



**Air-Conditioning, Heating, and Refrigeration
Institute (AHRI) Low-GWP Alternative Refrigerants
Evaluation Program (Low-GWP AREP)**

TEST REPORT #28

Compressor Calorimeter Test of R- 404A Alternative Refrigerant L-40 in Reciprocating Compressors

Jozef Sedliak

Embraco Slovakia
Odorinska cesta 2, 052 01 Spisska Nova Ves,
Slovakia

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**This report has been made available to the public
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Air-Conditioning, Heating, and Refrigeration Institute
2111 Wilson Boulevard, Suite 500
Arlington VA 22201
(703) 524-8800
www.ahrinet.org

List of Tested Refrigerant's Compositions (Mass%)

L-40	R-32/R-152a/R-1234yf/R-1234ze(E) (40/10/20/30)
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1. Introduction:

Scope of the work is evaluation of the compressor performance with new low GWP refrigerant L-40 in compressor NEK2134GK primarily used for R404A refrigerant.

2. Details of Test Setup:

a. Description of Test Refrigerant-Lubricant and Charge

- Refrigerant or refrigerant blend tested
 - R404A by supplier LINDE
 - New mixture refrigerant named L-40 delivered by Honeywell
- Lubricant
 - Compressor lubricant is POE oil Emkarate RL 22HB by Lubrizol

b. Description of Compressors and test conditions/methodology

The evaluation was done by testing of 2 compressors model NEK2134GK, 958AG71 made by Embraco, type hermetic reciprocating one piston compressor. Compressors are primarily used for R404A refrigerant. First test was done with R404A for purpose of reference values and then they were tested with new refrigerant L-40. Average from 2 compressors was considered in the final results.

Model	NEK2134GK	NEK2134GK
BOM	958AG71	958AG71
Application	LBP-HST	LBP-HST
S/N	P12RLC52	P12RPA8D
Oil	POE 22	POE 22
Motor	CSIR, monophase	CSIR, monophase
Power supply	115V/60Hz	115V/60Hz
Ambient temperature	35°C	35°C
Subcooling	0°C	0°C
Fan cooling	270 m ³ /h	270 m ³ /h
Temperature determination	Dewpoint	Dewpoint

Table 2-1, Compressor configuration and test description

Thermodynamic properties of R404A determined from Refprop 6.0 (by NIST USA), thermodynamic properties of L-40 determined from .xls file received from Honeywell.

c. Test facilities

The performance tests were performed on a calorimeter using Calorimetric method A Secondary fluid calorimeter on the suction side, see EN13771. Before the measurements were done, the calorimeter was cleaned from potential residues of previous tests, evacuated and subsequently charged with the correct refrigerant R404A and L-40.

Calorimeter charge with R404A: 0.7 kg
 Calorimeter charge with L-40: 1.2 kg

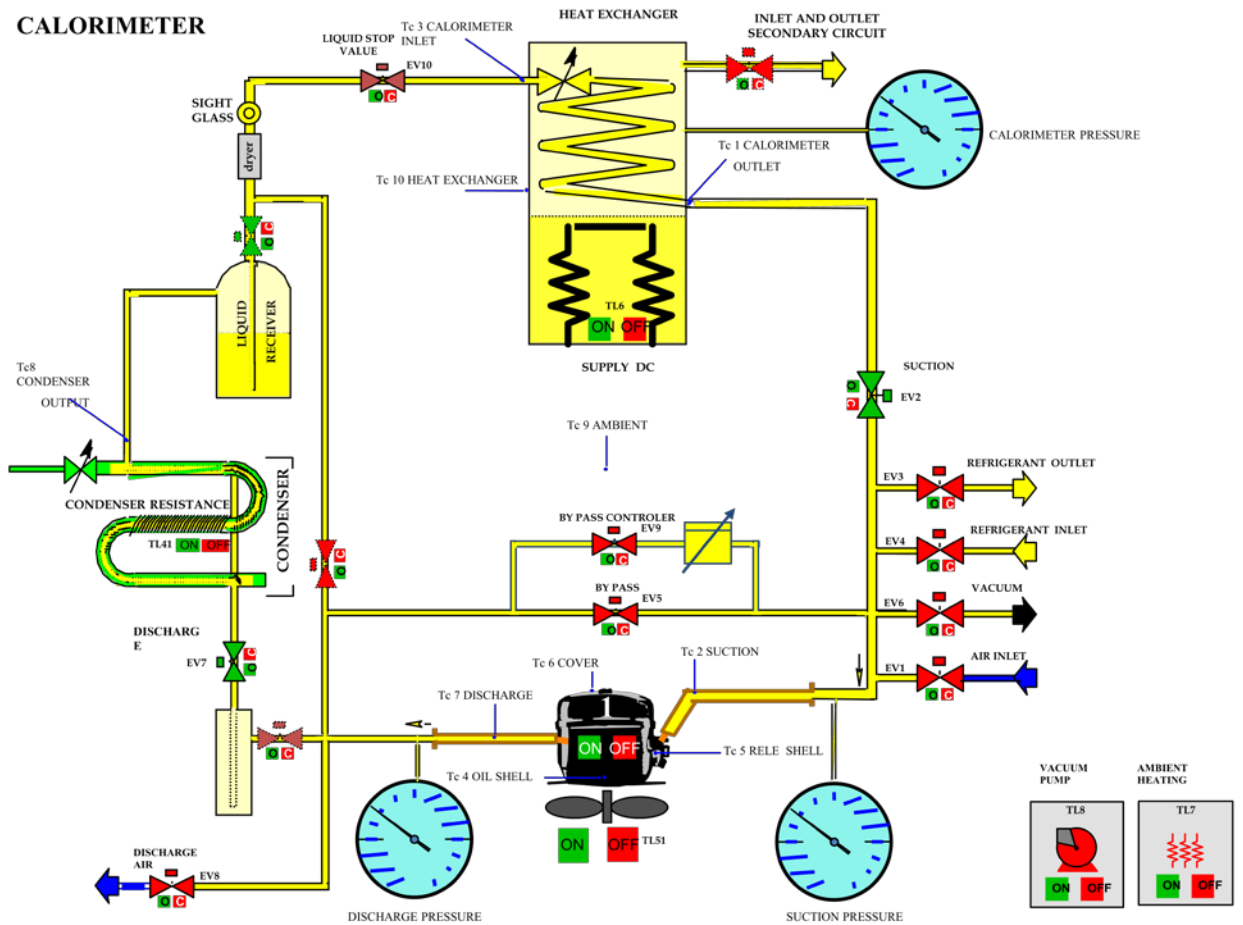


Figure 2-1, Schematic diagram of the calorimeter

Parameter	Instrument	Accuracy
Compressor power input	Yokogawa WT230	± (0.1% of reading + 0.1% of range),
Compressor voltage	Yokogawa WT230	± (0.1% of reading + 0.1% of range), 300 V
Compressor current	Yokogawa WT230	± (0.1% of reading + 0.1% of range), 10 A
Heat exchanger DC power input	Yokogawa WT230	± (0.3% of reading + 0.2% of range)
Heat exchanger DC voltage	Yokogawa WT230	± (0.2% of reading + 0.2% of range), 300 V
Heat exchanger DC current	Yokogawa WT230	± (0.2% of reading + 0.2% of range), 20 A
Suction pressure transducer	BD sensor 10 bar	± 0.1% of range
Discharge pressure transducer	BD sensor 40 bar	± 1% of range
Temperature - Heat exchanger input	TC "T", Agilent 34970A	± 0.5°C
Temperature - Heat exchanger output	TC "T", Agilent 34970A	± 0.5°C
Temperature - Heat exchanger internal	TC "T", Agilent 34970A	± 0.3°C
Temperature - Calorimeter ambient	TC "T", Agilent 34970A	± 0.5°C
Temperature - Compressor shell	TC "T", Agilent 34970A	± 0.5°C
Temperature - Return gas	TC "T", Agilent 34970A	± 0.5°C

Table 2-2, List of instruments with their accuracy

d. Coefficients equation format

Coefficients equation format:

$$X = C1 + C2 \cdot (S) + C3 \cdot D + C4 \cdot (S^2) + C5 \cdot (S \cdot D) + C6 \cdot (D^2) + C7 \cdot (S^3) + C8 \cdot (D \cdot S^2) + C9 \cdot (S \cdot D^2) + C10 \cdot (D^3)$$

where:

C = Equation coefficient, represents compressor performance

S = Suction dew point temperature, °F [°C]

D = Discharge dew point temperature, °F [°C]

X = compressor performance (mass flow rate, capacity, power and COP)

e. Uncertainties

Uncertainty for cooling capacity: ± 47.29 BTU/h (valid for all points)

Power input uncertainty: ± 3.46 W (valid for all points)

3. Results

General statement:

All compressor tests are performed at a refrigerant's dew point temperature for suction and discharge pressure conditions, per AHRI Standard 540 requirements. This does not have an impact on comparing compressor performance between two or more refrigerants that do not exhibit temperature glide. However, when refrigerants exhibit temperature glide, it is important to note that actual systems operate closer to the mid-point condition. When comparing compressor performance of one refrigerant with glide to another refrigerant without glide, or comparing two refrigerants with significantly different glides, comparison at pressures corresponding to the mid-point of the temperature glide rather than the dew point will yield results that are more representative of actual operation in a system.

3.1. Return gas temperature 18.3 °C

3.1.1. Reference measurement with R404A

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
R404A	30	-12	18.3	30.3	3399.9	458.4	5.80	7.42	25.01
R404A	30	-20	18.3	38.3	2399.7	398.1	5.39	6.03	17.40
R404A	30	-30	18.3	48.3	1477.2	324.4	4.97	4.56	10.59
R404A	30	-40	18.3	58.3	897.4	263.0	4.71	3.41	6.39
R404A	45	-12	18.3	30.3	2635.8	521.8	6.22	5.05	23.39
R404A	45	-20	18.3	38.3	1864.1	443.9	5.68	4.20	16.33
R404A	45	-30	18.3	48.3	1177.3	349.5	5.11	3.37	10.15
R404A	45	-40	18.3	58.3	653.6	261.9	4.67	2.50	5.58
R404A	60	-12	18.3	30.3	1841.5	587.0	6.69	3.14	21.49
R404A	60	-20	18.3	38.3	1301.3	483.6	5.93	2.69	14.88
R404A	60	-30	18.3	48.3	782.9	360.5	5.15	2.17	8.79
R404A	60	-40	18.3	58.3	396.5	247.4	4.62	1.60	4.41

Table 3-1a, Measured data of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
R404A	30	-12	18.3	30.3	2.6	0.6	0.9	1.9	2.8
R404A	30	-20	18.3	38.3	2.0	0.6	1.1	1.4	2.1
R404A	30	-30	18.3	48.3	2.2	1.7	1.4	3.8	2.1
R404A	30	-40	18.3	58.3	1.4	2.9	1.3	1.5	1.8
R404A	45	-12	18.3	30.3	1.6	1.7	1.3	0.0	1.4
R404A	45	-20	18.3	38.3	1.2	1.4	1.2	0.2	1.2
R404A	45	-30	18.3	48.3	0.5	3.0	2.0	3.4	0.2
R404A	45	-40	18.3	58.3	2.1	2.7	1.5	0.6	2.0
R404A	60	-12	18.3	30.3	2.2	3.0	2.1	0.7	2.3
R404A	60	-20	18.3	38.3	2.4	2.8	2.0	0.3	2.1
R404A	60	-30	18.3	48.3	4.0	3.6	2.4	0.4	4.1
R404A	60	-40	18.3	58.3	4.2	3.6	2.0	0.6	3.9

Table 3-1b, Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg/h, °C)	Power input (W, °C)
C1	8.633E+03	5.039E+01	3.710E+02
C2	2.922E+02	1.919E+00	3.588E+00
C3	-1.360E+02	-4.483E-01	5.509E+00
C4	3.689E+00	2.900E-02	-6.073E-02
C5	-3.030E+00	-9.549E-03	6.228E-02
C6	1.310E+00	6.495E-03	6.398E-03
C7	1.238E-02	1.532E-04	-1.175E-03
C8	-3.356E-02	-1.197E-04	1.103E-04
C9	2.412E-04	1.556E-05	1.282E-03
C10	-1.034E-02	-5.299E-05	5.070E-05

Table 3-2, Coefficients C1 – C10 for NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

CURVE-FITTED CHARTS

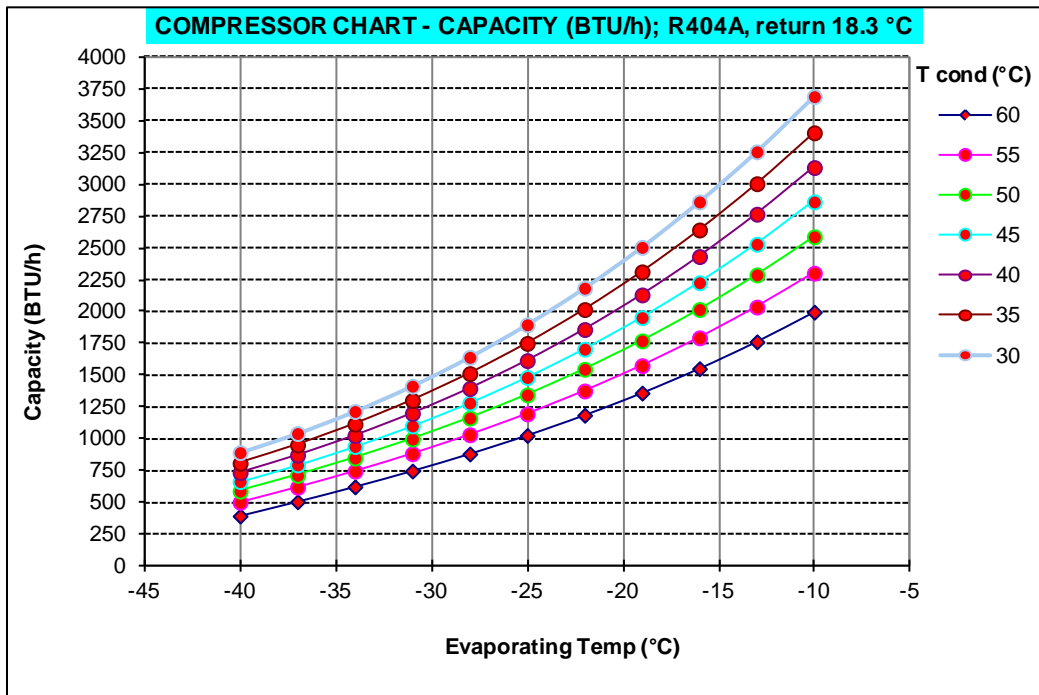


Figure 3-1, Cooling capacity of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

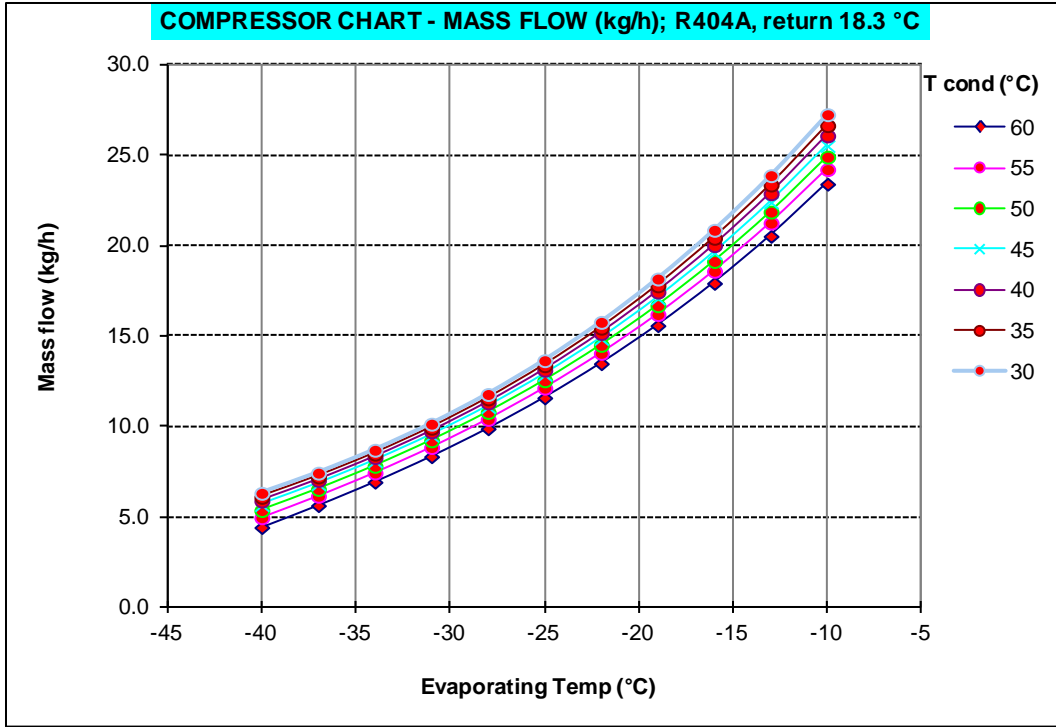


Figure 3-2, Mass flow of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

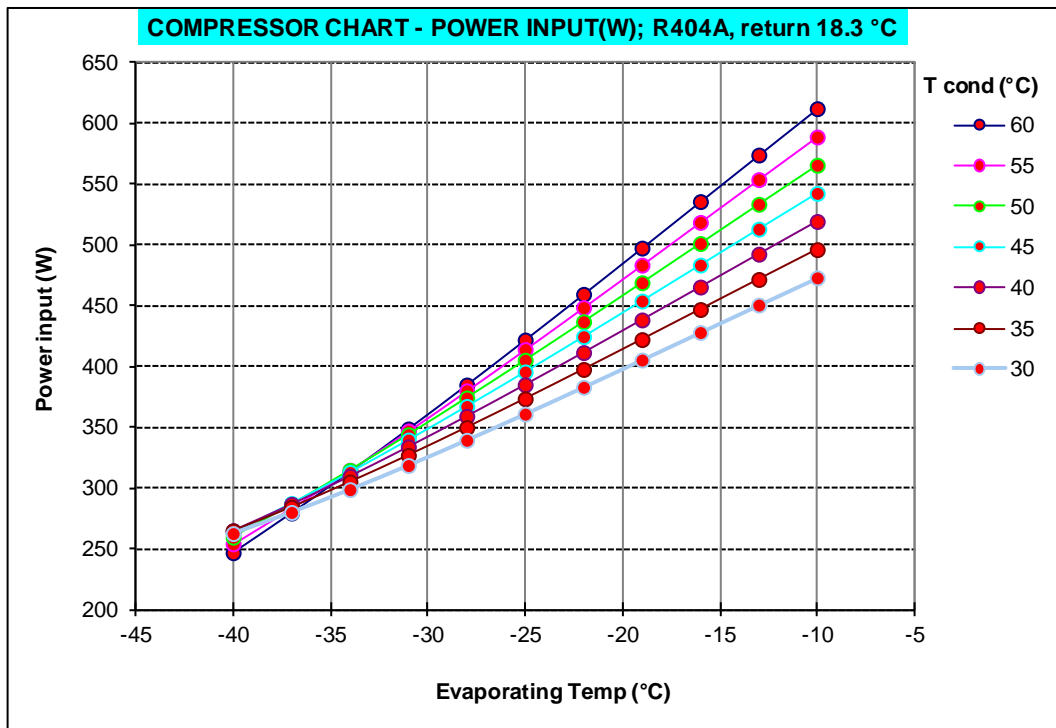


Figure 3-3, Power input of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

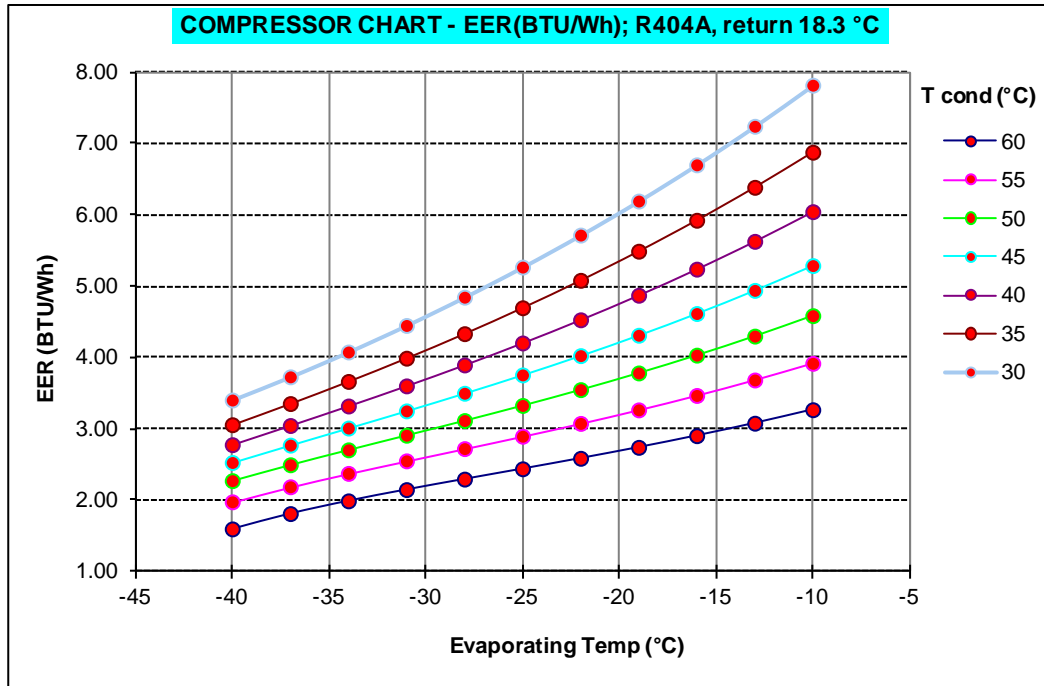


Figure 3-4, EER of NEK2134GK, refrigerant R404A, return gas temperature 18.3 °C

3.1.2. Measurement with new refrigerant L-40

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
L-40	30	-12	18.3	30.3	2761.5	377.9	5.43	7.31	12.96
L-40	30	-20	18.3	38.3	1881.6	328.9	5.16	5.72	8.78
L-40	30	-30	18.3	48.3	1136.6	267.5	4.88	4.25	5.25
L-40	30	-40	18.3	58.3	548.2	216.0	4.69	2.54	2.53
L-40	45	-12	18.3	30.3	2244.6	429.6	5.72	5.23	11.93
L-40	45	-20	18.3	38.3	1507.3	361.3	5.33	4.17	7.96
L-40	45	-30	18.3	48.3	883.0	287.4	4.98	3.07	4.61
L-40	45	-40	18.3	58.3	482.5	221.7	4.77	2.18	2.48
L-40	60	-12	18.3	30.3	1714.9	474.3	6.01	3.62	10.67
L-40	60	-20	18.3	38.3	1156.0	393.5	5.50	2.94	7.11
L-40	60	-30	18.3	48.3	666.4	296.5	5.02	2.25	4.08
L-40	60	-40	18.3	58.3	367.2	223.9	4.79	1.64	2.21

Table 3-3a, Measured data of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
L-40	30	-12	18.3	30.3	1.0	1.5	2.2	0.5	0.8
L-40	30	-20	18.3	38.3	1.2	1.6	2.4	2.8	1.0
L-40	30	-30	18.3	48.3	2.4	2.9	3.5	0.5	3.9
L-40	30	-40	18.3	58.3	2.0	4.1	2.8	2.1	2.6
L-40	45	-12	18.3	30.3	3.5	1.1	1.4	2.4	3.2
L-40	45	-20	18.3	38.3	4.0	1.4	1.1	2.6	4.0
L-40	45	-30	18.3	48.3	0.8	2.2	2.0	1.4	0.9
L-40	45	-40	18.3	58.3	3.3	2.6	1.9	0.7	2.5
L-40	60	-12	18.3	30.3	3.0	0.7	0.2	2.2	3.0
L-40	60	-20	18.3	38.3	3.3	0.2	0.9	3.5	4.2
L-40	60	-30	18.3	48.3	3.4	2.8	1.6	0.6	3.2
L-40	60	-40	18.3	58.3	3.6	2.7	3.8	0.8	3.7

Table 3-3b., Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg/h, °C)	Power input (W, °C)
C1	6.725E+03	2.600E+01	2.476E+02
C2	2.393E+02	9.643E-01	-1.573E+00
C3	-8.870E+01	-1.800E-01	7.270E+00
C4	3.402E+00	1.624E-02	-1.418E-01
C5	-1.679E+00	-5.849E-05	2.036E-01
C6	8.080E-01	2.377E-03	-2.994E-02
C7	2.305E-02	1.211E-04	-1.454E-03
C8	-8.357E-03	4.717E-07	1.836E-03
C9	2.622E-03	-2.247E-05	-2.261E-05
C10	-5.502E-03	-2.138E-05	1.270E-04

Table 3-4, Coefficients C1 – C10 for NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

CURVE-FITTED CHARTS

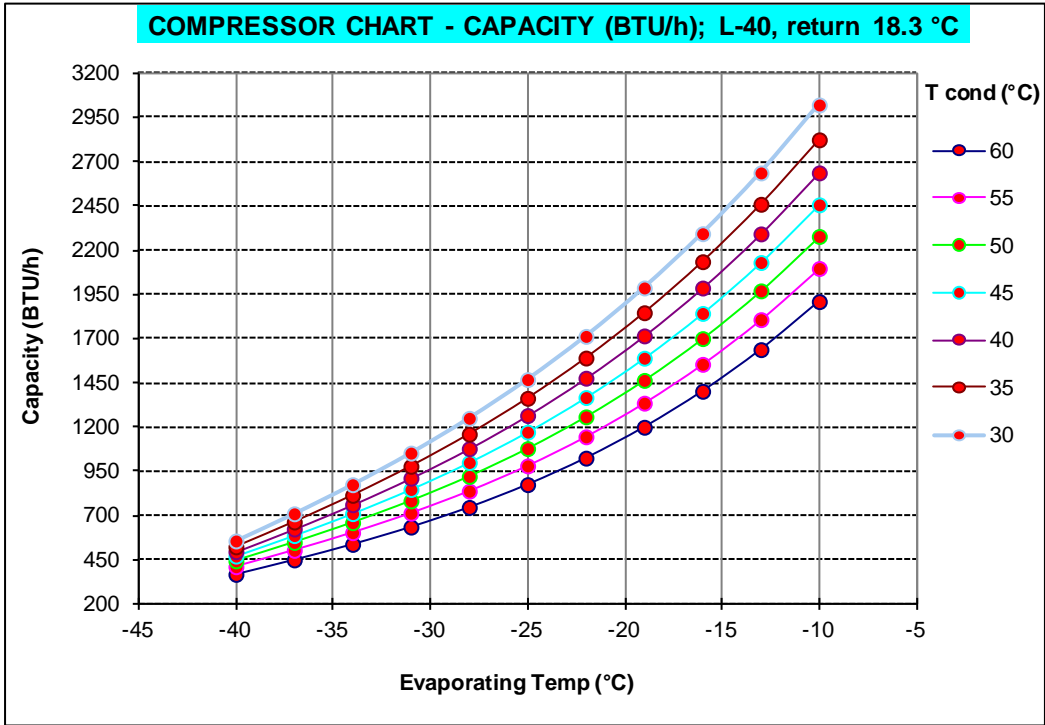


Figure 3-5, Cooling capacity of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

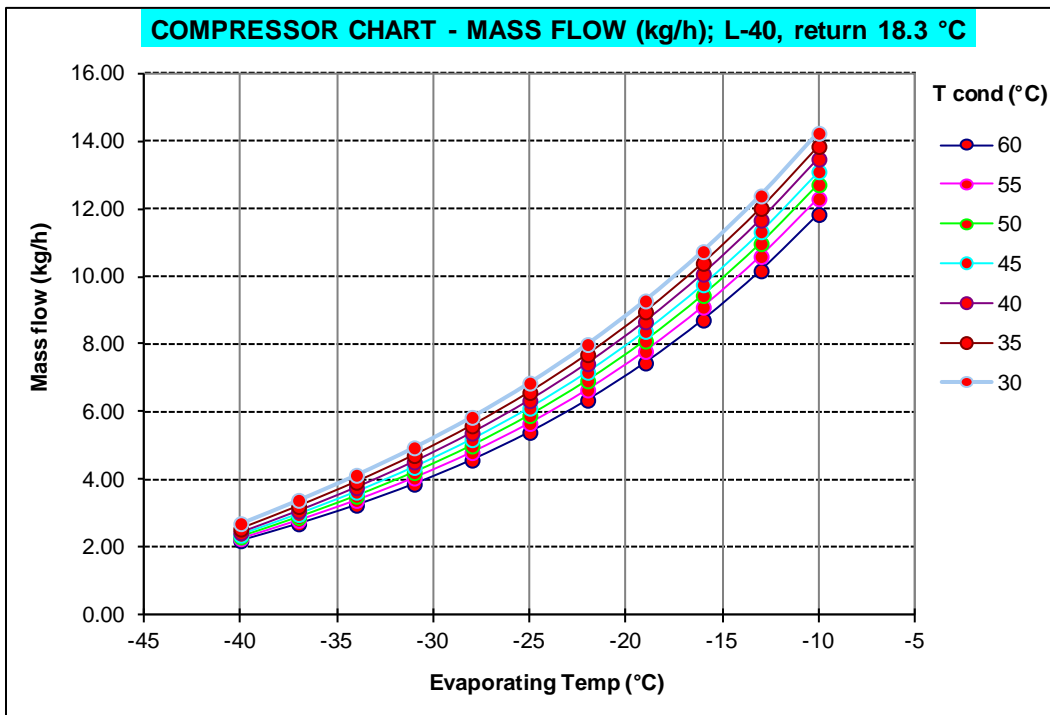


Figure 3-6, Mass flow of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

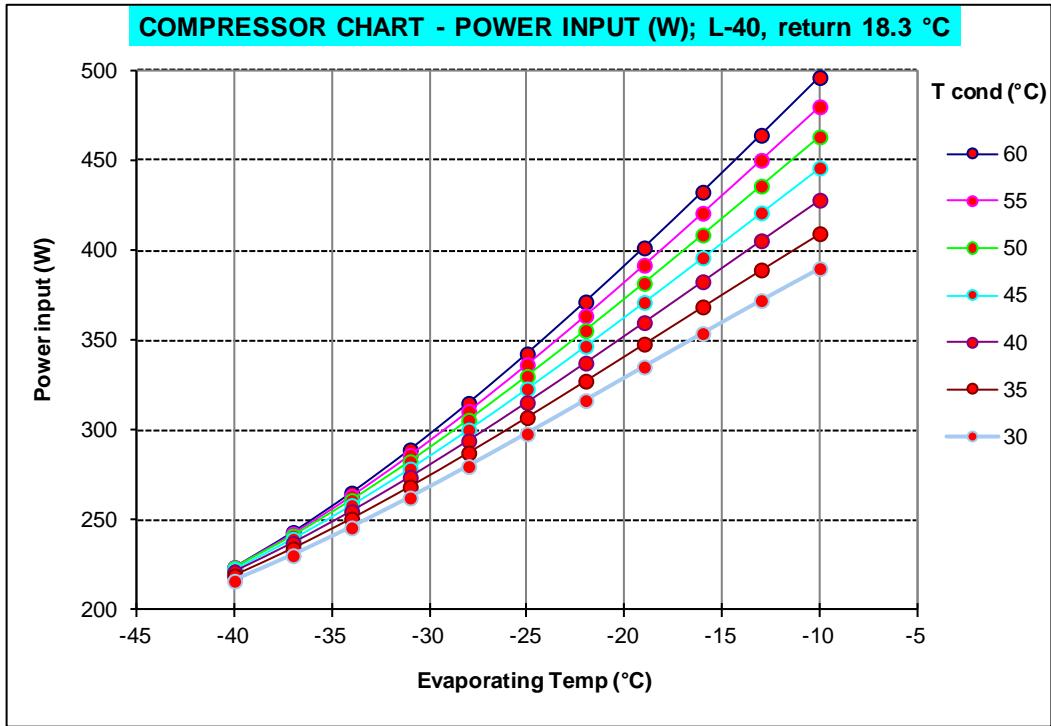


Figure 3-7, Power input of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

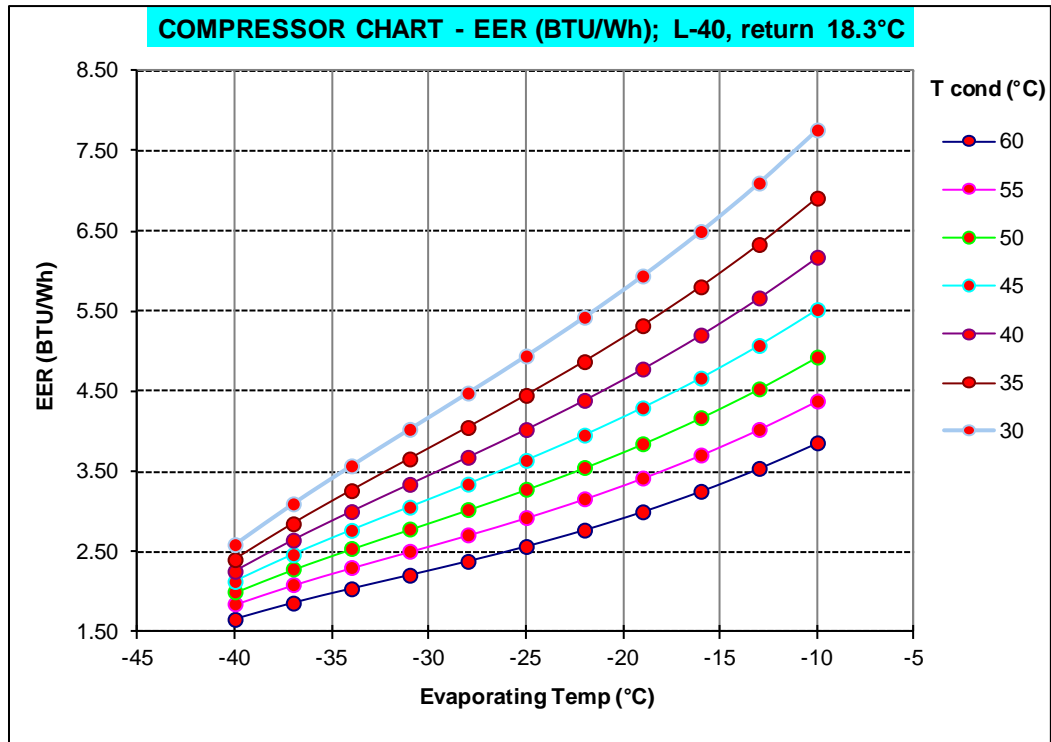


Figure 3-8, EER of NEK2134GK, refrigerant L-40, return gas temperature 18.3 °C

3.1.3. Comparison of the results

Capacity (BTU/h) L-40

°C	60	55	50	45	40	35	30
-40	369	412	445	472	497	524	557
-37	450	505	549	588	625	665	711
-34	538	604	661	712	762	815	875
-31	636	714	784	849	912	979	1054
-28	747	839	922	1001	1079	1161	1251
-25	876	982	1079	1173	1266	1364	1470
-22	1026	1146	1259	1368	1477	1591	1714
-19	1200	1336	1465	1590	1717	1848	1988
-16	1403	1556	1701	1844	1987	2136	2294
-13	1639	1808	1971	2131	2293	2461	2638
-10	1910	2098	2279	2457	2638	2825	3022

Mass Flow (kg/h) L-40

°C	60	55	50	45	40	35	30
-40	2.22	2.28	2.33	2.38	2.45	2.56	2.72
-37	2.71	2.82	2.90	2.99	3.09	3.23	3.41
-34	3.26	3.41	3.53	3.65	3.78	3.94	4.15
-31	3.88	4.07	4.23	4.38	4.54	4.73	4.96
-28	4.59	4.82	5.01	5.20	5.39	5.61	5.86
-25	5.41	5.68	5.91	6.13	6.35	6.59	6.87
-22	6.36	6.67	6.94	7.19	7.44	7.71	8.01
-19	7.46	7.80	8.11	8.40	8.68	8.97	9.29
-16	8.73	9.11	9.45	9.77	10.08	10.40	10.75
-13	10.18	10.60	10.98	11.34	11.68	12.02	12.39
-10	11.84	12.31	12.72	13.11	13.48	13.85	14.24

Capacity (BTU/h) R404A

°C	60	55	50	45	40	35	30
-40	393	501	588	664	734	808	892
-37	505	619	713	795	871	951	1042
-34	622	746	849	940	1026	1115	1215
-31	747	883	998	1102	1200	1302	1415
-28	881	1032	1163	1282	1396	1513	1641
-25	1027	1196	1346	1483	1615	1751	1898
-22	1186	1377	1548	1706	1860	2017	2186
-19	1360	1576	1771	1954	2133	2314	2507
-16	1552	1795	2018	2228	2435	2644	2864
-13	1764	2037	2290	2531	2768	3008	3259
-10	1997	2303	2590	2865	3135	3408	3693

Mass Flow (kg/h) R404A

°C	60	55	50	45	40	35	30
-40	4.46	5.00	5.40	5.69	5.92	6.13	6.35
-37	5.67	6.19	6.57	6.84	7.06	7.25	7.46
-34	6.96	7.47	7.84	8.11	8.33	8.52	8.73
-31	8.37	8.88	9.25	9.53	9.75	9.95	10.17
-28	9.92	10.44	10.82	11.11	11.35	11.57	11.81
-25	11.62	12.16	12.57	12.89	13.15	13.40	13.68
-22	13.51	14.09	14.53	14.88	15.19	15.48	15.80
-19	15.62	16.23	16.72	17.12	17.47	17.82	18.19
-16	17.95	18.62	19.17	19.63	20.04	20.45	20.89
-13	20.55	21.29	21.90	22.42	22.91	23.39	23.91
-10	23.44	24.25	24.93	25.54	26.11	26.67	27.28

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	-6.1	-17.7	-24.4	-28.9	-32.3	-35.1	-37.5
-37	-10.8	-18.5	-23.0	-26.0	-28.3	-30.1	-31.7
-34	-13.5	-19.0	-22.2	-24.2	-25.7	-26.9	-28.0
-31	-14.9	-19.1	-21.5	-23.0	-24.0	-24.8	-25.5
-28	-15.2	-18.7	-20.7	-21.9	-22.7	-23.3	-23.8
-25	-14.7	-17.9	-19.8	-20.9	-21.6	-22.1	-22.6
-22	-13.5	-16.7	-18.6	-19.8	-20.6	-21.1	-21.6
-19	-11.8	-15.2	-17.3	-18.6	-19.5	-20.2	-20.7
-16	-9.6	-13.3	-15.7	-17.3	-18.4	-19.2	-19.9
-13	-7.1	-11.2	-13.9	-15.8	-17.2	-18.2	-19.1
-10	-4.3	-8.9	-12.0	-14.2	-15.8	-17.1	-18.2

Mass flow: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	-50.3	-54.4	-56.9	-58.2	-58.6	-58.2	-57.2
-37	-52.1	-54.5	-55.8	-56.3	-56.2	-55.5	-54.3
-34	-53.1	-54.4	-55.0	-55.0	-54.6	-53.7	-52.5
-31	-53.6	-54.2	-54.3	-54.0	-53.4	-52.5	-51.2
-28	-53.7	-53.8	-53.7	-53.2	-52.5	-51.5	-50.4
-25	-53.4	-53.3	-53.0	-52.4	-51.7	-50.8	-49.8
-22	-52.9	-52.7	-52.3	-51.7	-51.0	-50.2	-49.3
-19	-52.2	-51.9	-51.5	-51.0	-50.3	-49.6	-48.9
-16	-51.4	-51.1	-50.7	-50.2	-49.7	-49.1	-48.5
-13	-50.5	-50.2	-49.8	-49.4	-49.0	-48.6	-48.2
-10	-49.5	-49.2	-49.0	-48.7	-48.4	-48.1	-47.8

Power Input (W) L-40								EER (BTU/Wh) L-40							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	224	224	223	222	221	219	216	-40	1.65	1.84	1.99	2.12	2.25	2.39	2.58
-37	243	242	241	239	237	234	230	-37	1.85	2.08	2.28	2.46	2.64	2.84	3.09
-34	265	263	261	258	255	251	246	-34	2.03	2.30	2.53	2.76	2.99	3.25	3.56
-31	289	286	282	278	274	268	262	-31	2.20	2.50	2.78	3.05	3.33	3.65	4.02
-28	315	310	306	300	294	287	280	-28	2.37	2.70	3.02	3.34	3.67	4.04	4.47
-25	342	336	330	323	315	307	298	-25	2.56	2.92	3.27	3.63	4.02	4.44	4.93
-22	371	364	355	347	337	327	316	-22	2.76	3.15	3.54	3.95	4.38	4.86	5.42
-19	401	392	382	371	360	348	335	-19	2.99	3.41	3.84	4.29	4.77	5.31	5.93
-16	432	421	409	396	383	369	354	-16	3.25	3.70	4.16	4.66	5.19	5.80	6.49
-13	464	450	436	421	405	389	372	-13	3.53	4.02	4.52	5.06	5.66	6.32	7.09
-10	496	480	463	446	428	409	390	-10	3.85	4.37	4.92	5.51	6.16	6.90	7.75

Power Input (W) R404A								EER (BTU/Wh) R404A							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	247	254	259	263	265	265	262	-40	1.59	1.97	2.27	2.52	2.77	3.05	3.40
-37	279	284	286	287	286	284	280	-37	1.81	2.18	2.49	2.77	3.04	3.35	3.72
-34	313	315	314	313	310	305	298	-34	1.99	2.37	2.70	3.01	3.32	3.66	4.07
-31	348	347	344	339	334	327	318	-31	2.14	2.55	2.91	3.25	3.60	3.99	4.44
-28	385	380	374	367	359	350	339	-28	2.29	2.72	3.11	3.49	3.89	4.33	4.84
-25	422	414	405	395	385	373	361	-25	2.43	2.89	3.32	3.75	4.20	4.69	5.26
-22	459	448	437	424	411	397	383	-22	2.58	3.07	3.54	4.02	4.52	5.08	5.71
-19	497	483	469	454	438	422	405	-19	2.74	3.26	3.78	4.31	4.87	5.49	6.19
-16	535	518	501	483	465	447	428	-16	2.90	3.46	4.03	4.61	5.23	5.92	6.70
-13	574	554	533	513	492	471	450	-13	3.07	3.68	4.29	4.94	5.62	6.38	7.24
-10	612	589	565	542	519	496	473	-10	3.26	3.91	4.58	5.28	6.04	6.87	7.81

Power input: L40 change relative to R404A (%)								EER: L40 change relative to R404A (%)							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	-9.4	-11.9	-13.9	-15.4	-16.5	-17.3	-17.7	-40	3.6	-6.6	-12.1	-15.9	-18.9	-21.6	-24.1
-37	-12.9	-14.5	-15.8	-16.7	-17.3	-17.6	-17.7	-37	2.5	-4.6	-8.6	-11.2	-13.3	-15.2	-17.0
-34	-15.4	-16.3	-17.0	-17.5	-17.7	-17.8	-17.7	-34	2.3	-3.2	-6.2	-8.2	-9.7	-11.1	-12.5
-31	-17.0	-17.5	-17.8	-18.0	-18.0	-17.8	-17.6	-31	2.6	-1.9	-4.5	-6.1	-7.3	-8.4	-9.6
-28	-18.1	-18.3	-18.3	-18.2	-18.1	-17.8	-17.5	-28	3.6	-0.6	-3.0	-4.5	-5.7	-6.6	-7.6
-25	-18.8	-18.7	-18.5	-18.3	-18.0	-17.7	-17.4	-25	5.0	0.9	-1.5	-3.2	-4.4	-5.3	-6.3
-22	-19.1	-18.9	-18.6	-18.3	-18.0	-17.6	-17.3	-22	7.0	2.7	0.0	-1.9	-3.2	-4.2	-5.2
-19	-19.3	-18.9	-18.6	-18.2	-17.9	-17.6	-17.3	-19	9.3	4.6	1.6	-0.5	-2.0	-3.2	-4.2
-16	-19.3	-18.8	-18.5	-18.1	-17.8	-17.5	-17.3	-16	12.0	6.8	3.4	1.0	-0.8	-2.1	-3.1
-13	-19.1	-18.7	-18.3	-17.9	-17.6	-17.5	-17.4	-13	14.9	9.2	5.3	2.6	0.6	-0.9	-2.0
-10	-18.9	-18.5	-18.1	-17.8	-17.6	-17.5	-17.5	-10	18.0	11.7	7.4	4.3	2.1	0.4	-0.8

Table 3-5, Comparison of the results, return gas temperature 18.3 °C

3.2. Superheating 11.1 °C

3.2.1. Reference measurement with R404A

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
R404A	30	-12	-0.9	11.1	3112.8	464.0	5.84	6.71	26.02
R404A	30	-20	-8.9	11.1	2094.8	406.5	5.45	5.15	18.26
R404A	30	-30	-18.9	11.1	1238.6	330.5	5.01	3.75	11.32
R404A	30	-40	-28.9	11.1	690.1	264.2	4.69	2.61	6.69
R404A	45	-12	-0.9	11.1	2335.4	525.8	6.27	4.44	24.29
R404A	45	-20	-8.9	11.1	1552.6	447.3	5.71	3.47	16.96
R404A	45	-30	-18.9	11.1	894.8	351.9	5.12	2.54	10.45
R404A	45	-40	-28.9	11.1	462.0	264.8	4.69	1.75	5.82
R404A	60	-12	-0.9	11.1	1526.7	583.5	6.68	2.62	22.13
R404A	60	-20	-8.9	11.1	992.6	481.1	5.93	2.06	15.39
R404A	60	-30	-18.9	11.1	528.5	364.9	5.20	1.45	9.03
R404A	60	-40	-28.9	11.1	238.2	252.5	4.67	0.94	4.54

Table 3-6a, Measured data of NEK2134GK, refrigerant R404A, superheating 11.1°C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
R404A	30	-12	-0.9	11.1	2.6	1.0	1.0	1.6	2.7
R404A	30	-20	-8.9	11.1	1.6	0.0	0.7	1.5	1.3
R404A	30	-30	-18.9	11.1	1.8	2.6	1.6	0.7	1.8
R404A	30	-40	-28.9	11.1	0.0	3.3	1.9	3.2	0.1
R404A	45	-12	-0.9	11.1	2.2	1.6	1.4	0.6	2.4
R404A	45	-20	-8.9	11.1	1.2	1.6	1.4	0.4	1.4
R404A	45	-30	-18.9	11.1	0.9	2.1	1.6	2.9	1.0
R404A	45	-40	-28.9	11.1	0.0	2.6	1.3	2.5	0.9
R404A	60	-12	-0.9	11.1	3.2	2.3	2.0	2.6	3.1
R404A	60	-20	-8.9	11.1	3.5	3.1	2.0	0.4	3.3
R404A	60	-30	-18.9	11.1	1.4	3.4	2.3	1.9	1.7
R404A	60	-40	-28.9	11.1	2.7	4.3	4.2	1.6	2.6

Table 3-6b, Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant R404A, superheating 11.1 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg/h, °C)	Power input (W, °C)
C1	8.298E+03	4.921E+01	3.491E+02
C2	3.025E+02	1.761E+00	2.883E+00
C3	-1.241E+02	-3.407E-01	7.655E+00
C4	4.329E+00	2.364E-02	-2.829E-02
C5	-2.670E+00	-6.993E-03	1.374E-01
C6	1.054E+00	4.286E-03	-3.252E-02
C7	2.020E-02	9.636E-05	-2.655E-04
C8	-2.970E-02	-9.929E-05	8.385E-04
C9	-2.365E-03	-1.872E-06	6.640E-04
C10	-8.525E-03	-3.910E-05	2.346E-04

Table 3-7, Coefficients C1 – C10 for NEK2134GK, refrigerant R404A, superheating 11.1°C

CURVE-FITTED CHARTS

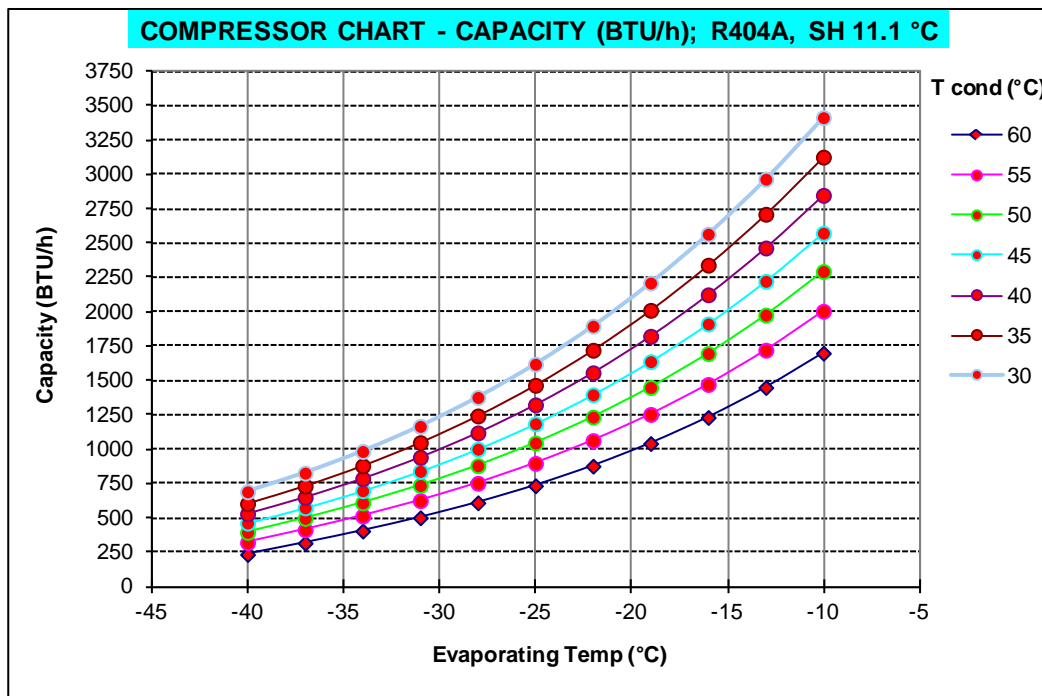


Figure 3-9, Cooling capacity of NEK2134GK, refrigerant R404A, superheating 11.1 °C

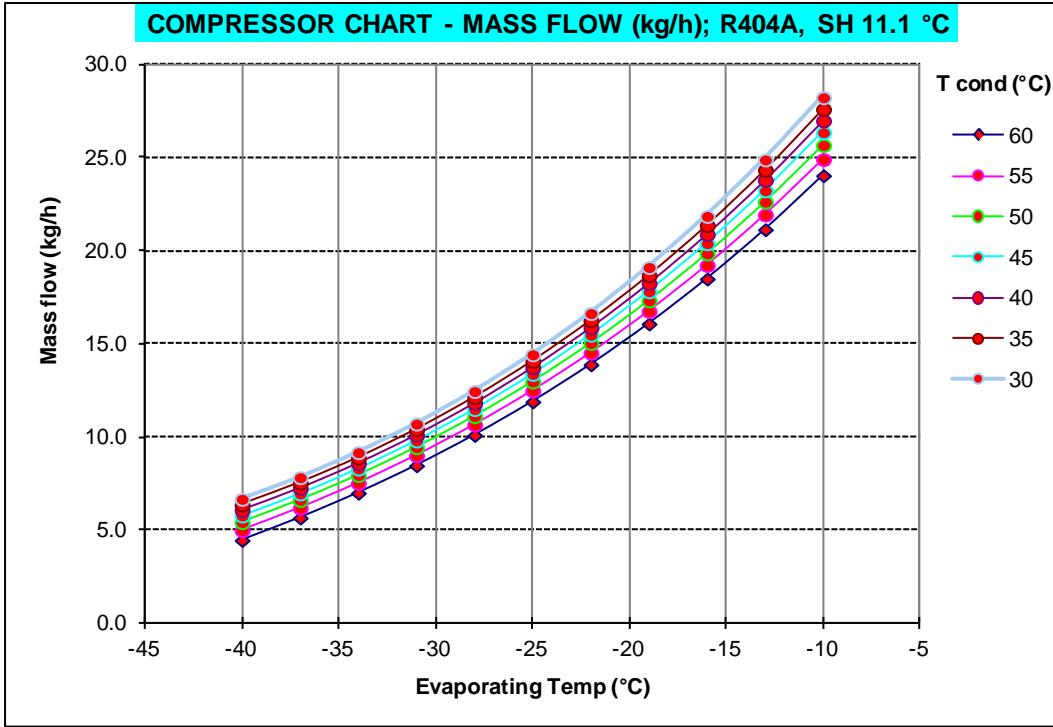


Figure 3-10, Mass flow of NEK2134GK, refrigerant R404A, superheating 11.1 °C

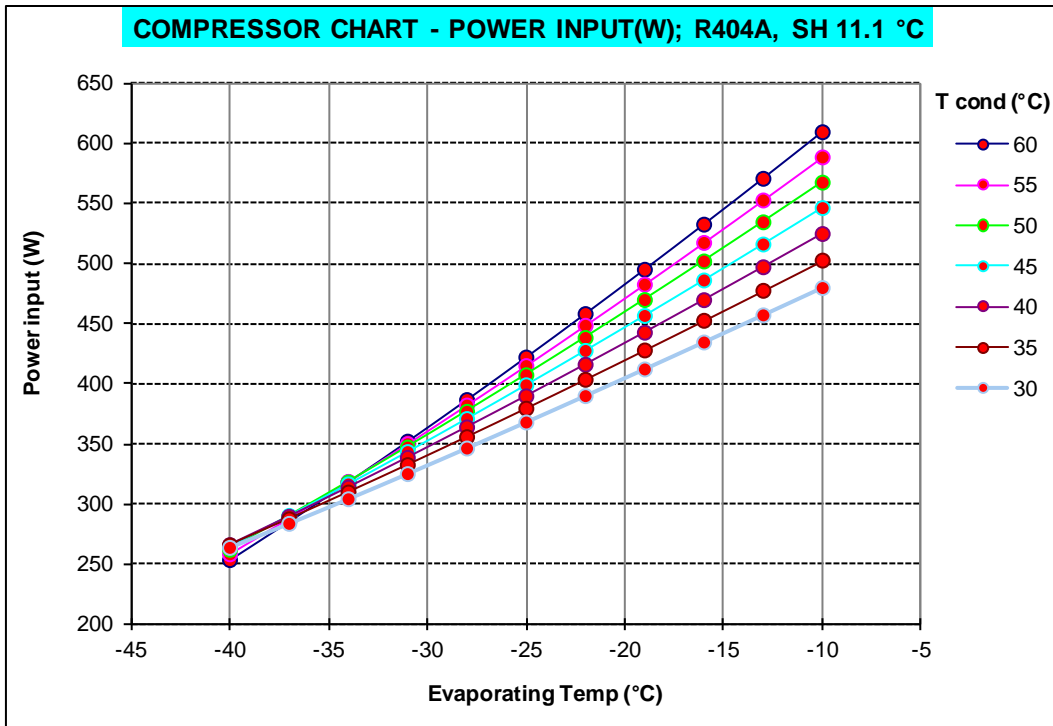


Figure 3-11, Power input of NEK2134GK, refrigerant R404A, superheating 11.1 °C

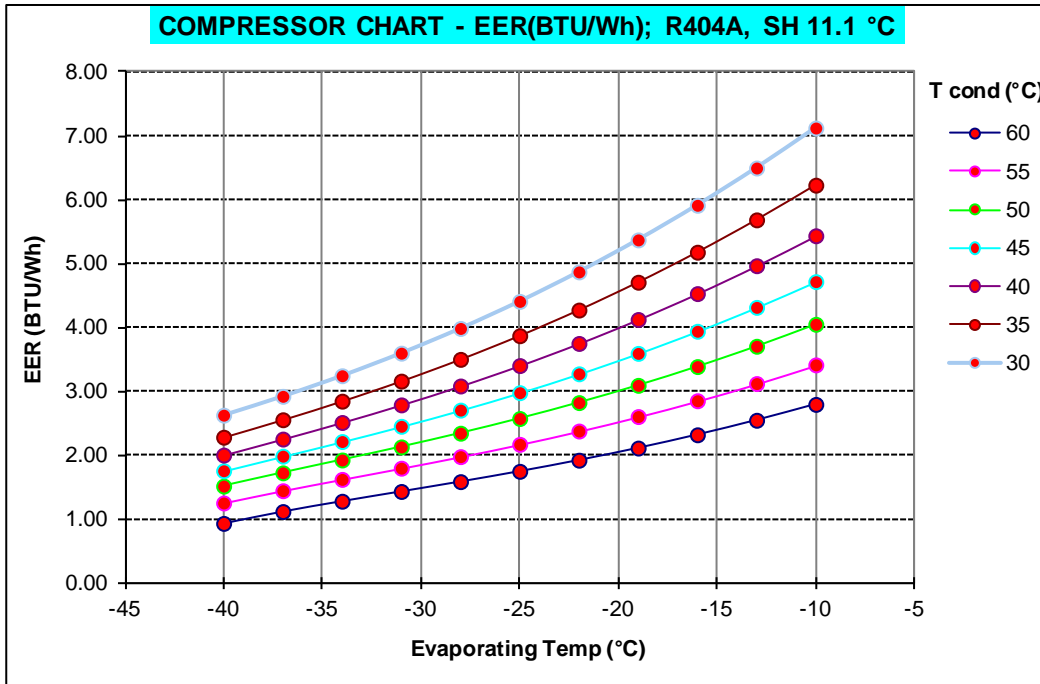


Figure 3-12, EER of NEK2134GK, refrigerant R404A, superheating 11.1 °C

3.2.2. Measurement with new refrigerant L-40

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
L-40	30	-12	-0.9	11.1	2562.8	382.7	5.50	6.70	13.07
L-40	30	-20	-8.9	11.1	1713.0	330.8	5.17	5.18	8.97
L-40	30	-30	-18.9	11.1	969.7	269.0	4.88	3.61	5.24
L-40	30	-40	-28.9	11.1	534.1	217.9	4.70	2.45	2.80
L-40	45	-12	-0.9	11.1	2040.4	432.3	5.76	4.72	11.96
L-40	45	-20	-8.9	11.1	1356.0	363.5	5.36	3.73	8.16
L-40	45	-30	-18.9	11.1	716.2	289.2	4.99	2.48	4.46
L-40	45	-40	-28.9	11.1	347.1	220.0	4.80	1.58	2.60
L-40	60	-12	-0.9	11.1	1564.8	475.9	6.03	3.29	10.90
L-40	60	-20	-8.9	11.1	1010.3	393.7	5.51	2.57	7.27
L-40	60	-30	-18.9	11.1	566.8	298.3	5.03	1.90	4.22
L-40	60	-40	-28.9	11.1	245.2	222.1	4.83	1.10	2.11

Table 3-8a, Measured data of NEK2134GK, refrigerant L-40, superheating 11.1 °C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
L-40	30	-12	-0.9	11.1	1.0	1.1	1.5	2.1	1.4
L-40	30	-20	-8.9	11.1	0.0	1.8	2.9	1.8	0.0
L-40	30	-30	-18.9	11.1	1.9	2.9	3.3	1.0	1.7
L-40	30	-40	-28.9	11.1	2.8	1.4	1.9	1.4	2.4
L-40	45	-12	-0.9	11.1	3.1	1.0	1.6	2.1	2.0
L-40	45	-20	-8.9	11.1	2.3	2.0	2.1	0.3	2.4
L-40	45	-30	-18.9	11.1	3.2	1.9	1.4	1.3	2.5
L-40	45	-40	-28.9	11.1	3.5	2.3	2.1	1.2	3.1
L-40	60	-12	-0.9	11.1	3.3	0.8	0.3	2.4	3.5
L-40	60	-20	-8.9	11.1	1.8	2.3	2.4	0.5	3.2
L-40	60	-30	-18.9	11.1	1.9	3.0	2.0	1.0	2.2
L-40	60	-40	-28.9	11.1	3.8	2.0	1.7	1.8	4.2

Table 3-8b, Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant L-40, superheating 11.1 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg/h, °C)	Power input (W, °C)
C1	6.291E+03	2.524E+01	2.685E+02
C2	2.292E+02	8.622E-01	7.105E-01
C3	-7.598E+01	-1.624E-01	7.363E+00
C4	3.136E+00	1.017E-02	-7.150E-02
C5	-1.607E+00	-1.977E-03	1.808E-01
C6	4.766E-01	1.303E-03	-4.004E-02
C7	1.035E-02	4.161E-05	-9.137E-04
C8	-2.312E-02	-6.825E-06	1.132E-03
C9	-5.023E-03	-4.519E-06	-1.713E-04
C10	-3.454E-03	-8.773E-06	1.861E-04

Table 3-9, Coefficients C1 – C10 for NEK2134GK, refrigerant L-40, superheating 11.1°C

CURVE-FITTED CHARTS

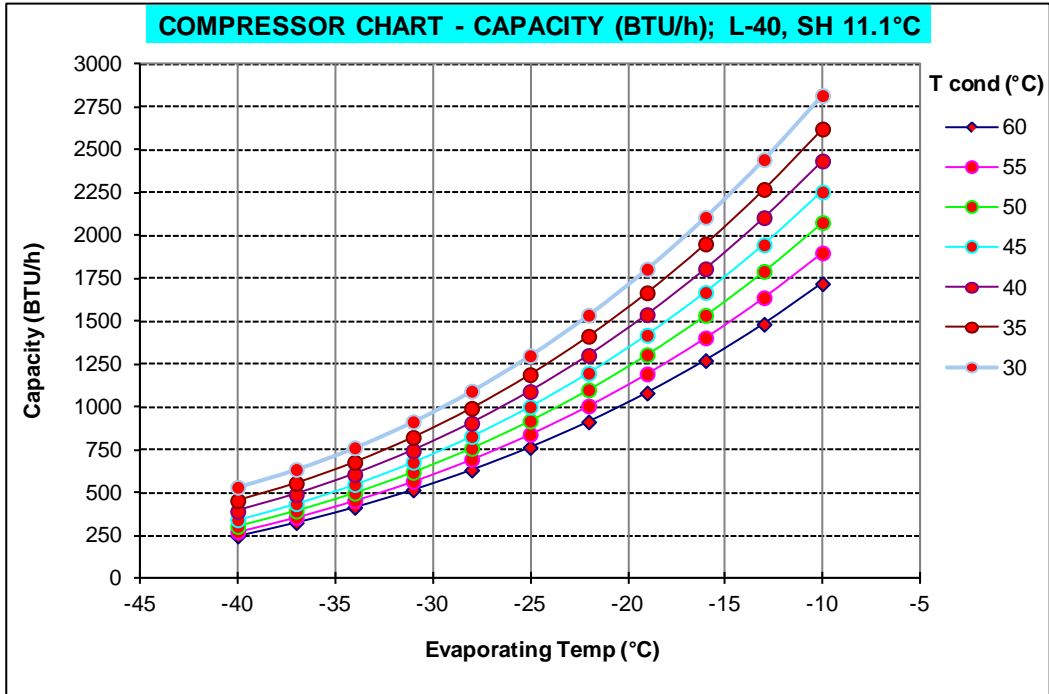


Figure 3-13, Cooling capacity of NEK2134GK, refrigerant L-40, superheating 11.1 °C

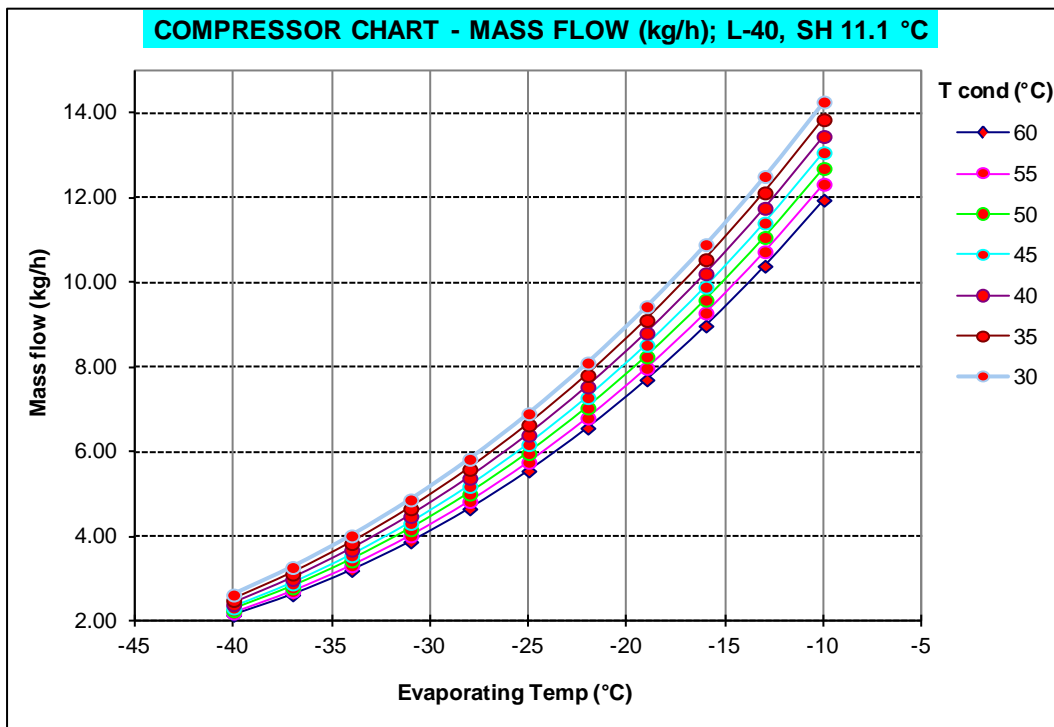


Figure 3-14, Mass flow of NEK2134GK, refrigerant L-40, superheating 11.1 °C

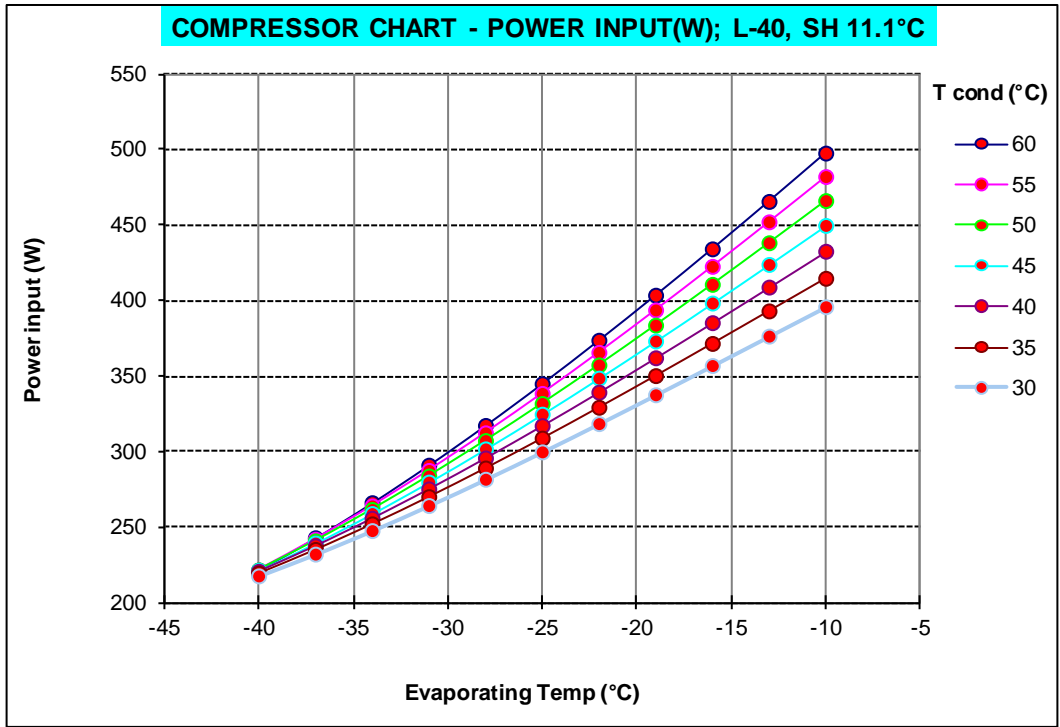


Figure 3-15, Power input of NEK2134GK, refrigerant L-40, superheating 11.1 °C

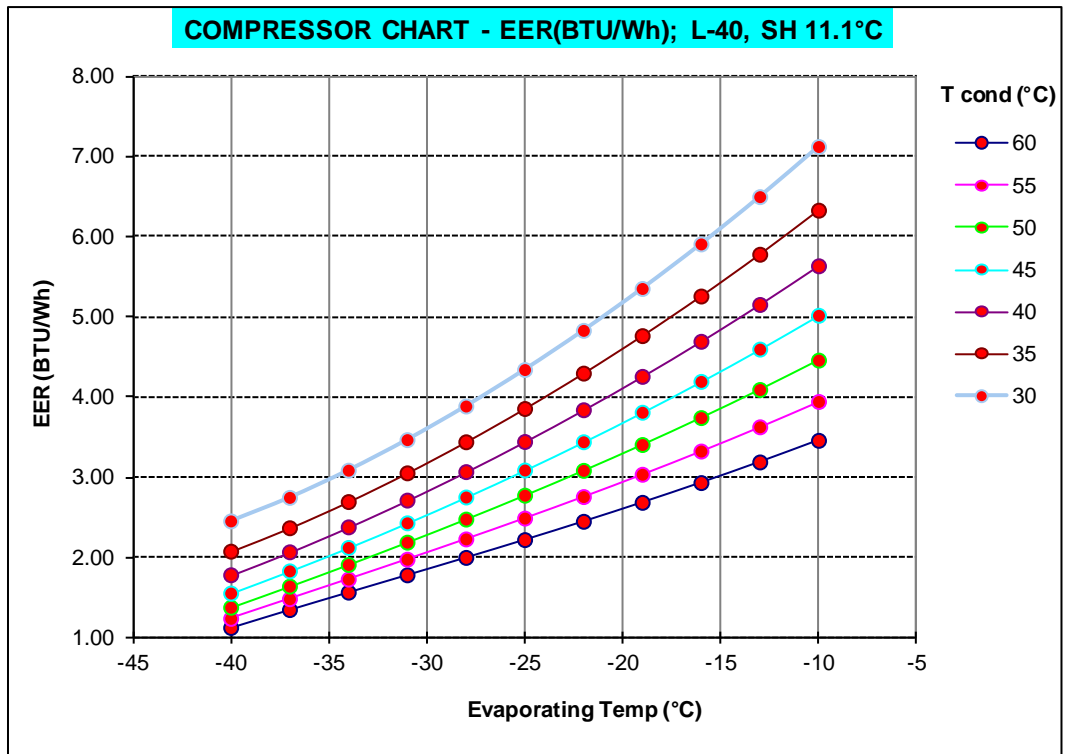


Figure 3-16, EER of NEK2134GK, refrigerant L-40, superheating 11.1 °C

3.2.3. Comparison of the results

Capacity (BTU/h) L-40

°C	60	55	50	45	40	35	30
-40	249	274	305	344	393	455	533
-37	327	359	395	438	491	556	637
-34	416	456	499	549	608	679	763
-31	518	568	620	679	746	824	915
-28	634	696	760	829	906	994	1093
-25	765	842	920	1002	1091	1189	1300
-22	914	1007	1101	1198	1301	1413	1537
-19	1082	1194	1306	1420	1539	1667	1805
-16	1272	1404	1535	1669	1807	1952	2106
-13	1483	1638	1792	1946	2105	2269	2443
-10	1719	1899	2076	2254	2435	2622	2816

Mass Flow (kg/h) L-40

°C	60	55	50	45	40	35	30
-40	2.15	2.21	2.26	2.33	2.40	2.50	2.63
-37	2.64	2.72	2.80	2.89	3.00	3.13	3.28
-34	3.21	3.32	3.44	3.56	3.69	3.85	4.03
-31	3.89	4.03	4.17	4.32	4.49	4.67	4.88
-28	4.67	4.84	5.02	5.20	5.39	5.60	5.84
-25	5.56	5.77	5.97	6.18	6.41	6.65	6.91
-22	6.57	6.81	7.05	7.29	7.55	7.82	8.11
-19	7.71	7.98	8.25	8.53	8.81	9.11	9.44
-16	8.98	9.29	9.59	9.90	10.22	10.55	10.90
-13	10.39	10.74	11.07	11.41	11.76	12.13	12.51
-10	11.95	12.33	12.70	13.08	13.46	13.85	14.27

Capacity (BTU/h) R404A

°C	60	55	50	45	40	35	30
-40	235	322	396	464	531	605	691
-37	318	414	498	575	651	733	827
-34	406	515	611	699	787	880	985
-31	502	627	737	840	942	1049	1167
-28	611	753	881	1001	1120	1243	1378
-25	735	898	1046	1186	1324	1466	1620
-22	878	1064	1235	1397	1557	1722	1896
-19	1042	1254	1451	1638	1823	2012	2211
-16	1232	1473	1697	1912	2125	2341	2566
-13	1450	1722	1977	2223	2466	2711	2966
-10	1700	2005	2294	2573	2849	3127	3414

Mass Flow (kg/h) R404A

°C	60	55	50	45	40	35	30
-40	4.49	5.03	5.45	5.80	6.11	6.40	6.70
-37	5.70	6.22	6.64	6.99	7.29	7.57	7.86
-34	7.03	7.56	7.98	8.33	8.63	8.91	9.21
-31	8.50	9.04	9.47	9.83	10.14	10.44	10.74
-28	10.13	10.69	11.14	11.52	11.85	12.16	12.49
-25	11.93	12.52	13.00	13.41	13.77	14.11	14.46
-22	13.92	14.55	15.07	15.51	15.91	16.29	16.68
-19	16.12	16.79	17.36	17.85	18.29	18.71	19.15
-16	18.53	19.26	19.88	20.43	20.93	21.40	21.89
-13	21.18	21.97	22.66	23.27	23.83	24.37	24.93
-10	24.08	24.95	25.71	26.39	27.02	27.64	28.26

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	5.9	-14.9	-23.0	-25.9	-26.0	-24.7	-22.8
-37	3.0	-13.5	-20.8	-23.8	-24.6	-24.1	-23.0
-34	2.6	-11.5	-18.2	-21.4	-22.7	-22.9	-22.5
-31	3.1	-9.5	-15.8	-19.2	-20.8	-21.5	-21.6
-28	3.7	-7.7	-13.8	-17.2	-19.1	-20.1	-20.7
-25	4.1	-6.3	-12.1	-15.5	-17.6	-18.9	-19.7
-22	4.1	-5.3	-10.8	-14.2	-16.4	-17.9	-19.0
-19	3.8	-4.8	-10.0	-13.3	-15.6	-17.1	-18.4
-16	3.2	-4.7	-9.5	-12.8	-15.0	-16.6	-17.9
-13	2.3	-4.9	-9.4	-12.5	-14.6	-16.3	-17.6
-10	1.1	-5.3	-9.5	-12.4	-14.5	-16.2	-17.5

Mass flow: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	-52.1	-56.1	-58.5	-59.9	-60.7	-60.9	-60.7
-37	-53.8	-56.3	-57.8	-58.6	-58.8	-58.7	-58.3
-34	-54.3	-56.0	-56.9	-57.3	-57.2	-56.8	-56.2
-31	-54.3	-55.4	-56.0	-56.0	-55.8	-55.3	-54.6
-28	-53.9	-54.7	-55.0	-54.9	-54.5	-54.0	-53.3
-25	-53.4	-53.9	-54.1	-53.9	-53.5	-52.9	-52.2
-22	-52.8	-53.2	-53.2	-53.0	-52.6	-52.0	-51.4
-19	-52.2	-52.4	-52.4	-52.2	-51.8	-51.3	-50.7
-16	-51.5	-51.8	-51.7	-51.5	-51.2	-50.7	-50.2
-13	-50.9	-51.1	-51.1	-51.0	-50.6	-50.2	-49.8
-10	-50.4	-50.6	-50.6	-50.5	-50.2	-49.9	-49.5

Power Input (W) L-40								EER (BTU/Wh) L-40							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	221	221	221	221	221	219	217	-40	1.12	1.24	1.38	1.55	1.78	2.08	2.45
-37	243	242	241	239	237	235	232	-37	1.35	1.48	1.64	1.83	2.07	2.37	2.75
-34	266	264	261	259	256	252	247	-34	1.56	1.73	1.91	2.12	2.38	2.69	3.08
-31	291	287	284	280	275	270	264	-31	1.78	1.98	2.19	2.43	2.71	3.05	3.47
-28	317	312	307	302	296	289	281	-28	2.00	2.23	2.48	2.75	3.07	3.44	3.88
-25	345	338	332	325	317	309	300	-25	2.22	2.49	2.77	3.09	3.44	3.85	4.34
-22	374	365	357	348	339	329	318	-22	2.45	2.76	3.08	3.44	3.84	4.29	4.83
-19	403	394	383	373	362	350	337	-19	2.68	3.03	3.40	3.81	4.25	4.76	5.35
-16	434	422	411	398	385	371	357	-16	2.93	3.32	3.74	4.19	4.69	5.25	5.90
-13	465	452	438	424	409	393	376	-13	3.19	3.63	4.09	4.59	5.15	5.78	6.49
-10	497	482	466	450	432	415	396	-10	3.46	3.94	4.46	5.01	5.63	6.32	7.12

Power Input (W) R404A								EER (BTU/Wh) R404A							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	254	258	262	265	266	266	264	-40	0.93	1.25	1.51	1.75	2.00	2.28	2.62
-37	285	288	290	290	290	287	284	-37	1.11	1.44	1.72	1.98	2.25	2.55	2.92
-34	318	319	318	316	314	310	304	-34	1.27	1.62	1.92	2.21	2.51	2.84	3.24
-31	352	350	347	343	339	333	325	-31	1.43	1.79	2.12	2.45	2.78	3.15	3.59
-28	387	382	377	371	364	356	346	-28	1.58	1.97	2.34	2.70	3.08	3.49	3.98
-25	422	415	407	399	390	379	368	-25	1.74	2.16	2.57	2.97	3.40	3.87	4.40
-22	458	448	438	427	416	403	390	-22	1.92	2.37	2.82	3.27	3.74	4.27	4.86
-19	495	483	470	457	443	428	412	-19	2.11	2.60	3.09	3.59	4.12	4.70	5.37
-16	532	517	502	486	470	453	434	-16	2.31	2.85	3.38	3.93	4.52	5.17	5.91
-13	571	553	534	516	497	477	457	-13	2.54	3.12	3.70	4.31	4.96	5.68	6.49
-10	609	588	567	546	525	503	480	-10	2.79	3.41	4.04	4.71	5.43	6.22	7.12

Power input: L40 change relative to R404A (%)								EER: L40 change relative to R404A (%)							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	-12.7	-14.3	-15.5	-16.5	-17.1	-17.4	-17.5	-40	21.3	-0.7	-8.9	-11.3	-10.8	-8.8	-6.4
-37	-15.0	-16.1	-16.9	-17.6	-18.0	-18.2	-18.2	-37	21.1	3.1	-4.6	-7.5	-8.0	-7.2	-5.8
-34	-16.4	-17.2	-17.8	-18.2	-18.5	-18.7	-18.6	-34	22.8	6.9	-0.5	-3.9	-5.1	-5.2	-4.7
-31	-17.4	-17.9	-18.3	-18.6	-18.7	-18.8	-18.8	-31	24.8	10.3	3.0	-0.7	-2.5	-3.3	-3.5
-28	-18.0	-18.3	-18.5	-18.7	-18.8	-18.8	-18.7	-28	26.4	13.0	5.8	1.8	-0.4	-1.6	-2.4
-25	-18.3	-18.5	-18.6	-18.6	-18.7	-18.6	-18.6	-25	27.4	14.9	7.9	3.8	1.3	-0.3	-1.4
-22	-18.5	-18.5	-18.5	-18.5	-18.5	-18.4	-18.4	-22	27.7	16.1	9.4	5.2	2.5	0.6	-0.8
-19	-18.5	-18.4	-18.4	-18.3	-18.2	-18.2	-18.1	-19	27.4	16.7	10.2	6.1	3.3	1.3	-0.3
-16	-18.5	-18.3	-18.2	-18.1	-18.0	-17.9	-17.9	-16	26.6	16.7	10.6	6.5	3.7	1.6	0.0
-13	-18.4	-18.2	-18.0	-17.9	-17.8	-17.7	-17.7	-13	25.4	16.3	10.5	6.6	3.8	1.7	0.1
-10	-18.4	-18.1	-17.9	-17.7	-17.6	-17.5	-17.5	-10	23.9	15.6	10.2	6.4	3.7	1.7	0.0

Table 3-10, Comparison of the results, superheating 11.1 °C

3.3. Superheating 22.2 °C

3.3.1. Reference measurement with R404A

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
R404A	30	-12	10.2	22.2	3299.6	463.0	5.83	7.13	25.61
R404A	30	-20	2.2	22.2	2223.8	403.1	5.44	5.52	17.90
R404A	30	-30	-7.8	22.2	1286.5	328.2	5.00	3.92	10.91
R404A	30	-40	-17.8	22.2	724.6	262.9	4.68	2.76	6.49
R404A	45	-12	10.2	22.2	2511.8	523.6	6.24	4.80	24.09
R404A	45	-20	2.2	22.2	1679.2	445.4	5.69	3.77	16.69
R404A	45	-30	-7.8	22.2	980.3	351.2	5.12	2.79	10.36
R404A	45	-40	-17.8	22.2	510.8	262.8	4.67	1.94	5.81
R404A	60	-12	10.2	22.2	1716.3	584.8	6.68	2.93	21.84
R404A	60	-20	2.2	22.2	1118.3	480.5	5.93	2.33	15.18
R404A	60	-30	-7.8	22.2	596.3	358.7	5.15	1.66	8.84
R404A	60	-40	-17.8	22.2	273.1	246.8	4.62	1.11	4.46

Table 3-11a, Measured data of NEK2134GK, refrigerant R404A, superheating 22.2 °C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
R404A	30	-12	10.2	22.2	2.4	0.3	0.9	2.1	2.5
R404A	30	-20	2.2	22.2	1.5	0.0	0.9	1.4	1.4
R404A	30	-30	-7.8	22.2	2.0	2.2	1.4	4.1	2.0
R404A	30	-40	-17.8	22.2	1.7	1.8	1.5	0.2	1.2
R404A	45	-12	10.2	22.2	1.9	1.6	1.3	0.3	2.6
R404A	45	-20	2.2	22.2	1.9	1.9	1.8	0.1	2.0
R404A	45	-30	-7.8	22.2	0.9	2.8	1.8	3.6	0.7
R404A	45	-40	-17.8	22.2	1.3	2.3	1.3	3.5	1.5
R404A	60	-12	10.2	22.2	3.1	2.4	1.7	0.7	3.1
R404A	60	-20	2.2	22.2	2.7	2.6	1.9	0.1	2.8
R404A	60	-30	-7.8	22.2	2.5	3.8	2.2	1.3	2.5
R404A	60	-40	-17.8	22.2	1.6	3.7	2.2	3.0	1.6

Table 3-11b., Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant R404A, superheating 22.2 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg, °C)	Power input (W, °C)
C1	8.572E+03	4.858E+01	3.868E+02
C2	3.206E+02	1.838E+00	3.480E+00
C3	-1.189E+02	-3.140E-01	5.000E+00
C4	4.249E+00	2.550E-02	-5.375E-02
C5	-3.191E+00	-8.308E-03	7.891E-02
C6	8.157E-01	4.060E-03	1.670E-02
C7	1.671E-02	1.102E-04	-7.084E-04
C8	-3.125E-02	-1.092E-04	7.155E-04
C9	2.459E-03	5.844E-06	1.349E-03
C10	-6.092E-03	-4.050E-05	-2.527E-05

Table 3-12, Coefficients C1 – C10 for NEK2134GK, refrigerant R404A, superheating 22.2 °C

CURVE-FITTED CHARTS

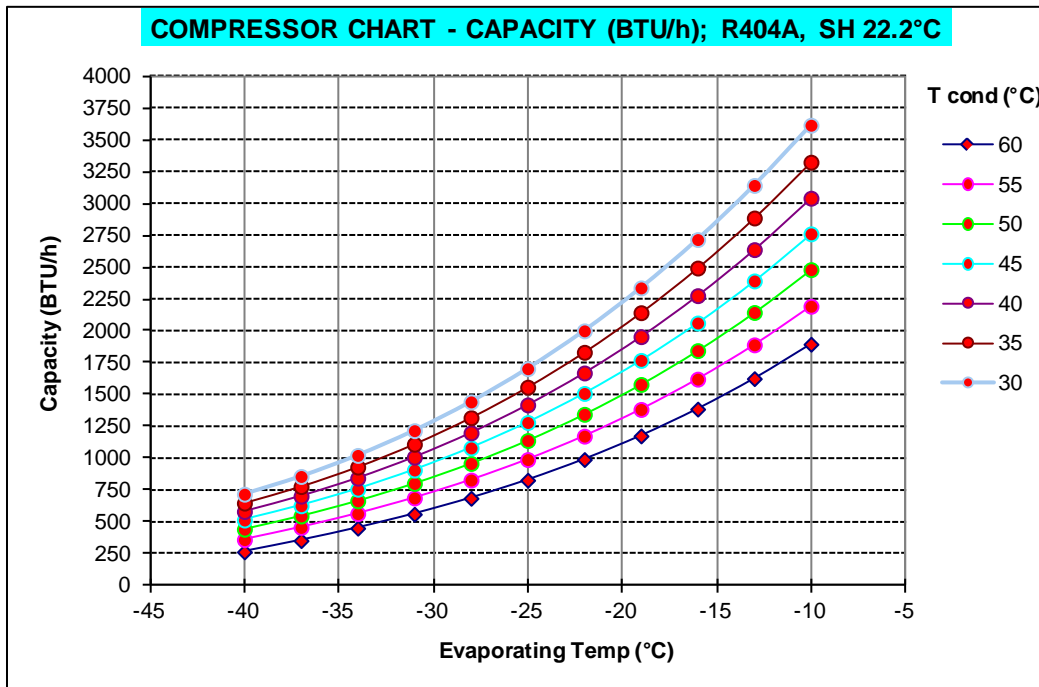


Figure 3-17, Cooling capacity of NEK2134GK, refrigerant R404A, superheating 22.2 °C

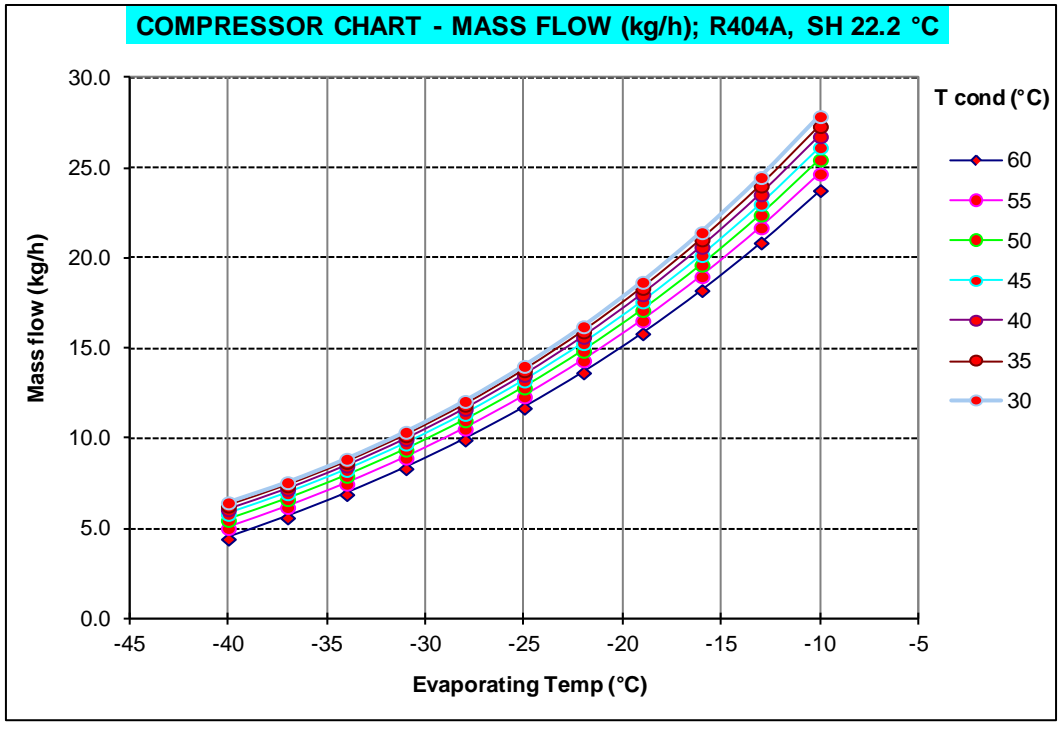


Figure 3-18, Mass flow of NEK2134GK, refrigerant R404A, superheating 22.2 °C

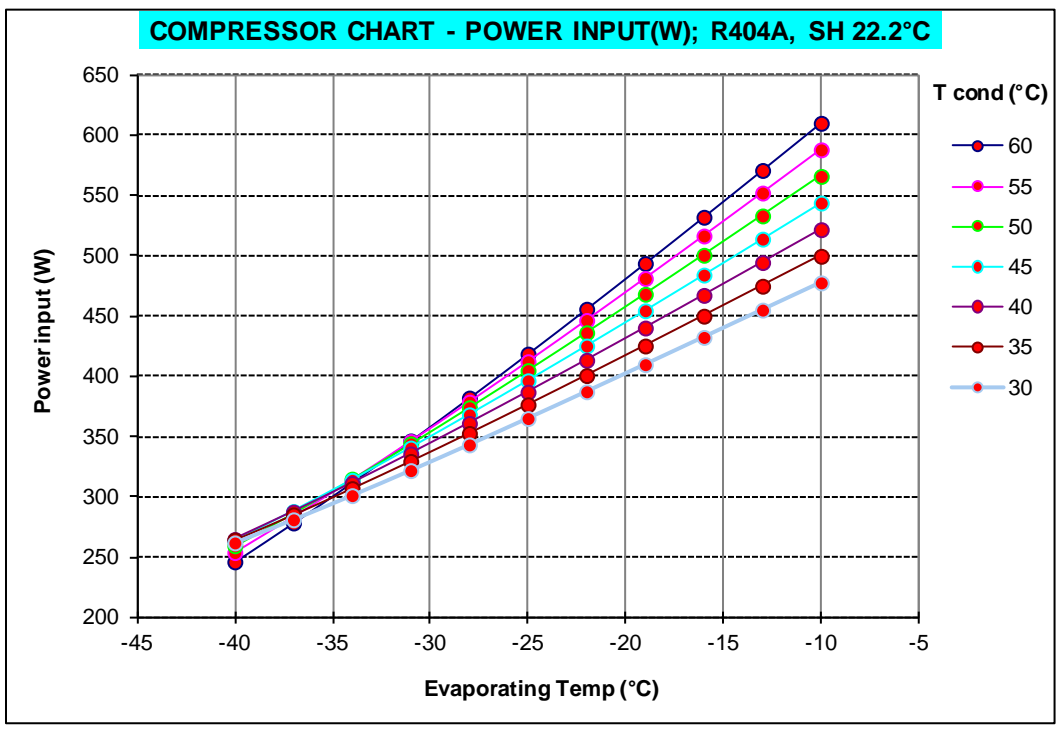


Figure 3-19, Power input of NEK2134GK, refrigerant R404A, superheating 22.2 °C

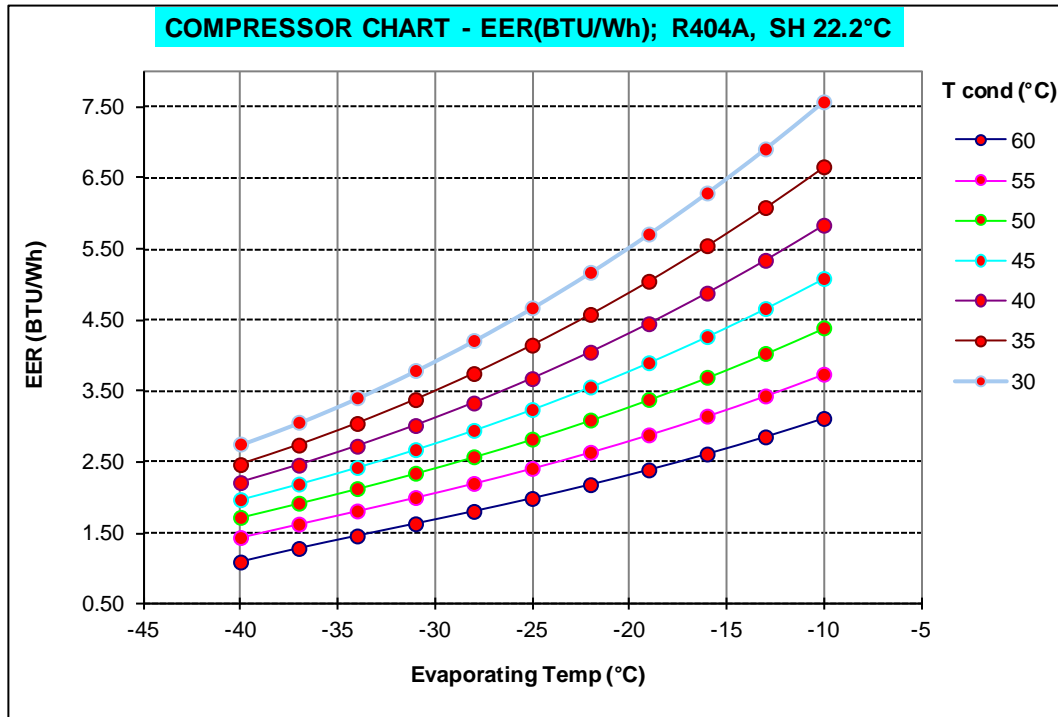


Figure 3-20, EER of NEK2134GK, refrigerant R404A, superheating 22.2 °C

3.3.2. Measurement with new refrigerant L-40

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	BTU/h	W	A	(BTU/Wh)	kg/h
L-40	30	-12	10.2	22.2	2712.2	378.3	5.43	7.17	13.16
L-40	30	-20	2.2	22.2	1775.6	330.2	5.18	5.38	8.84
L-40	30	-30	-7.8	22.2	1005.6	268.8	4.88	3.74	5.18
L-40	30	-40	-17.8	22.2	556.2	219.1	4.71	2.54	2.66
L-40	45	-12	10.2	22.2	2222.6	430.9	5.75	5.16	12.32
L-40	45	-20	2.2	22.2	1424.0	362.5	5.34	3.93	8.09
L-40	45	-30	-7.8	22.2	808.3	288.2	4.97	2.80	4.77
L-40	45	-40	-17.8	22.2	437.1	221.3	4.80	1.98	2.35
L-40	60	-12	10.2	22.2	1663.7	475.1	6.03	3.50	10.84
L-40	60	-20	2.2	22.2	1070.5	393.1	5.50	2.72	7.19
L-40	60	-30	-7.8	22.2	584.9	297.7	5.02	1.96	4.10
L-40	60	-40	-17.8	22.2	275.0	221.9	4.82	1.24	2.17

Table 3-13a, Measured data of NEK2134GK, refrigerant L-40, superheating 22.2 °C

AVERAGE	T cond (dew)	T evap (dew)	T return gas	T Superheat	Cool. Capacity	Power input	Current	EER	Mass flow
REFRIGERANT	(°C)	(°C)	(°C)	(°C)	%	%	%	%	%
L-40	30	-12	-0.9	22.2	0.7	1.9	3.2	1.1	0.8
L-40	30	-20	-8.9	22.2	0.7	2.1	3.3	1.3	0.2
L-40	30	-30	-18.9	22.2	2.6	2.5	2.9	0.1	2.7
L-40	30	-40	-28.9	22.2	3.5	1.4	0.9	2.1	3.6
L-40	45	-12	-0.9	22.2	0.5	0.9	1.2	1.4	0.6
L-40	45	-20	-8.9	22.2	3.6	1.9	1.9	1.7	3.4
L-40	45	-30	-18.9	22.2	1.9	1.8	1.6	0.1	1.9
L-40	45	-40	-28.9	22.2	3.3	2.3	1.0	1.0	3.5
L-40	60	-12	-0.9	22.2	3.8	1.2	0.8	3.6	4.6
L-40	60	-20	-8.9	22.2	2.6	2.4	2.6	0.2	2.5
L-40	60	-30	-18.9	22.2	3.6	2.6	1.6	1.0	2.2
L-40	60	-40	-28.9	22.2	3.7	3.0	1.9	0.8	3.6

Table 3-13b., Difference (abs %) between 2 measured pieces of NEK2134GK, refrigerant L-40, superheating 22.2 °C

Coefficients	Capacity (BTU/h, °C)	Mass flow (kg, °C)	Power input (W, °C)
C1	7.003E+03	2.449E+01	2.255E+02
C2	2.859E+02	1.044E+00	-1.342E+00
C3	-9.119E+01	-3.933E-02	8.824E+00
C4	4.580E+00	1.991E-02	-1.067E-01
C5	-2.122E+00	1.435E-03	2.236E-01
C6	8.813E-01	2.784E-04	-5.773E-02
C7	2.457E-02	1.522E-04	-1.172E-03
C8	-2.520E-02	-1.954E-05	1.436E-03
C9	-1.114E-03	-5.104E-05	-4.131E-04
C10	-7.310E-03	-1.549E-05	2.591E-04

Table 3-14, Coefficients C1 – C10 for NEK2134GK, refrigerant L-40, superheating 22.2 °C

CURVE-FITTED CHARTS

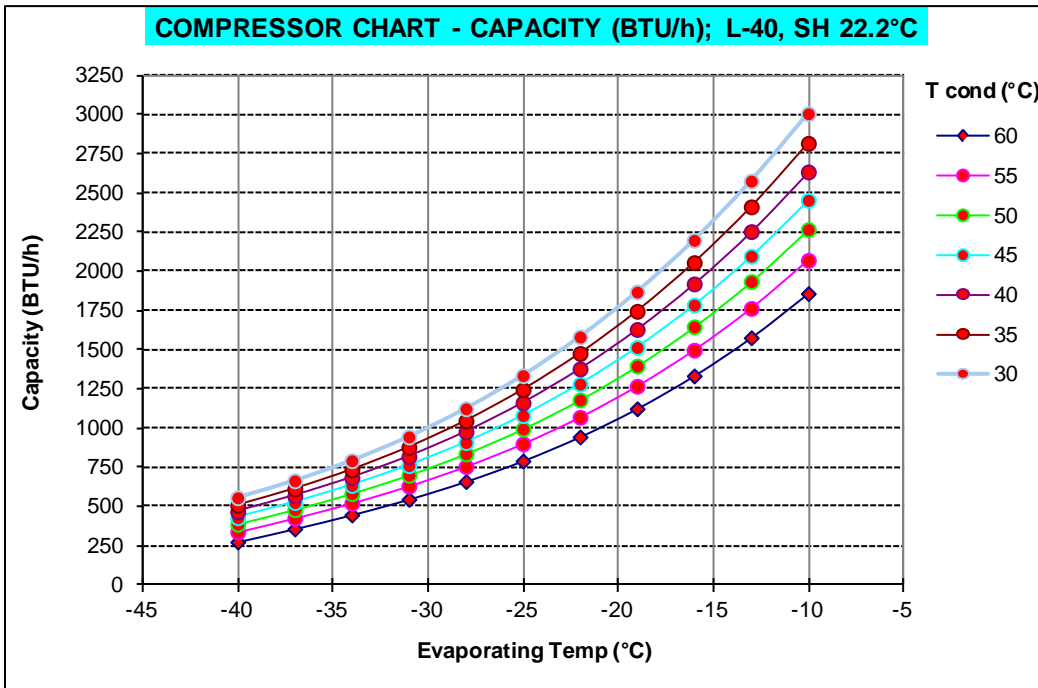


Figure 3-21, Cooling capacity of NEK2134GK, refrigerant L-40, superheating 22.2 °C

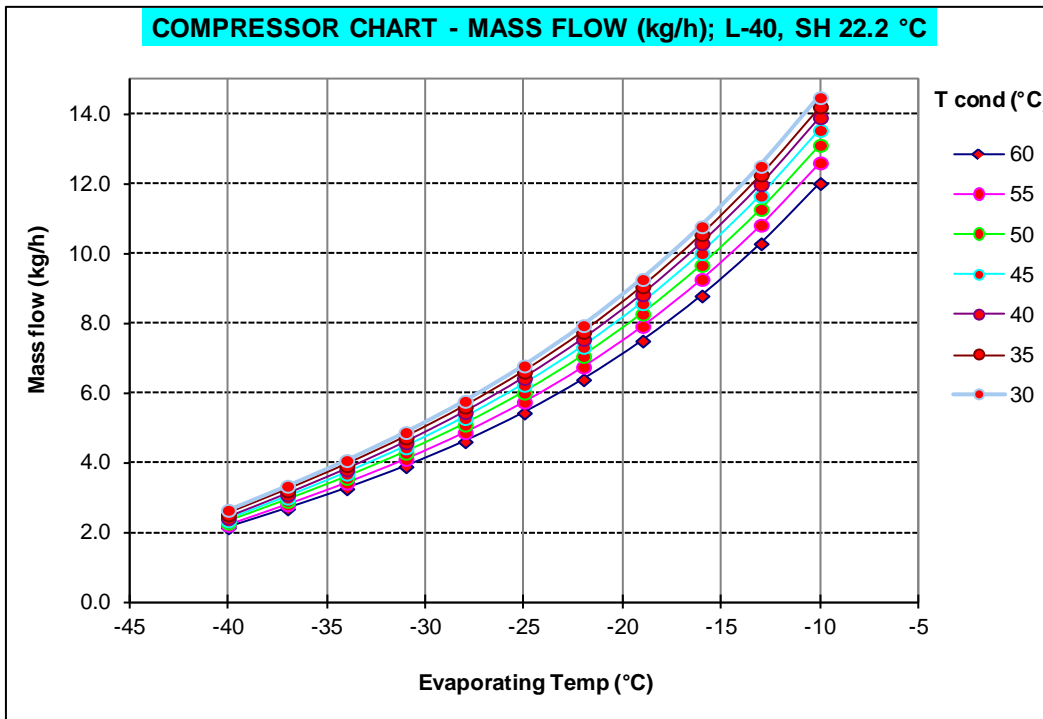


Figure 3-22, Mass flow of NEK2134GK, refrigerant L-40, superheating 22.2 °C

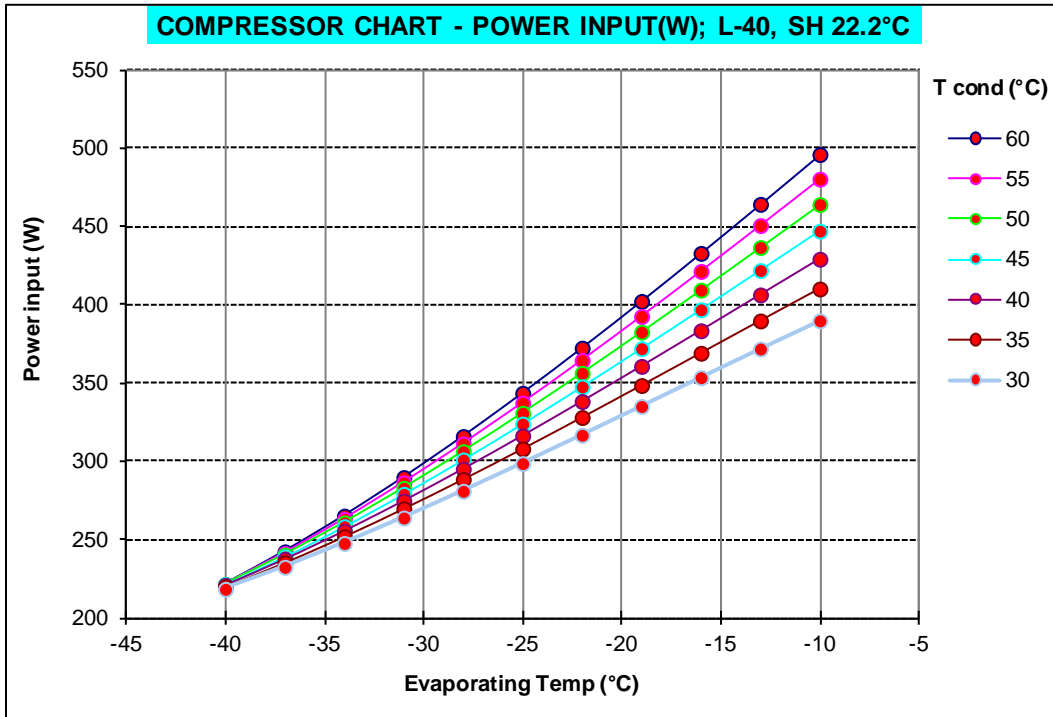


Figure 3-23, Power input of NEK2134GK, refrigerant L-40, superheating 22.2 °C

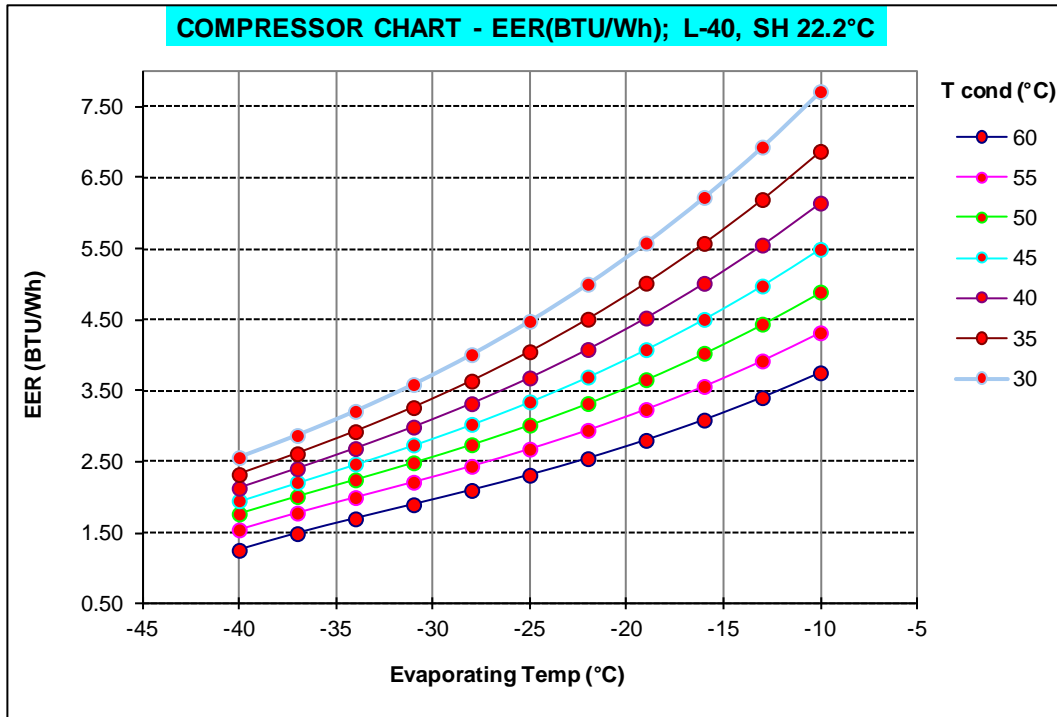


Figure 3-24, EER of NEK2134GK, refrigerant L-40, superheating 22.2 °C

3.3.3. Comparison of the results

Capacity (BTU/h) L-40

°C	60	55	50	45	40	35	30
-40	277	341	391	432	470	510	559
-37	360	429	483	528	571	615	667
-34	449	525	586	638	686	737	795
-31	549	633	703	764	821	881	947
-28	662	758	839	911	979	1049	1127
-25	794	903	998	1083	1165	1248	1338
-22	947	1073	1183	1284	1381	1479	1585
-19	1127	1270	1399	1518	1633	1749	1871
-16	1336	1501	1649	1789	1923	2059	2201
-13	1580	1767	1938	2100	2257	2415	2579
-10	1861	2073	2270	2456	2638	2820	3008

Mass Flow (kg/h) L-40

°C	60	55	50	45	40	35	30
-40	2.16	2.23	2.30	2.36	2.43	2.53	2.66
-37	2.70	2.82	2.92	3.01	3.11	3.22	3.35
-34	3.28	3.44	3.58	3.70	3.82	3.95	4.09
-31	3.91	4.13	4.30	4.46	4.60	4.74	4.89
-28	4.63	4.89	5.11	5.30	5.47	5.63	5.79
-25	5.45	5.77	6.03	6.25	6.45	6.63	6.81
-22	6.41	6.78	7.08	7.34	7.57	7.77	7.96
-19	7.52	7.94	8.30	8.60	8.85	9.08	9.29
-16	8.82	9.29	9.69	10.04	10.33	10.58	10.81
-13	10.32	10.85	11.30	11.69	12.01	12.29	12.54
-10	12.05	12.64	13.14	13.57	13.93	14.24	14.51

Capacity (BTU/h) R404A

°C	60	55	50	45	40	35	30
-40	269	365	447	519	586	652	722
-37	357	461	551	631	706	781	861
-34	455	569	669	761	848	935	1026
-31	565	692	806	911	1012	1114	1220
-28	689	833	963	1085	1203	1322	1446
-25	831	994	1143	1284	1423	1562	1707
-22	994	1177	1349	1513	1673	1836	2004
-19	1179	1387	1583	1772	1958	2147	2341
-16	1390	1625	1849	2066	2280	2497	2721
-13	1629	1894	2148	2396	2642	2890	3146
-10	1899	2197	2485	2766	3045	3328	3618

Mass Flow (kg/h) R404A

°C	60	55	50	45	40	35	30
-40	4.47	5.06	5.51	5.85	6.10	6.30	6.48
-37	5.64	6.22	6.66	6.99	7.23	7.43	7.60
-34	6.94	7.52	7.96	8.28	8.53	8.72	8.90
-31	8.38	8.96	9.41	9.74	10.00	10.21	10.40
-28	9.97	10.57	11.03	11.39	11.67	11.90	12.11
-25	11.73	12.36	12.86	13.24	13.55	13.81	14.05
-22	13.69	14.36	14.89	15.31	15.66	15.96	16.25
-19	15.86	16.57	17.15	17.63	18.02	18.38	18.71
-16	18.25	19.03	19.66	20.20	20.65	21.07	21.47
-13	20.89	21.74	22.44	23.04	23.57	24.05	24.52
-10	23.80	24.72	25.50	26.18	26.79	27.35	27.90

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	3.2	-6.5	-12.5	-16.8	-19.7	-21.7	-22.5
-37	0.9	-7.0	-12.3	-16.3	-19.2	-21.3	-22.5
-34	-1.2	-7.8	-12.5	-16.2	-19.0	-21.1	-22.5
-31	-2.8	-8.5	-12.8	-16.2	-18.9	-21.0	-22.4
-28	-3.9	-9.0	-12.8	-16.0	-18.6	-20.6	-22.1
-25	-4.6	-9.1	-12.7	-15.7	-18.1	-20.1	-21.6
-22	-4.7	-8.9	-12.3	-15.1	-17.5	-19.4	-20.9
-19	-4.4	-8.4	-11.6	-14.3	-16.6	-18.5	-20.1
-16	-3.9	-7.7	-10.8	-13.4	-15.7	-17.5	-19.1
-13	-3.0	-6.7	-9.8	-12.4	-14.6	-16.4	-18.0
-10	-2.0	-5.6	-8.6	-11.2	-13.4	-15.3	-16.9

Mass flow: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	-51.7	-55.9	-58.3	-59.6	-60.1	-59.9	-58.9
-37	-52.1	-54.7	-56.2	-56.9	-57.1	-56.7	-55.9
-34	-52.8	-54.2	-55.0	-55.3	-55.2	-54.8	-54.0
-31	-53.3	-54.0	-54.3	-54.3	-54.0	-53.6	-52.9
-28	-53.5	-53.7	-53.7	-53.5	-53.2	-52.7	-52.2
-25	-53.5	-53.4	-53.1	-52.8	-52.4	-52.0	-51.6
-22	-53.2	-52.8	-52.4	-52.1	-51.7	-51.3	-51.0
-19	-52.6	-52.1	-51.6	-51.2	-50.9	-50.6	-50.4
-16	-51.7	-51.2	-50.7	-50.3	-50.0	-49.8	-49.7
-13	-50.6	-50.1	-49.6	-49.3	-49.0	-48.9	-48.9
-10	-49.4	-48.9	-48.5	-48.2	-48.0	-47.9	-48.0

Power Input (W) L-40								EER (BTU/Wh) L-40							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	222	222	222	222	221	220	219	-40	1.25	1.54	1.76	1.95	2.12	2.32	2.56
-37	243	242	241	239	238	236	233	-37	1.49	1.77	2.01	2.21	2.40	2.61	2.87
-34	265	263	261	259	256	252	248	-34	1.69	1.99	2.24	2.47	2.68	2.92	3.21
-31	290	287	283	279	275	270	264	-31	1.89	2.21	2.48	2.73	2.99	3.26	3.58
-28	316	312	307	301	295	289	281	-28	2.09	2.43	2.74	3.02	3.32	3.63	4.01
-25	344	338	331	324	317	308	299	-25	2.31	2.68	3.01	3.34	3.68	4.05	4.48
-22	373	365	357	348	339	328	317	-22	2.54	2.94	3.32	3.69	4.08	4.51	5.00
-19	403	393	383	372	361	349	335	-19	2.80	3.23	3.65	4.08	4.52	5.01	5.58
-16	433	422	410	397	384	369	354	-16	3.08	3.56	4.03	4.50	5.01	5.57	6.22
-13	465	451	437	422	407	390	372	-13	3.40	3.92	4.44	4.97	5.55	6.19	6.93
-10	496	481	464	447	430	410	390	-10	3.75	4.31	4.89	5.49	6.14	6.87	7.71

Power Input (W) R404A								EER (BTU/Wh) R404A							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	247	254	260	264	265	265	262	-40	1.09	1.43	1.72	1.97	2.21	2.46	2.75
-37	279	284	287	288	288	286	282	-37	1.28	1.62	1.92	2.19	2.45	2.74	3.06
-34	312	315	315	314	312	307	302	-34	1.46	1.81	2.12	2.42	2.72	3.04	3.40
-31	347	346	344	341	336	330	322	-31	1.63	2.00	2.34	2.67	3.01	3.38	3.79
-28	382	379	374	369	361	353	344	-28	1.80	2.20	2.57	2.94	3.33	3.74	4.21
-25	419	413	405	397	387	377	365	-25	1.98	2.41	2.82	3.24	3.67	4.14	4.67
-22	456	447	437	426	414	401	388	-22	2.18	2.64	3.09	3.55	4.04	4.58	5.17
-19	494	482	469	455	441	426	410	-19	2.39	2.88	3.38	3.90	4.45	5.04	5.71
-16	532	517	501	484	468	450	433	-16	2.61	3.14	3.69	4.26	4.88	5.54	6.29
-13	571	552	533	514	495	475	455	-13	2.85	3.43	4.03	4.66	5.34	6.08	6.91
-10	610	588	566	544	522	500	478	-10	3.11	3.73	4.39	5.08	5.83	6.66	7.57

Power input: L40 change relative to R404A (%)								EER: L40 change relative to R404A (%)							
°C	60	55	50	45	40	35	30	°C	60	55	50	45	40	35	30
-40	-10.1	-12.8	-14.7	-15.9	-16.6	-16.8	-16.6	-40	14.8	7.2	2.6	-1.0	-3.8	-5.9	-7.1
-37	-13.0	-14.9	-16.2	-17.0	-17.4	-17.5	-17.3	-37	16.0	9.3	4.7	0.9	-2.2	-4.6	-6.2
-34	-15.0	-16.3	-17.2	-17.7	-17.9	-17.9	-17.8	-34	16.3	10.2	5.6	1.8	-1.4	-3.9	-5.7
-31	-16.4	-17.2	-17.8	-18.1	-18.2	-18.1	-18.0	-31	16.2	10.6	6.1	2.3	-0.9	-3.4	-5.3
-28	-17.3	-17.8	-18.1	-18.3	-18.3	-18.2	-18.1	-28	16.2	10.8	6.4	2.7	-0.4	-3.0	-4.8
-25	-17.9	-18.2	-18.3	-18.3	-18.2	-18.2	-18.2	-25	16.3	11.1	6.8	3.2	0.1	-2.3	-4.2
-22	-18.3	-18.3	-18.3	-18.2	-18.2	-18.1	-18.2	-22	16.6	11.6	7.4	3.8	0.8	-1.6	-3.3
-19	-18.5	-18.4	-18.3	-18.1	-18.0	-18.0	-18.2	-19	17.3	12.3	8.1	4.6	1.7	-0.6	-2.3
-16	-18.6	-18.4	-18.2	-18.0	-17.9	-18.0	-18.2	-16	18.2	13.2	9.1	5.6	2.7	0.5	-1.1
-13	-18.7	-18.4	-18.1	-17.9	-17.8	-17.9	-18.3	-13	19.2	14.3	10.2	6.7	3.9	1.8	0.3
-10	-18.7	-18.3	-18.0	-17.8	-17.7	-17.9	-18.4	-10	20.5	15.5	11.4	8.0	5.3	3.2	1.9

Table 3-15, Comparison of the results, superheating 22.2 °C

4. Summary

Return gas temperature 18.3 °C

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	-6.1	-17.7	-24.4	-28.9	-32.3	-35.1	-37.5
-37	-10.8	-18.5	-23.0	-26.0	-28.3	-30.1	-31.7
-34	-13.5	-19.0	-22.2	-24.2	-25.7	-26.9	-28.0
-31	-14.9	-19.1	-21.5	-23.0	-24.0	-24.8	-25.5
-28	-15.2	-18.7	-20.7	-21.9	-22.7	-23.3	-23.8
-25	-14.7	-17.9	-19.8	-20.9	-21.6	-22.1	-22.6
-22	-13.5	-16.7	-18.6	-19.8	-20.6	-21.1	-21.6
-19	-11.8	-15.2	-17.3	-18.6	-19.5	-20.2	-20.7
-16	-9.6	-13.3	-15.7	-17.3	-18.4	-19.2	-19.9
-13	-7.1	-11.2	-13.9	-15.8	-17.2	-18.2	-19.1
-10	-4.3	-8.9	-12.0	-14.2	-15.8	-17.1	-18.2

EER: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	3.6	-6.6	-12.1	-15.9	-18.9	-21.6	-24.1
-37	2.5	-4.6	-8.6	-11.2	-13.3	-15.2	-17.0
-34	2.3	-3.2	-6.2	-8.2	-9.7	-11.1	-12.5
-31	2.6	-1.9	-4.5	-6.1	-7.3	-8.4	-9.6
-28	3.6	-0.6	-3.0	-4.5	-5.7	-6.6	-7.6
-25	5.0	0.9	-1.5	-3.2	-4.4	-5.3	-6.3
-22	7.0	2.7	0.0	-1.9	-3.2	-4.2	-5.2
-19	9.3	4.6	1.6	-0.5	-2.0	-3.2	-4.2
-16	12.0	6.8	3.4	1.0	-0.8	-2.1	-3.1
-13	14.9	9.2	5.3	2.6	0.6	-0.9	-2.0
-10	18.0	11.7	7.4	4.3	2.1	0.4	-0.8

Superheating 11.1 °C

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	5.9	-14.9	-23.0	-25.9	-26.0	-24.7	-22.8
-37	3.0	-13.5	-20.8	-23.8	-24.6	-24.1	-23.0
-34	2.6	-11.5	-18.2	-21.4	-22.7	-22.9	-22.5
-31	3.1	-9.5	-15.8	-19.2	-20.8	-21.5	-21.6
-28	3.7	-7.7	-13.8	-17.2	-19.1	-20.1	-20.7
-25	4.1	-6.3	-12.1	-15.5	-17.6	-18.9	-19.7
-22	4.1	-5.3	-10.8	-14.2	-16.4	-17.9	-19.0
-19	3.8	-4.8	-10.0	-13.3	-15.6	-17.1	-18.4
-16	3.2	-4.7	-9.5	-12.8	-15.0	-16.6	-17.9
-13	2.3	-4.9	-9.4	-12.5	-14.6	-16.3	-17.6
-10	1.1	-5.3	-9.5	-12.4	-14.5	-16.2	-17.5

EER: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	21.3	-0.7	-8.9	-11.3	-10.8	-8.8	-6.4
-37	21.1	3.1	-4.6	-7.5	-8.0	-7.2	-5.8
-34	22.8	6.9	-0.5	-3.9	-5.1	-5.2	-4.7
-31	24.8	10.3	3.0	-0.7	-2.5	-3.3	-3.5
-28	26.4	13.0	5.8	1.8	-0.4	-1.6	-2.4
-25	27.4	14.9	7.9	3.8	1.3	-0.3	-1.4
-22	27.7	16.1	9.4	5.2	2.5	0.6	-0.8
-19	27.4	16.7	10.2	6.1	3.3	1.3	-0.3
-16	26.6	16.7	10.6	6.5	3.7	1.6	0.0
-13	25.4	16.3	10.5	6.6	3.8	1.7	0.1
-10	23.9	15.6	10.2	6.4	3.7	1.7	0.0

Superheating 22.2 °C

Capacity: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	3.2	-6.5	-12.5	-16.8	-19.7	-21.7	-22.5
-37	0.9	-7.0	-12.3	-16.3	-19.2	-21.3	-22.5
-34	-1.2	-7.8	-12.5	-16.2	-19.0	-21.1	-22.5
-31	-2.8	-8.5	-12.8	-16.2	-18.9	-21.0	-22.4
-28	-3.9	-9.0	-12.8	-16.0	-18.6	-20.6	-22.1
-25	-4.6	-9.1	-12.7	-15.7	-18.1	-20.1	-21.6
-22	-4.7	-8.9	-12.3	-15.1	-17.5	-19.4	-20.9
-19	-4.4	-8.4	-11.6	-14.3	-16.6	-18.5	-20.1
-16	-3.9	-7.7	-10.8	-13.4	-15.7	-17.5	-19.1
-13	-3.0	-6.7	-9.8	-12.4	-14.6	-16.4	-18.0
-10	-2.0	-5.6	-8.6	-11.2	-13.4	-15.3	-16.9

EER: L40 change relative to R404A (%)

°C	60	55	50	45	40	35	30
-40	14.8	7.2	2.6	-1.0	-3.8	-5.9	-7.1
-37	16.0	9.3	4.7	0.9	-2.2	-4.6	-6.2
-34	16.3	10.2	5.6	1.8	-1.4	-3.9	-5.7
-31	16.2	10.6	6.1	2.3	-0.9	-3.4	-5.3
-28	16.2	10.8	6.4	2.7	-0.4	-3.0	-4.8
-25	16.3	11.1	6.8	3.2	0.1	-2.3	-4.2
-22	16.6	11.6	7.4	3.8	0.8	-1.6	-3.3
-19	17.3	12.3	8.1	4.6	1.7	-0.6	-2.3
-16	18.2	13.2	9.1	5.6	2.7	0.5	-1.1
-13	19.2	14.3	10.2	6.7	3.9	1.8	0.3
-10	20.5	15.5	11.4	8.0	5.3	3.2	1.9