



UNIVERSITI KUALA LUMPUR
MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE : FRB 40103 / FRB30503
SUBJECT TITLE : TECHNOLOGY OF INDUSTRIAL REFRIGERATION
LEVEL : BACHELOR
TIME/DURATION : 9.00 AM – 12.00 PM
(3 HOURS)
DATE : 2 JUNE 2014

INSTRUCTIONS TO CANDIDATES

1. All documents authorized (OPEN BOOK EXAMINATION)
 2. This question paper is printed on both sides of the paper.
 3. Answer should be written in blue or black ink except for sketching, graphic and illustration.
 4. This question paper consists only one section. Answer all questions.
 5. Answer all questions in English.
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THERE ARE 2 PRINTED PAGES OF QUESTIONS AND 8 PAGES OF APPENDICE, EXCLUDING THIS PAGE

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

A project consultant is designing a booster system for 2 types of freezer room at 5°C, with cooling capacity of 300kW and freezer room at -25°C, with cooling capacity of 100Kw

The design completed with HP and LP circuit which have 2 single stage compressors. A condenser with a cooling tower and maximum water temperature is 28°C. LP evaporator supplied by thermal expansion valve and HP evaporator supplied by horizontal low pressure bottle. Each compressor with its own oil separator and its own oil cooler is cooled by a cooling tower.

The design as the following conditions:

Refrigerant	:	R404A
Superheated in the piping of suction	:	5 °C
Superheated at exit of evaporator is	:	5 °C
Subcool of the liquid at exit condenser	:	3 °C

Question 1

To determine the range of temperature and pressure of the condensing and evaporating of HP circuit and evaporating of LP circuit.

(15 marks)

Question 2

From appendices 1 to 4, calculate the energy performances and the annual cost of the electric consumption of the compressors operate for 24 hours per day for 300kW of HP circuit and 100kW of LP circuit with a tariff of RM0.323 kWh.

From power consumption point of view, select the suitable compressor model for HP and LP circuit and justify your answer

(15 marks)

Question 3

Draw the refrigeration schematics with dispositive of return, balancing, and separation of oil, expansion, bottle, condenser, compressor, economizer if necessary and well placed pipes and valves between the components. Refer to appendix 1 and 3

(10 marks)

Question 4

By using the attached diagram, you are asked to draw the cycle and return the copy together with the answer booklet. Hence, state the values of discharge enthalpy and temperature of LP compressors. Assume that isentropic efficiency of compressor is 0.8 and the operating conditions of cycles are $-35 / -15 / +33$ ° C

(15 marks)

Question 5

Knowing that the oil content after the separator is 120ppm and the limit of miscibility of oil in the R404A at -15°C is 1.5%, calculate the power in kW of return or distiller of oil. The compressors operate under the mode $-15^{\circ}\text{C} / 33^{\circ}\text{C}$, refer to appendix 1.

Hence, calculate the mass and volume flow rate for each inlet and outlet of oil rectification.

(15 marks)

Question 6

Calculate the volume flow rate of R404A supply to and return from HP and LP evaporator. Hence, calculate the diameter of the pipings for supply to and return from HP and LP evaporator. Refer to appendix 1 and 3, the velocity for entry evaporator is 1m/s, velocity for return from evaporator is 15m/s.

(15 marks)


Question 7

To calculate the mass and volume flow rate of all entry and exit of economizer, based on the power of the 2 compressors at 100% from Appendix 1

(15 marks)

END OF QUESTION

Appendix 1

	Appendix 1
BITZER Software v6.4.0 rev1076	4/30/2014 / All data subject to change. 4 / 7

Compressor Selection: Open Drive Screw Compressors

Input Values:


Cooling capacity		kW
Refrigerant	R404A	
Reference temperature		
Evaporating SST		°C
Condensing SDT		°C
Liquid subcooling (in condenser)		K
Auto. subcooling		
Suct. gas superheat		K
Useful superheat		
Operating mode	Economizer	
Power supply		
Capacity control		
Additional cooling		
Max. Discharge gas temp.		°C
Subcooling (after condenser)		K

Output:

Compressor model	OSK7471-k	
Cooling capacity	158.4	kW
Cooling capacity *	164.6	kW
Evaporator capacity	158.4	kW
Shaft power	50.1	kW
COP/EER	-	
COP/EER *	-	
Mass flow LP	4255	kg/h
Mass flow HP	4900	kg/h
Operating mode	Economizer	
Liquid temp.(sc)	19.54	°C
Mass flow ECO	644	kg/h
sub cooler load	23.7	kW
sat. ECO Temp.	9.54	°C
ECO pressure	8.09	bar(a)
Oil volume flow	1.64	m ³ /h
Discharge gas temp. w/o cooling	49.2	°C

*According to EN12900 (10K suction gas superheat, liquid subcooling in Economiser with 5K temperature difference)

Appendix 2

 BITZER Software v6.4.0 rev1076	Appendix 2 4/29/2014 / All data subject to change.	4 / 9
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Semi-hermetic Screw Compressors HS

Model HSK8551-110
Refrigerant R404A
Operating mode Economizer

Tc[°C]		Te	10°C	5°C	0°C	-5°C	-10°C	-15°C	-20°C
30	Q	[W]		298582	256976	219830	186844	157651	131877
	P	[kW]		56.4	55.2	54	52.9	52	51.2
	I	[A]		97.6	95.9	94.2	92.7	91.4	90.3
	COP	-		5.29	4.66	4.07	3.53	3.03	2.58
	mLP	[kg/h]		8232	7007	5930	4984	4155	3430
	mHP	[kg/h]		8290	7259	6321	5470	4701	4007
	Qac	[kW]		0	0	0	0	0	0
	tcu	[°C]		28.9	26.3	23.6	20.8	17.78	14.58
	pm	[bar(a)]		10.58	9.83	9.11	8.39	7.68	6.97
	Qsc	[kW]		2.29	9.84	15.11	18.61	20.7	21.5
40	Q	[W]		273405	235046	200963	170744	143982	120288
	P	[kW]		68.4	67.3	66.3	65.4	64.5	63.7
	I	[A]		114.7	113.1	111.7	110.3	109.1	107.9
	COP	-		4	3.49	3.03	2.61	2.23	1.89
	mLP	[kg/h]		8076	6865	5798	4860	4036	3315
	mHP	[kg/h]		8607	7536	6564	5684	4886	4163
	Qac	[kW]		0	0	0	0	0	0
	tcu	[°C]		34.5	31.9	29.3	26.4	23.3	19.87
	pm	[bar(a)]		12.27	11.48	10.67	9.85	9.01	8.17
	Qsc	[kW]		18.94	23.7	26.8	28.5	29	28.5
50	Q	[W]		240459	206454	176287	149509	125708	104506
	P	[kW]		83.6	82.7	81.8	81	80.2	79.3
	I	[A]		137.8	136.4	135	133.7	132.4	131.1
	COP	-		2.88	2.5	2.15	1.85	1.57	1.32
	mLP	[kg/h]		7791	6597	5545	4618	3803	3088
	mHP	[kg/h]		8823	7723	6724	5816	4989	4233
	Qac	[kW]		0	0	0	0	0	11.81
	tcu	[°C]		41	38.5	35.8	32.7	29.4	25.7
	pm	[bar(a)]		14.56	13.65	12.71	11.73	10.71	9.66
	Qsc	[kW]		32.6	35.2	36.5	36.7	35.8	33.9


Q [W]
 P [kW]
 I [A]
 COP [-]
 mLP [kg/h]

Cooling capacity
 Power input
 Current
 COP/EER
 Mass flow LP

mHP [kg/h]
 Qac [kW]
 tcu [°C]
 pm [bar(a)]
 Qso [kW]

Mass flow HP
 Additional cooling
 Liquid temp.
 ECO pressure
 sub cooler capacity (ECO)

Appendix 3

 BITZER Software v6.4.0 rev1076	Appendix 3 4/29/2014 / All data subject to change.	4 / 6
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Compressor model : Semi-hermetic Reciprocating Compressors

Model selected 6F-40.2Y
Refrigerant R404A
Operating Mode Standard

Tc[°C]		Te	-30°C	-35°C	-40°C	-45°C			
-15	Q	[W]	67757	52990	40828	30913			
	Qo*	[kW]	69967	55036	42668	32529			
	P	[kW]	10.32	10.13	9.67	8.95			
	I	[A]	31.4	31.3	30.9	30.5			
	Qc	[kW]	78078	63124	50494	39859			
	COP	-	-	-	-	-			
	COP*		-	-	-	-			
	m	[kg/h]	1400	1114	874	674			
	Mode		Booster	Booster	Booster	Booster			
-10	Q	[W]	64233	50113	38487	29015			
	Qo*	[kW]	66811	52468	40580	30830			
	P	[kW]	11.78	11.26	10.49	9.53			
	I	[A]	32.5	32.1	31.5	30.9			
	Qc	[kW]	76017	61372	48973	38546			
	COP	-	-	-	-	-			
	COP*		-	-	-	-			
	m	[kg/h]	1380	1096	858	659			
	Mode		Booster	Booster	Booster	Booster			
-5	Q	[W]	60690	47216	36125	27092			
	Qo*	[kW]	63625	49870	38459	29093			
	P	[kW]	13.12	12.29	11.27	10.12			
	I	[A]	33.5	32.9	32.1	31.2			
	Qc	[kW]	73810	59510	47391	37215			
	COP	-	-	-	-	-			
	COP*		-	-	-	-			
	m	[kg/h]	1359	1077	841	643			
	Mode		Booster	Booster	Booster	Booster			

Q [W]
 P [kW]
 I [A]
 COP [-]
 mLP [kg/h]

Cooling capacity
 Power input
 Current
 COP/EER
 Mass flow LP

mHP [kg/h]
 Qac [kW]
 tco [°C]
 pm [bar(a)]
 Qsc [kW]

Mass flow HP
 Additional cooling
 Liquid temp.
 ECO pressure
 sub cooler capacity (ECO)

Appendix 4

COMPRESSOR DATA

Model AMFI540
 Refrigerant R404A
 Suction temperature : 20 °C
 Sub Cooling : 0 °C
 Compressor with swept volume 180 m3/h
 Operating Mode Standard

Cooling Capacity (kW)

Tcond(0C)	T evaporation(0C)							
	-15	-20	-25	-30	-35	-40	-45	-50
-20				74.18	59.82	47.78	37.77	29.53
-15			88.42	71.93	58.01	46.34	36.63	28.64
-10		104.39	85.60	69.65	56.17	44.88	35.48	27.74
-5	122.14	100.90	82.76	67.34	54.32	43.40	34.31	26.83
0	117.93	97.44	79.93	65.05	52.48	41.93	33.16	25.92
5	113.50	93.80	76.96	62.64	50.54	40.38	31.94	24.97
10	109.09	90.18	74.00	60.24	48.61	38.85	30.72	24.03
15	104.62	86.50	71.00	57.80	46.65	37.29	29.49	23.07
20	100.06	82.75	67.94	55.32	44.66	35.70	28.24	22.09
25	95.40	78.93	64.81	52.79	42.62	34.07	26.96	21.09
30	90.62	75.00	61.60	50.19	40.53	32.41	25.64	20.06
35	85.69	70.94	58.29	47.51	38.37	30.69	24.29	19.00
40	80.57	66.74	54.86	44.72	36.13	28.90	22.88	17.90
45	75.22	62.34	51.27	41.81	33.79	27.04	21.41	16.75

Absorbed Power (kW)

Tcond(0C)	T evaporation(0C)							
	-15	-20	-25	-30	-35	-40	-45	-50
-20				5.34	6.57	7.20	7.35	7.15
-15			6.21	7.72	8.53	8.80	8.65	8.19
-10		7.18	8.99	10.02	10.43	10.35	9.90	9.19
-5	8.23	10.39	11.68	12.26	12.27	11.86	11.12	10.17
0	11.92	13.50	14.28	14.42	14.06	13.32	12.30	11.12
5	15.49	16.51	16.81	16.52	15.79	14.73	13.45	12.04
10	18.95	19.43	19.25	18.55	17.47	16.11	14.56	12.93
15	22.29	22.25	21.61	20.52	19.09	17.44	15.64	13.79
20	25.52	24.98	23.91	22.43	20.67	18.73	16.69	14.63
25	28.65	27.62	26.12	24.28	22.20	19.98	17.70	15.44
30	31.67	30.18	28.27	26.07	23.68	21.19	18.69	16.24
35	34.60	32.66	30.36	27.81	25.12	22.37	19.64	17.01
40	37.43	35.06	32.38	29.50	26.52	23.52	20.58	17.75
45	40.18	37.39	34.34	31.14	27.87	24.63	21.48	18.48

Appendix 5

Table of R404A saturated

T (C)	Liquid with saturated				Vapour with saturated			
	P (bar)	h (kJ/kg)	s (J/kg K)	v (dm ³ /kg)	P (bar)	h (kJ/kg)	s (J/kg K)	v (dm ³ /kg)
-45	1.077	141.26	767.09	0.7670	1.039	339.88	1639.9	176.34
-40	1.354	147.45	794.21	0.7762	1.310	342.91	1634.1	141.69
-35	1.684	153.73	821.00	0.7858	1.634	345.91	1629.0	114.94
-30	2.074	160.10	847.45	0.7959	2.017	348.86	1624.6	94.06
-25	2.531	166.56	873.57	0.8064	2.466	351.77	1620.6	77.59
-20	3.060	173.10	899.37	0.8176	2.989	354.63	1617.0	64.47
-15	3.671	179.74	924.88	0.8293	3.592	357.42	1613.8	53.93
-10	4.371	186.46	950.12	0.8417	4.284	360.13	1611.0	45.38
-5	5.166	193.25	975.15	0.8548	5.072	362.77	1608.3	38.40
0	6.066	200.00	1000.00	0.8688	5.965	365.31	1605.9	32.65
5	7.079	207.10	1024.73	0.8838	6.970	367.75	1603.6	27.88
10	8.212	214.16	1049.41	0.8999	8.097	370.07	1601.4	23.90
15	9.476	221.34	1074.09	0.9174	9.354	372.25	1599.2	20.55
20	10.880	228.64	1098.87	0.9363	10.751	374.28	1596.9	17.71
25	12.432	236.11	1123.84	0.9571	12.297	376.13	1594.4	15.30
30	14.145	243.77	1149.07	0.9801	14.004	377.77	1591.7	13.23
35	16.028	251.67	1174.68	1.0059	15.883	379.15	1588.6	11.44
40	18.094	259.87	1200.78	1.0353	17.945	380.20	1584.9	9.88
45	20.356	268.45	1227.49	1.0692	20.204	380.82	1580.3	8.51
50	22.830	277.47	1254.92	1.1096	22.677	380.88	1574.3	7.29
55	25.531	287.05	1283.22	1.1595	25.381	380.12	1566.5	6.20
60	28.481	297.28	1312.53	1.2251	28.339	378.15	1555.5	5.20

Appendix 6 Table of R404A superheated vapour

R404A		SUPERHEATED (K)																
T _{sat} (°C)	P _{sat} (bar)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70		
-45	1.04	h(kJ/kg)	339.88	343.74	347.64	351.58	355.55	359.57	363.62	367.72	371.85	376.03	380.24	384.50	388.80	393.15	397.53	
		s(I/kg.K)	1639.85	1656.60	1673.15	1689.51	1705.69	1721.70	1737.56	1753.27	1768.83	1784.26	1799.56	1814.74	1829.80	1844.74	1859.57	1874.24
		v(m³/kg)	0.17634	0.18087	0.18537	0.18982	0.19425	0.19864	0.20300	0.20735	0.21167	0.21597	0.22025	0.22452	0.22877	0.23301	0.23724	0.24147
-40	1.31	h(kJ/kg)	342.91	346.86	350.85	354.87	358.92	363.01	367.14	371.30	375.51	379.75	384.03	388.36	392.72	397.12	401.57	
		s(I/kg.K)	1634.11	1650.89	1667.45	1683.81	1699.98	1715.98	1731.82	1747.50	1763.03	1778.43	1793.69	1808.82	1823.83	1838.72	1853.50	
		v(m³/kg)	0.14169	0.14536	0.14899	0.15259	0.15615	0.15968	0.16319	0.16668	0.17015	0.17360	0.17703	0.18045	0.18385	0.18724	0.19062	
-35	1.63	h(kJ/kg)	345.91	349.95	354.03	358.13	362.27	366.44	370.64	374.88	379.16	383.47	387.82	392.21	396.63	401.10	405.60	
		s(I/kg.K)	1629.04	1645.86	1662.45	1678.82	1695.00	1711.00	1726.82	1742.48	1757.99	1773.36	1788.59	1803.68	1818.66	1833.51	1848.24	
		v(m³/kg)	0.11494	0.11795	0.12092	0.12386	0.12677	0.12965	0.13250	0.13534	0.13816	0.14096	0.14374	0.14651	0.14927	0.15202	0.15475	
-30	2.02	h(kJ/kg)	348.86	353.01	357.18	361.37	365.59	369.85	374.13	378.44	382.79	387.18	391.59	396.05	400.54	405.07	409.63	
		s(I/kg.K)	1624.55	1641.43	1658.06	1674.46	1690.66	1706.66	1722.49	1738.14	1753.64	1768.98	1784.19	1799.25	1814.19	1829.01	1843.71	
		v(m³/kg)	0.09656	0.09956	0.10256	0.10556	0.10856	0.11156	0.11456	0.11756	0.12056	0.12356	0.12656	0.12956	0.13256	0.13556	0.13856	
-25	2.47	h(kJ/kg)	351.77	356.02	360.29	364.58	368.89	373.23	377.59	381.99	386.41	390.87	395.36	399.88	404.44	409.03	413.66	
		s(I/kg.K)	1620.56	1637.52	1654.21	1670.66	1686.89	1702.92	1718.75	1734.41	1749.90	1765.23	1780.41	1795.46	1810.37	1825.16	1839.82	
		v(m³/kg)	0.07759	0.07969	0.08175	0.08379	0.08579	0.08778	0.08974	0.09168	0.09360	0.09551	0.09741	0.09929	0.10116	0.10303	0.10488	
-20	2.99	h(kJ/kg)	354.63	358.99	363.36	367.75	372.15	376.58	381.03	385.50	390.01	394.54	399.10	403.69	408.32	412.98	417.67	
		s(I/kg.K)	1617.01	1634.07	1650.85	1667.36	1683.63	1699.69	1715.54	1731.21	1746.70	1762.03	1777.21	1792.24	1807.13	1821.89	1836.52	
		v(m³/kg)	0.06447	0.06626	0.06801	0.06973	0.07142	0.07310	0.07475	0.07638	0.07800	0.07960	0.08119	0.08277	0.08433	0.08589	0.08744	
-15	3.59	h(kJ/kg)	357.42	361.90	366.38	370.87	375.37	379.89	384.43	388.99	393.57	398.18	402.82	407.49	412.18	416.91	421.67	
		s(I/kg.K)	1613.83	1631.02	1647.89	1664.48	1680.82	1696.92	1712.81	1728.50	1744.00	1759.34	1774.51	1789.53	1804.41	1819.15	1833.76	
		v(m³/kg)	0.05393	0.05546	0.05696	0.05844	0.05988	0.06131	0.06271	0.06410	0.06547	0.06683	0.06818	0.06951	0.07083	0.07215	0.07345	
-10	4.28	h(kJ/kg)	360.13	364.74	369.34	373.94	378.55	383.17	387.80	392.44	397.11	401.80	406.52	411.26	416.03	420.82	425.65	
		s(I/kg.K)	1610.95	1628.30	1645.30	1661.99	1678.40	1694.56	1710.49	1726.22	1741.74	1757.09	1772.27	1787.29	1802.16	1816.89	1831.48	
		v(m³/kg)	0.04538	0.04672	0.04802	0.04929	0.05054	0.05176	0.05297	0.05416	0.05533	0.05649	0.05764	0.05878	0.05991	0.06103	0.06214	
-5	5.07	h(kJ/kg)	362.77	367.51	372.24	376.96	381.67	386.39	391.12	395.86	400.61	405.39	410.18	415.00	419.84	424.71	429.61	
		s(I/kg.K)	1608.33	1625.86	1643.01	1659.82	1676.32	1692.56	1708.55	1724.32	1739.88	1755.24	1770.44	1785.46	1800.33	1815.05	1829.64	
		v(m³/kg)	0.03840	0.03957	0.04071	0.04182	0.04291	0.04397	0.04502	0.04604	0.04706	0.04806	0.04905	0.05003	0.05100	0.05196	0.05291	
0	5.96	h(kJ/kg)	365.31	370.20	375.07	379.91	384.74	389.56	394.33	399.23	404.08	408.94	413.81	418.71	423.63	428.57	433.54	
		s(I/kg.K)	1605.90	1623.65	1640.97	1657.92	1674.54	1690.87	1706.93	1722.75	1738.36	1753.76	1768.97	1784.01	1798.88	1813.61	1828.19	
		v(m³/kg)	0.03265	0.03369	0.03469	0.03567	0.03663	0.03756	0.03847	0.03937	0.04025	0.04112	0.04198	0.04283	0.04367	0.04451	0.04533	
5	6.97	h(kJ/kg)	367.75	372.80	377.81	382.78	387.74	392.68	397.61	402.55	407.49	412.44	417.41	422.39	427.38	432.40	437.44	
		s(I/kg.K)	1603.60	1621.61	1639.14	1656.26	1673.01	1689.45	1705.60	1721.49	1737.14	1752.58	1767.82	1782.88	1797.77	1812.50	1827.08	
		v(m³/kg)	0.02788	0.02881	0.02971	0.03058	0.03142	0.03225	0.03305	0.03384	0.03462	0.03538	0.03613	0.03688	0.03761	0.03833	0.03905	
10	8.10	h(kJ/kg)	370.07	375.30	380.46	385.58	390.67	395.73	400.78	405.82	410.86	415.90	420.96	426.02	431.10	436.19	441.31	
		s(I/kg.K)	1601.38	1619.69	1637.46	1654.77	1671.68	1688.25	1704.50	1720.47	1736.19	1751.68	1766.96	1782.05	1796.96	1811.70	1826.29	
		v(m³/kg)	0.02390	0.02474	0.02555	0.02633	0.02708	0.02781	0.02853	0.02923	0.02992	0.03059	0.03125	0.03191	0.03255	0.03319	0.03382	
15	9.35	h(kJ/kg)	372.25	377.68	383.02	388.29	393.51	398.70	403.87	409.02	414.17	419.31	424.46	429.61	434.77	439.95	445.14	
		s(I/kg.K)	1599.16	1617.83	1635.89	1653.42	1670.52	1687.22	1703.59	1719.66	1735.46	1751.01	1766.34	1781.47	1796.40	1811.16	1825.76	
		v(m³/kg)	0.02055	0.02132	0.02205	0.02276	0.02343	0.02409	0.02473	0.02536	0.02597	0.02657	0.02716	0.02774	0.02831	0.02887	0.02943	
20	10.75	h(kJ/kg)	374.28	379.93	385.46	390.90	396.27	401.60	406.89	412.16	417.41	422.66	427.90	433.14	438.39	443.65	448.92	
		s(I/kg.K)	1596.87	1615.97	1634.36	1652.16	1669.46	1686.34	1702.85	1719.02	1734.91	1750.54	1765.92	1781.09	1796.07	1810.85	1825.47	
		v(m³/kg)	0.01771	0.01842	0.01910	0.01974	0.02035	0.02095	0.02153	0.02209	0.02264	0.02317	0.02370	0.02422	0.02473	0.02523	0.02572	

T _{sat} (°C)	P _{sat} (Bar)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70
12.30	h(kj/kg)	376.13	382.03	387.77	393.39	398.93	404.41	409.83	415.22	420.59	425.94	431.29	436.62	441.96	447.31	452.66
	s(lj/kg.K)	1594.42	1614.04	1632.82	1650.92	1668.47	1685.54	1702.21	1718.51	1734.51	1750.21	1765.67	1780.89	1795.91	1810.73	1825.37
	v(m ³ /kg)	0.01530	0.01596	0.01658	0.01717	0.01774	0.01828	0.01880	0.01931	0.01980	0.02029	0.02076	0.02123	0.02168	0.02213	0.02257
25	h(kj/kg)	377.77	383.95	389.93	395.76	401.48	407.11	412.68	418.20	423.69	429.15	434.60	440.04	445.47	450.91	456.34
	s(lj/kg.K)	1591.71	1611.95	1631.19	1649.66	1667.49	1684.78	1701.63	1718.08	1734.19	1750.00	1765.54	1780.83	1795.89	1810.75	1825.42
	v(m ³ /kg)	0.01323	0.01385	0.01443	0.01498	0.01550	0.01599	0.01647	0.01694	0.01739	0.01782	0.01825	0.01867	0.01908	0.01949	0.01988
30	h(kj/kg)	379.15	385.67	391.92	397.98	403.89	409.70	415.42	421.08	426.70	432.28	437.84	443.38	448.91	454.43	459.96
	s(lj/kg.K)	1588.59	1609.60	1629.41	1648.29	1666.45	1684.01	1701.06	1717.68	1733.93	1749.85	1765.48	1780.84	1795.97	1810.87	1825.59
	v(m ³ /kg)	0.01144	0.01203	0.01258	0.01309	0.01357	0.01403	0.01447	0.01490	0.01531	0.01571	0.01610	0.01648	0.01685	0.01722	0.01758
35	h(kj/kg)	380.20	387.14	393.71	400.02	406.15	412.15	418.04	423.85	429.60	435.31	440.98	446.63	452.26	457.89	463.50
	s(lj/kg.K)	1584.87	1606.86	1627.36	1646.75	1665.29	1683.15	1700.44	1717.26	1733.66	1749.71	1765.44	1780.89	1796.09	1811.05	1825.81
	v(m ³ /kg)	0.00988	0.01046	0.01098	0.01146	0.01191	0.01234	0.01275	0.01314	0.01351	0.01388	0.01424	0.01458	0.01492	0.01526	0.01558
40	h(kj/kg)	380.82	388.29	395.25	401.86	408.24	414.44	420.51	426.49	432.39	438.23	444.02	449.78	455.52	461.25	466.96
	s(lj/kg.K)	1580.26	1603.57	1624.92	1644.92	1663.92	1682.13	1699.70	1716.74	1733.32	1749.52	1765.37	1780.92	1796.19	1811.23	1826.04
	v(m ³ /kg)	0.00851	0.00908	0.00958	0.01004	0.01047	0.01087	0.01125	0.01161	0.01196	0.01230	0.01262	0.01294	0.01325	0.01356	0.01385
45	h(kj/kg)	380.88	389.06	396.49	403.46	410.11	416.55	422.82	428.97	435.03	441.01	446.93	452.82	458.67	464.50	470.31
	s(lj/kg.K)	1574.34	1599.48	1621.95	1642.71	1662.25	1680.87	1698.76	1716.05	1732.84	1749.20	1765.19	1780.85	1796.22	1811.33	1826.21
	v(m ³ /kg)	0.00729	0.00787	0.00836	0.00880	0.00921	0.00959	0.00994	0.01028	0.01060	0.01092	0.01122	0.01151	0.01180	0.01208	0.01235
50	h(kj/kg)	380.12	389.34	397.37	404.76	411.74	418.44	424.93	431.28	437.50	443.63	449.70	455.71	461.68	467.61	473.53
	s(lj/kg.K)	1566.46	1594.33	1618.26	1639.96	1660.16	1679.26	1697.53	1715.11	1732.14	1748.69	1764.83	1780.62	1796.10	1811.30	1826.24
	v(m ³ /kg)	0.00620	0.00680	0.00729	0.00772	0.00811	0.00847	0.00880	0.00912	0.00942	0.00971	0.00999	0.01026	0.01052	0.01078	0.01103
55	h(kj/kg)	378.15	388.98	397.81	405.71	413.07	420.07	426.81	433.37	439.77	446.07	452.28	458.43	464.52	470.58	476.60
	s(lj/kg.K)	1574.34	1599.48	1621.95	1642.71	1662.25	1680.87	1698.76	1716.05	1732.84	1749.20	1765.19	1780.85	1796.22	1811.33	1826.21
	v(m ³ /kg)	0.00729	0.00787	0.00836	0.00880	0.00921	0.00959	0.00994	0.01028	0.01060	0.01092	0.01122	0.01151	0.01180	0.01208	0.01235
60	h(kj/kg)	378.15	388.98	397.81	405.71	413.07	420.07	426.81	433.37	439.77	446.07	452.28	458.43	464.52	470.58	476.60
	s(lj/kg.K)	1574.34	1599.48	1621.95	1642.71	1662.25	1680.87	1698.76	1716.05	1732.84	1749.20	1765.19	1780.85	1796.22	1811.33	1826.21
	v(m ³ /kg)	0.00729	0.00787	0.00836	0.00880	0.00921	0.00959	0.00994	0.01028	0.01060	0.01092	0.01122	0.01151	0.01180	0.01208	0.01235

