TECHNICAL DATA SHEET R-480A (RS-20)

Features

RS-20 is a zero-tropic, non-flammable HFC+HFO refrigerant gas mixture with ODP = 0 and a much lower global warming potential (GWP) than its predecessor, R-134a. It was developed to fulfil the requirements developed in F-Gas in Europe for reducing the greenhouse effect.

Some of its main features are:

- It is a good alternative to R-134a for installations that have been using this refrigerant, including automotive air conditioning applications.
- It is a R-134a **'drop-in': direct** replacement for R-134a in existing installations.
- The global warming potential (GWP) is approximately 291. around 80 per cent lower than that of R-134a.
- Similar cooling capacity and energy efficiency (COP) to R-134a.
- It is compatible with PAG and POE synthetic oils.
- Because RS-20 is a blend, it should always be transferred in liquid phase or at full load if in gaseous phase.

Applications

- RS-20 is the only substitute for R-134a with a GWP reduction of over 75 per cent, suitable for all applications except for installations with a flooded evaporator.
- O RS-20 can also be used in new equipment designed for R-134a and has the great advantage of being **non-flammable**.

Working and operating conditions

- As RS-20 is a mixture, it must always be transferred in liquid phase or in full loads if it is in gaseous phase.
- There is no need to make any changes to an R-134a installation when converting to RS-20. either with a fixed expansion system (capillary) or with a thermostatic expansion valve (TXV).

Lubricants

RS-20 is compatible with the same polyalkylene glycol (PAG) or polyolester (POE) oils that are used with R-134a in car air conditioning systems and other refrigeration systems, so there is no need to change the type of oil when converting from R-134a to RS-20.

Environmental data

None of the components in RS-20 contain chlorine, so the product has ODP = 0 (ozone depletion potential).

RS-20 (R-480A) has a low global warming potential (GWP), less than a quarter that of R-134a, thus reducing CO2 emissions in the event of a direct leakage.

Toxicity, safety and storage

RS-20 has no acute oral, inhalation or eye contact toxicity. It is not considered a skin irritant or corrosive, nor a respiratory sensitiser. As usual, being denser than air, it can be deposited in low areas of confined spaces and cause asphyxiation due to oxygen displacement.

Studies of its components in animals have shown that repeated exposure does not produce teratogenic (reproductive) effects.

Furthermore, it is unlikely to present a carcinogenic risk to humans.

RS-20 does not contain components with endocrine disrupting properties in accordance with Article 57(f) of REACH or Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels equal to or greater than 0.1 per cent.

RS-20 (R-480A) is not flammable in any mixture fractionation situation in accordance with ASHRAE Standard 34.

Therefore, the safety classification of RS-20 is **A1 group L1**.

Cylinders of RS-20 should be stored in a dry, well-ventilated place at less than 50°C, away from direct sunlight, heat sources, open flames,. Avoid storage near the entrance to air conditioning units, boilers or open drains.

Material compatibility

RS-20 is compatible with all materials normally used in systems that have previously worked with R-134a.

In general, materials compatible with R-134a can also be used with RS-20 without any problems.

It is advisable to check with the equipment manufacturer if there are any special requirements regarding the compatibility of materials for adaptation.

Components

Chemical name	% by weight	CAS No	CE No
Trans-1.3.3.3-Tetrafluoroprop-1-ene (R-1234ze)	86.0	29118-24-9	417-480-0
1.1.1.2.3.3.3-Heptafluoropropane (R-227ea)	9.0	431-89-0	207-079-2
Carbon dioxide (R-744)	5.0	124-38-9	204-696-9

Physical properties

Property	Units	RS-20 (R-480A)	R-134a
Molecular weight	g/mol	102.8	102.0
Liquid density (at 25 ºC)	Kg/l	1.175	1.207
Saturated vapour density (at 25 ºC)	Kg/l	0.02827	0.03235
Boiling point (at 1 atm)	ºC	-34.09 (1)	-26.07
Liquid viscosity (at 25 ºC)	cP	0.1860	0.195
Vapour viscosity (at 25 ºC) (4)	cP	0.0123	0.0118
Surface tension (liquid at 25 ºC)	mN/m	8.518	8.031
Absolute vapour pressure (at 25 ºC)	bar	7.517	6.654
Constant specific heat in volume Cv (at 25 ºC/1bar)	kJ/kg·K	1.391	1.425
Constant pressure specific heat Cp (at 25 ºC/1bar)	kJ/kg·K	0.863	0.606
Absolute critical pressure	bar	43.51	40.06
Critical temperature	ºC	107.4	101.1
Latent heat of vaporisation at boiling point	kJ/kg	229.4 (2)	217 (2)
Thermal conductivity (liquid at 25 ºC)	W/m·K	0.0828	0.0892
LFL (Low Flammable Limit)	% v/v	No inflamable	No inflamable
ODP		0	0
GWP		291 (3)	1430 (3)
Toxicity		No	No

(1) Boiling point at 1 atm (mean of bubble and dew points)
(2) Enthalpy difference between liquid at bubble point and vapour at dew point at 1 atmosphere.
(3) According to the Regulation EU 2024/573.
(4) Mean of bubble and dew points at 250C. Property calculations on the midpoint liquid and vapour compositions as appropriate.

Please refer to the R-480A (RS-20) Retrofit Guidelines.

Pressure/temperature tables

Temperature	Absolute Pressure		Density		Enthalpy		Entropy	
°C	Bubble	Dew	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
	bar	bar	Kg/m³	Kg/m³	kJ/Kg	kJ/Kg	kJ/Kg·K	kJ/Kg·K
-60	0.55605	0.12538	1421.3	0.77458	123.34	343.46	0.69	1.74
-59	0.58302	0.13394	1418.7	0.82394	124.58	344.15	0.69	1.74
-58	0.61101	0.14298	1416.0	0.87583	125.84	344.85	0.70	1.74
-57	0.64004	0.15252	1413.3	0.93034	127.09	345.56	0.70	1.74
-56	0.67013	0.16257	1410.6	0.98757	128.34	346.26	0.71	1.74
-55	0.70132	0.17317	1408.0	1.0476	129.60	346.96	0.71	1.73
-54	0.73364	0.18433	1405.3	1.1106	130.85	347.67	0.72	1.73
-53	0.76710	0.19607	1402.6	1.1766	132.11	348.37	0.73	1.73
-52	0.80174	0.20842	1399.9	1.2457	133.36	349.08	0.73	1.73
-51	0.83758	0.22141	1397.2	1.3181	134.62	349.78	0.74	1.73
-50	0.87466	0.23504	1394.5	1.3938	135.88	350.49	0.74	1.73
-49	0.9130	0.24936	1391.8	1.4729	137.14	351.20	0.75	1.72
-48	0.95263	0.26439	1389.1	1.5557	138.40	351.91	0.75	1.72
-47	0.99357	0.28014	1386.4	1.6421	139.66	352.61	0.76	1.72
-46	1.0359	0.29665	1383.6	1.7324	140.93	353.32	0.77	1.72
-45	1.0795	0.31395	1380.9	1.8266	142.19	354.03	0.77	1.72
-44	1.1246	0.33205	1378.2	1.9248	143.46	354.74	0.78	1.72
-43	1.1711	0.35100	1375.4	2.0272	144.73	355.45	0.78	1.72
-42	1.2191	0.37081	1372.7	2.1339	146.00	356.16	0.79	1.72
-41	1.2686	0.39152	1369.9	2.2451	147.26	356.86	0.79	1.72
-40	1.3196	0.41316	1367.2	2.3608	148.54	357.57	0.80	1.71
-39	1.3722	0.43575	1364.4	2.4812	149.81	358.28	0.80	1.71
-38	1.4264	0.45933	1361.7	2.6065	151.08	358.99	0.81	1.71
-37	1.4822	0.48392	1358.9	2.7367	152.36	359.70	0.81	1.71
-36	1.5397	0.50957	1356.1	2.8721	153.64	360.41	0.82	1.71
-35	1.5988	0.53630	1353.3	3.0127	154.91	361.12	0.83	1.71
-34	1.6596	0.56414	1350.5	3.1587	156.19	361.83	0.83	1.71
-33	1.7223	0.59313	1347.7	3.3103	157.47	362.54	0.84	1.71
-32	1.7867	0.62330	1344.9	3.4676	158.76	363.25	0.84	1.71
-31	1.8529	0.65469	1342.1	3.6307	160.05	363.96	0.85	1.71
-30	1.9209	0.68733	1339.3	3.7999	161.33	364.66	0.85	1.71
-29	1.9909	0.72126	1336.5	3.9752	162.62	365.37	0.86	1.71
-28	2.0628	0.75651	1333.6	4.1569	163.91	366.08	0.86	1.70
-27	2.1366	0.79312	1330.8	4.3451	165.20	366.78	0.87	1.70
-26	2.2124	0.83113	1327.9	4.5399	166.49	367.49	0.87	1.70

Temperature	Absolute Pressure		Density		Enthalpy		Entropy	
°C	Bubble bar	Dew bar	Liquid Kg/m³	Vapour Kg/m³	Liquid kJ/Kg	Vapour kJ/Kg	Liquid kJ/Kg·K	Vapour kJ/Kg·K
-25	2.2902	0.87057	1325.1	4.7416	167.79	368.20	0.88	1.70
-24	2.3701	0.91148	1322.2	4.9502	169.08	368.90	0.88	1.70
-23	2.4520	0.9539	1319.3	5.1661	170.38	369.60	0.89	1.70
-22	2.5361	0.99787	1316.5	5.3893	171.68	370.31	0.89	1.70
-21	2.6224	1.0434	1313.6	5.62	172.98	371.01	0.90	1.70
-20	2.7108	1.0906	1310.7	5.8584	174.28	371.72	0.90	1.70
-19	2.8015	1.1395	1307.7	6.1048	175.59	372.42	0.91	1.70
-18	2.8944	1.19	1304.8	6.3592	176.90	373.12	0.91	1.70
-17	2.9896	1.2424	1301.9	6.6219	178.20	373.82	0.92	1.70
-16	3.0872	1.2965	1299.0	6.8931	179.51	374.52	0.92	1.70
-15	3.1871	1.3524	1296.0	7.173	180.83	375.22	0.93	1.70
-14	3.2894	1.4103	1293.1	7.4617	182.14	375.91	0.93	1.70
-13	3.3942	1.47	1290.1	7.7595	183.46	376.61	0.94	1.70
-12	3.5014	1.5317	1287.1	8.0666	184.77	377.31	0.94	1.70
-11	3.6112	1.5955	1284.1	8.3832	186.10	378.00	0.95	1.70
-10	3.7235	1.6613	1281.1	8.7095	187.42	378.69	0.95	1.70
-9	3.8383	1.7292	1278.1	9.0457	188.74	379.39	0.96	1.70
-8	3.9559	1.7992	1275.1	9.3921	190.07	380.08	0.96	1.70
-7	4.076	1.8714	1272.0	9.7488	191.40	380.77	0.97	1.70
-6	4.1989	1.9459	1269.0	10.116	192.73	381.46	0.97	1.70
-5	4.3245	2.0227	1265.9	10.494	194.07	382.14	0.98	1.70
-4	4.4528	2.1018	1262.9	10.884	195.40	382.83	0.98	1.70
-3	4.5840	2.1833	1259.8	11.284	196.74	383.51	0.99	1.69
-2	4.7180	2.2672	1256.7	11.697	198.08	384.20	0.99	1.69
-1	4.8549	2.3536	1253.6	12.121	199.42	384.88	1.00	1.69
0	4.9947	2.4426	1250.5	12.557	200.76	385.56	1.00	1.69
1	5.1375	2.5341	1247.4	13.005	202.11	386.23	1.01	1.69
2	5.2833	2.6282	1244.2	13.466	203.46	386.91	1.01	1.69
3	5.4320	2.7251	1241.1	13.94	204.81	387.58	1.02	1.69
4	5.5839	2.8246	1237.9	14.428	206.17	388.26	1.02	1.69
5	5.7389	2.927	1234.7	14.928	207.53	388.93	1.03	1.69
6	5.8970	3.0322	1231.5	15.443	208.89	389.60	1.03	1.69
7	6.0583	3.1403	1228.3	15.971	210.25	390.26	1.04	1.69
8	6.2228	3.2514	1225.0	16.514	211.61	390.93	1.04	1.69
9	6.3906	3.3654	1221.8	17.071	212.98	391.59	1.05	1.69

Temperature	Absolute Pressure		Density		Enthalpy		Entropy	
°C	Bubble bar	Dew Bar	Liquid Kg/m³	Vapour Kg/m³	Liquid kJ/Kg	Vapour kJ/Kg	Liquid kJ/Kg·K	Vapour kJ/Kg·K
10	6.5617	3.4825	1218.5	17.644	214.35	392.25	1.05	1.69
11	6.7361	3.6027	1215.3	18.231	215.72	392.91	1.06	1.69
12	6.9139	3.7261	1212.0	18.835	217.10	393.57	1.06	1.69
13	7.0951	3.8527	1208.7	19.454	218.48	394.22	1.07	1.69
14	7.2797	3.9826	1205.3	20.09	219.86	394.87	1.07	1.69
15	7.4679	4.1158	1202.0	20.742	221.25	395.52	1.08	1.69
16	7.6596	4.2524	1198.6	21.411	222.63	396.17	1.08	1.69
17	7.8548	4.3924	1195.3	22.098	224.03	396.81	1.09	1.69
18	8.0537	4.536	1191.9	22.803	225.42	397.45	1.09	1.69
19	8.2562	4.6831	1188.4	23.525	226.82	398.10	1.10	1.69
20	8.4623	4.8339	1185.0	24.267	228.22	398.73	1.10	1.69
21	8.6722	4.9884	1181.6	25.027	229.62	399.37	1.10	1.69
22	8.8859	5.1466	1178.1	25.807	231.03	400.00	1.11	1.69
23	9.1034	5.3086	1174.6	26.607	232.44	400.63	1.11	1.69
24	9.3247	5.4744	1171.1	27.426	233.85	401.25	1.12	1.69
25	9.5499	5.6443	1167.5	28.267	235.27	401.87	1.12	1.69
26	9.779	5.8181	1164.0	29.129	236.69	402.49	1.13	1.69
27	10.012	5.9959	1160.4	30.013	238.11	403.10	1.13	1.69
28	10.249	6.1779	1156.8	30.919	239.54	403.72	1.14	1.69
29	10.490	6.3641	1153.2	31.848	240.98	404.33	1.14	1.69
30	10.736	6.5545	1149.5	32.8	242.41	404.93	1.15	1.69
31	10.985	6.7493	1145.8	33.776	243.85	405.53	1.15	1.69
32	11.238	6.9484	1142.1	34.776	245.30	406.13	1.16	1.69
33	11.496	7.152	1138.4	35.801	246.74	406.72	1.16	1.69
34	11.758	7.3601	1134.6	36.852	248.19	407.32	1.17	1.69
35	12.024	7.5729	1130.8	37.929	249.65	407.90	1.17	1.69
36	12.295	7.7902	1127.0	39.033	251.11	408.48	1.17	1.69
37	12.570	8.0123	1123.2	40.164	252.57	409.06	1.18	1.69
38	12.849	8.2392	1119.3	41.324	254.04	409.63	1.18	1.69
39	13.132	8.471	1115.4	42.513	255.52	410.20	1.19	1.69
40	13.421	8.7077	1111.5	43.731	256.99	410.77	1.19	1.69
41	13.713	8.9495	1107.5	44.98	258.47	411.33	1.20	1.69
42	14.011	9.1963	1103.5	46.26	259.96	411.88	1.20	1.69
43	14.312	9.4484	1099.5	47.572	261.45	412.43	1.21	1.69

Temperature	Absolute Pressure		Density		Enthalpy		Entropy	
°C	Bubble bar	Dew bar	Liquid Kg/m³	Vapour Kg/m³	Liquid kJ/Kg	Vapour kJ/Kg	Liquid kJ/Kg·K	Vapour kJ/Kg·K
44	14.619	9.7056	1095.4	48.916	262.95	412.97	1.21	1.69
45	14.930	9.9682	1091.3	50.295	264.45	413.52	1.22	1.69
46	15.246	10.236	1087.1	51.709	265.95	414.05	1.22	1.69
47	15.567	10.51	1082.9	53.158	267.46	414.58	1.23	1.69
48	15.892	10.789	1078.7	54.644	268.98	415.10	1.23	1.69
49	16.222	11.073	1074.5	56.168	270.50	415.62	1.24	1.69
50	16.558	11.364	1070.1	57.73	272.03	416.13	1.24	1.69
51	16.898	11.66	1065.8	59.333	273.56	416.63	1.24	1.69
52	17.243	11.962	1061.4	60.976	275.10	417.13	1.25	1.69
53	17.593	12.27	1057.0	62.662	276.65	417.62	1.25	1.69
54	17.948	12.585	1052.5	64.392	278.20	418.11	1.26	1.69
55	18.308	12.905	1047.9	66.167	279.75	418.58	1.26	1.69
56	18.673	13.231	1043.4	67.989	281.32	419.05	1.27	1.69
57	19.044	13.564	1038.7	69.858	282.88	419.51	1.27	1.69
58	19.419	13.904	1034.0	71.777	284.46	419.97	1.28	1.69
59	19.800	14.25	1029.3	73.748	286.05	420.42	1.28	1.69
60	20.186	14.602	1024.5	75.771	287.63	420.84	1.29	1.69

The refrigerant pressure-temperature tables show the liquid up to the bubble point and the vapour up to the dew point.

Bubble temperature: Temperature at which the refrigerant begins to evaporate (appearance of the first bubble) at a given pressure. Below this temperature, the refrigerant is sub-cooled.

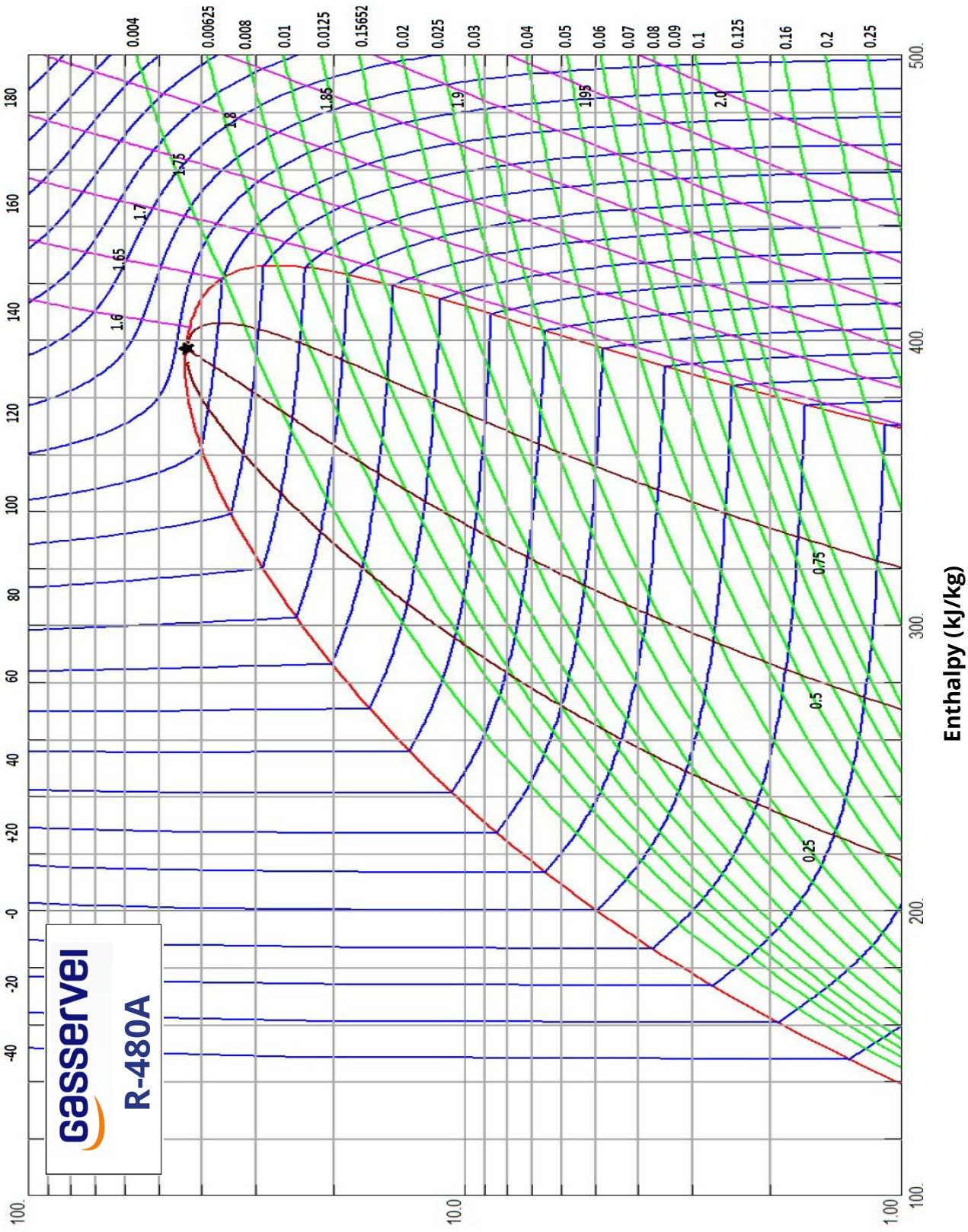
Dew point: Temperature at which the gaseous refrigerant (vapour) begins to condense (appearance of the first drop or dew) at a given pressure. Above this temperature, the refrigerant vapour is overheated.

Vapor sobreaquecido: Para determinar o sobreaquecimento do evaporador, medir a temperatura e a pressão da linha de sucção no tubo à saída do evaporador. Utilizando as tabelas P/T, determinar a temperatura do ponto de orvalho do vapor, que corresponde à pressão de sucção medida. Subtrair a temperatura medida da temperatura determinada utilizando as tabelas P/T, a diferença encontrada é o superaquecimento do evaporador.

Superheated vapour: To determine the superheat of the evaporator, measure the temperature and pressure of the suction line in the pipe at the outlet of the evaporator. Using the P/T tables, determine the dew point temperature of the vapour, which corresponds to the measured suction pressure. Subtract the measured temperature from the temperature determined using the P/T tables; the difference found is the evaporator superheat.

Note: *To adjust the calculations with the RS refrigerant range, determine the evaporation and condensation temperatures by taking the midpoint between the bubble and dew point temperatures.*

Ph Chart



Questions & Answers about R-480A (RS-20)

What is RS-20?

RS-20 is a non-ozone depleting low GWP replacement for R-134a.

Yes, but what does RS-20 contain?

RS-20 is a blend of carbon dioxide, R1234ze & R227ea.

Can RS-20 be used with the same lubricant when replacing R134a?

Yes. RS-20 is fully compatible with synthetic lubricants such as polyol ester (POE) and Polyalkylene Glycol. PAG oil is commonly used in mobile air conditioning.

Is RS-20 non-flammable and non-toxic?

RS-20 is non-flammable and non-toxic. Under all fractionation conditions, it is not flammable. It therefore has an A1 safety rating.

Is RS-20 approved by compressor manufacturers?

The individual components which comprise RS-20 are widely used in compressors produced by major manufacturers.

Does RS-20 need to be charged in the liquid or gaseous form?

Because RS-20 is a blend, the recommendation is to charge it into the system in the liquid form. However, if the entire contents of the cylinder are being charged, then vapour charging is acceptable.

Is RS-20 included in SNAP (US New Alternatives Programme)?

An application has been submitted to the EPA for inclusion on the SNAP list.

Does RS-20 have an ASHRAE number and what is its classification?

Yes, RS-20's ASHRAE number is R-480A and its safety classification is A1. i.e. low toxicity and non-flammable under all fractionation conditions.

How are the pressures of RS-20 compared to R-134a?

The discharge pressure of RS-20 is similar to that of R-134a.

What is the capacity of RS-20 compared to R-134a?

The capacity of RS-20 is similar to that of R-134a.

How is the discharge temperature of RS-20 compared to R-134a?

The discharge temperature of RS-20 is similar to that of R-134a.

What are the decomposition products resulting from the combustion of RS-20?

The decomposition products resulting from exposure of RS-20 to a high temperature source are similar to those formed by R-134a when exposed to fire. The decomposition products are in any case irritating and toxic, and self-contained breathing apparatus should be used in the event of exposure.

Are they any special precautions with RS-20?

There are no specific precautions which must be taken with RS-20. As with all refrigerants, common sense and good housekeeping is always recommended.

Is RS-20 compatible with all materials commonly used in systems that were designed and charged with R-134a.

Yes, RS-20 is compatible with all materials commonly used in systems that were designed and charged with R-134a. Magnesium and zinc alloys should be avoided.

Can RS-20 be recovered and recycled?

Yes. RS-20 can be recovered and re-used after a cleanning process.

What technical guidance do you advise when changing from R-134a to RS-20?

Use the same type of lubricant which will be Polyalkylene Glycol (particularly in mobile air conditioning), or polyolester, replace the filter/drier. Charge the system with similar amounts as for R-134a.

In systems operating with R-134a, what any adjustments need to be made to electronic expansion valves when using RS-20?

There is no need to make any adjustment to the electronic expansive device operating with R-134a.

How does RS-20 compare in price with R-134a?

RS-20 is competitive in price with R-134a.

What is the main advantage of RS-20?

RS-20 has a substantially lower Global Warming Potential which is 80% less than of R-134a while providing a similar thermodynamic performance & is simple & straightforward to retrofit.

Is RS-20 compatible with hoses, seals, gaskets and O-rings commonly used with R-134a?

Yes, there is no necessity change any seals, hoses etc when replacing R-134a with RS-20.

What is the specification for RS-20?

RS-20 complies with the refrigerant specification AHRI 700 for fluorocarbon refrigerants.

What is the effect of high exposure by inhalation of RS-20?

As is the case with all HFO and HFC based refrigerants high exposure to RS-20 may produce anaesthetic effects. Very high exposures may cause an abnormal heart rhythm and prove suddenly fatal as is the case with all HFO and HFC based refrigerants.

What type of leak detectors should be used with RS-20?

Leak detectors used with HFO are suitable for use with RS-20.

O What would be the effect of a large release of RS-20?

In common with other refrigerants of this type, the area should be immediately evacuated. The vapour may concentrate at floor level and in poorly ventilated areas may be slow to disperse. Forced ventilation should be provided before entering such areas.

Is RS-20 suitable for use with new equipment?

Yes. RS-20 can be used in new equipment & has the major advantage of being non-flammable.

Are RS-20 cylinders equipped with dip tube?

It depends on the type of cylinder, if they don't, the cylinder must be inverted to ensure that the liquid phase is extracted. All blue Gas Servei cylinders have them.