15.9	19.1	22.8	27	31.9	37.5
40	10.5	13.1	16.1	19.7	23.9	28.7	34.2	40.6	47.8	56.2
50	20.3	25.3	31.2	38	46	55.3	66	78.2	92.2	108
65	32.4	40.3	49.7	60.7	73.4	88.2	105	125	147	173
80	57.4	71.4	88	107	130	156	186	220	260	305
100	117	146	179	219	265	318	379	449	529	620

Note:

(i) Capacity based on saturated vapour (no useful superheat)

(ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 3c: Suction line capacities in kW for Klea® 410A Suction line vapour at 20.0 °C

Nominal line size mm	Saturation temperature change 4.0 K in 100 m Mean evaporating temperature °C at corresponding pressure drop, Pa/m									
T	-40	-35	-30	-25	-20	-15	-10	-5	0	5
dP/dL	319	379	446	521	604	695	796	905	1024	1153
Type L Copper										
10	0.227	0.289	0.363	0.452	0.557	0.68	0.824	0.991	1.18	1.41
12	0.526	0.668	0.839	1.04	1.28	1.56	1.89	2.27	2.71	3.22
15	0.996	1.26	1.58	1.96	2.41	2.94	3.55	4.27	5.09	6.04
19	1.71	2.16	2.71	3.36	4.12	5.02	6.06	7.27	8.67	10.3
22	2.65	3.35	4.2	5.2	6.38	7.76	9.36	11.2	13.4	15.9
28	5.4	6.83	8.53	10.6	12.9	15.7	19	22.7	27.1	32
35	9.44	11.9	14.9	18.4	22.6	27.4	33	39.5	47	55.7
42	15	18.9	23.6	29.2	35.7	43.3	52.2	62.5	74.3	87.9
54	31.2	39.3	49.1	60.6	74.1	89.8	108	129	154	182
67	55.3	69.7	86.8	107	131	159	191	228	271	320
79	88.5	111	139	171	209	253	304	363	431	509
92	132	166	206	254	310	376	452	539	640	755
105	186	234	291	359	438	530	636	759	901	1063
Schedule 40 steel										
10	0.647	0.808	0.999	1.22	1.48	1.78	2.13	2.53	2.98	3.51
15	1.2	1.5	1.86	2.27	2.75	3.31	3.95	4.68	5.53	6.49
20	2.54	3.17	3.91	4.78	5.79	6.96	8.31	9.85	11.6	13.7
25	4.82	6.01	7.41	9.05	11	13.2	15.7	18.6	22	25.8
32	9.97	12.4	15.3	18.7	22.6	27.1	32.4	38.4	45.2	53.1
40	15	18.6	23	28	33.9	40.7	48.5	57.5	67.8	79.6
50	28.9	36	44.3	54.1	65.4	78.5	93.6	111	131	153
65	46.2	57.4	70.7	86.2	104	125	149	177	208	244
80	81.7	102	125	152	184	221	264	312	368	432
100	167	207	255	310	375	450	536	636	749	879

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 4a: Discharge line capacities in kW for Klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Condenser Saturation temperature change 2.0 K in 100 m Pressure gradient of 1186 Pa/m Mean evaporating temperature °C Discharge line superheat of 45.0 K									
	-40.0	-35.0	-30.0	-25.0	-20.0	-15.0	-10.0	-5.0	0.0	5.0
T Type L Copper										
10	1.94	1.97	2	2.03	2.06	2.08	2.11	2.13	2.15	2.17
12	4.43	4.5	4.57	4.64	4.7	4.76	4.81	4.86	4.91	4.95
15	8.28	8.42	8.55	8.68	8.8	8.91	9.01	9.1	9.19	9.26
19	14.08	14.32	14.54	14.75	14.95	15.14	15.31	15.47	15.62	15.74
22	21.7	22.07	22.41	22.74	23.05	23.34	23.6	23.85	24.07	24.27
28	43.8	44.53	45.23	45.89	46.51	47.09	47.63	48.13	48.57	48.97
35	76.03	77.31	78.52	79.66	80.74	81.75	82.69	83.55	84.33	85.02
42	120	122	124	126	127	129	130	132	133	134
54	247	252	255	259	263	266	269	272	274	277
67	435	443	450	456	462	468	474	479	483	487
79	693	704	715	726	735	745	753	761	768	774
92	1027	1044	1060	1076	1090	1104	1117	1128	1139	1148
105	1444	1469	1492	1513	1534	1553	1571	1587	1602	1615
Schedule 40 steel										
10	4.73	4.81	4.88	4.95	5.02	5.08	5.14	5.2	5.25	5.29
15	8.76	8.9	9.04	9.17	9.3	9.42	9.52	9.62	9.71	9.79
20	18.4	18.71	19.01	19.28	19.54	19.79	20.02	20.22	20.41	20.58
25	34.76	35.35	35.9	36.42	36.92	37.38	37.81	38.2	38.56	38.87
32	71.56	72.76	73.89	74.97	75.99	76.94	77.82	78.63	79.37	80.02
40	107	109	111	112	114	115	117	118	119	120
50	207	210	213	217	219	222	225	227	229	231
65	329	335	340	345	350	354	358	362	365	368
80	582	591	601	609	618	625	632	639	645	650
100	1183	1203	1222	1240	1257	1272	1287	1300	1312	1323

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 4b: Discharge line capacities in kW for Klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Condenser Saturation temperature change 2.0 K in 100 m Pressure gradient of 1186 Pa/m Mean evaporating temperature °C Discharge line superheat of 60.0 K									
	-40.0	-35.0	-30.0	-25.0	-20.0	-15.0	-10.0	-5.0	0.0	5.0
T										
Type	L Copper									
10	1.85	1.89	1.91	1.94	1.97	1.99	2.02	2.04	2.06	2.07
12	4.24	4.31	4.37	4.44	4.5	4.56	4.61	4.66	4.7	4.74
15	7.93	8.07	8.19	8.31	8.42	8.53	8.63	8.72	8.8	8.87
19	13.49	13.71	13.93	14.13	14.32	14.5	14.67	14.82	14.96	15.08
22	20.8	21.15	21.48	21.79	22.09	22.36	22.62	22.86	23.07	23.26
28	41.99	42.69	43.36	43.99	44.59	45.14	45.66	46.14	46.57	46.95
35	72.92	74.14	75.3	76.4	77.43	78.4	79.3	80.12	80.87	81.53
42	115	117	119	121	122	124	125	126	128	129
54	237	241	245	249	252	255	258	261	263	265
67	418	425	432	438	444	449	455	459	464	467
79	665	676	687	697	706	715	723	731	737	744
92	986	1002	1018	1033	1047	1060	1072	1083	1093	1102
105	1387	1410	1432	1453	1473	1491	1509	1524	1539	1551
	Schedule 40 steel									
10	4.55	4.63	4.7	4.77	4.83	4.89	4.95	5	5.05	5.09
15	8.43	8.57	8.7	8.83	8.95	9.06	9.17	9.26	9.35	9.42
20	17.72	18.01	18.29	18.56	18.81	19.05	19.27	19.47	19.65	19.81
25	33.46	34.02	34.56	35.06	35.54	35.98	36.39	36.77	37.12	37.42
32	68.89	70.04	71.14	72.17	73.15	74.07	74.92	75.7	76.4	77.03
40	103	105	107	108	110	111	112	113	115	115
50	199	202	205	208	211	214	216	219	221	223
65	317	322	327	332	337	341	345	348	352	355
80	560	569	578	587	595	602	609	615	621	626
100	1139	1158	1177	1194	1210	1225	1239	1252	1264	1274

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 40.0 °C

Table 5a : Liquid line capacities in kW for Klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Liquid line velocity 0.5 m/s Mean evaporating temperature °C									
	-40.0	-35.0	-30.0	-25.0	-20.0	-15.0	-10.0	-5.0	0.0	5.0
Type L Copper										
10	3.45	3.5	3.56	3.61	3.66	3.71	3.75	3.79	3.82	3.85
12	6.42	6.53	6.63	6.73	6.82	6.9	6.98	7.06	7.12	7.18
15	10.31	10.49	10.65	10.81	10.95	11.09	11.22	11.33	11.44	11.53
19	15.42	15.67	15.92	16.15	16.37	16.58	16.77	16.94	17.1	17.24
22	21.41	21.77	22.11	22.43	22.74	23.02	23.28	23.53	23.75	23.94
28	36.51	37.13	37.71	38.26	38.77	39.26	39.71	40.12	40.5	40.83
35	55.59	56.52	57.41	58.24	59.03	59.77	60.46	61.09	61.66	62.16
42	78.7	80.02	81.27	82.46	83.57	84.62	85.59	86.48	87.29	88
54	137	139	141	143	145	147	149	150	152	153
67	211	215	218	221	224	227	230	232	234	236
79	301	306	311	316	320	324	328	331	334	337
92	408	414	421	427	433	438	443	448	452	456
105	530	539	547	555	563	570	576	582	588	592
Schedule 40 steel										
10	8.44	8.58	8.72	8.84	8.96	9.08	9.18	9.28	9.36	9.44
15	13.44	13.67	13.88	14.08	14.28	14.45	14.62	14.77	14.91	15.03
20	23.59	23.98	24.36	24.71	25.05	25.36	25.65	25.92	26.16	26.38
25	38.22	38.86	39.46	40.04	40.58	41.09	41.56	41.99	42.39	42.73
32	66.15	67.26	68.31	69.31	70.25	71.13	71.94	72.69	73.37	73.97
40	90.04	91.54	92.98	94.33	95.61	96.81	97.92	98.94	99.86	101
50	148	151	153	156	158	160	161	163	165	166
65	212	215	219	222	225	228	230	233	235	237
80	327	333	338	343	347	352	356	359	363	366
100	563	573	581	590	598	605	612	619	625	630

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling)

Table 5b : Liquid line capacities in kW for Klea® 410A Saturated vapour leaving evaporator

Nominal line size mm	Condenser saturation temperature change 2.0k in 100m Pressure gradient of 1186 Pa/m Mean evaporating temperature °C									
	-40.0	-35.0	-30.0	-25.0	-20.0	-15.0	-10.0	-5.0	0.0	5.0
Type L Copper										
10	6.82	6.94	7.05	7.15	7.24	7.34	7.42	7.5	7.57	7.63
12	15.64	15.9	16.15	16.39	16.61	16.82	17.01	17.19	17.35	17.49
15	29.36	29.85	30.32	30.76	31.18	31.57	31.93	32.26	32.56	32.83
19	50.02	50.86	51.65	52.4	53.11	53.78	54.4	54.96	55.47	55.93
22	77.25	78.54	79.77	80.93	82.03	83.05	84.01	84.88	85.67	86.38
28	156	159	161	164	166	168	170	172	173	175
35	272	277	281	285	289	292	296	299	302	304
42	430	437	444	450	456	462	467	472	476	480
54	889	903	918	931	944	955	966	976	986	994
67	1567	1593	1618	1642	1664	1685	1704	1722	1738	1752
79	2496	2538	2578	2615	2651	2684	2715	2743	2769	2791
92	3705	3767	3826	3882	3935	3984	4029	4071	4109	4143
105	5218	5306	5389	5467	5541	5610	5675	5734	5787	5835
Schedule 40 steel										
10	17.35	17.64	17.92	18.18	18.42	18.65	18.87	19.07	19.24	19.4
15	32.15	32.69	33.2	33.69	34.14	34.57	34.97	35.33	35.66	35.95
20	67.63	68.77	69.84	70.86	71.82	72.72	73.55	74.32	75.01	75.63
25	128	130	132	134	136	137	139	140	142	143
32	263	268	272	276	280	283	286	289	292	294
40	395	401	408	414	419	425	429	434	438	441
50	761	774	786	797	808	818	828	836	844	851
65	1213	1233	1252	1271	1288	1304	1319	1333	1345	1356
80	2143	2178	2213	2245	2275	2304	2330	2354	2376	2396
100	4361	4434	4503	4569	4631	4688	4742	4792	4836	4876

Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling)



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