



# LAMPIRAN

# Lampiran 1. Tabel Propertis Refrigerant R22.



Engineering Toolbox - Resources, Tools and Basic Information for Engineering and Design of Technical Applications!



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## Refrigerant R22 - Properties

### Properties of Refrigerant R22 Dichlorodifluoromethane - saturated liquid and saturated vapor - imperial and metric units

R22 is a single HydroChloroFluoroCarbon (HCFC) compound. It has low chlorine content and ozone depletion potential and a modest global warming potential.  $ODP^1) = 0.05$  and  $GWP^2) = 1700$

R22 can be used in small heat pump systems, but new systems can not be manufactured for use in the EU after 2003. From 2010 only recycled or saved stocks of R22 can be used. It will no longer be manufactured.

- [R22 properties in Imperial Units](#)
- [R22 properties in Metric Units](#)

#### Refrigerant 22 Properties in Imperial Units

Temperature (°F)	Pressure (psia)	Liquid Density (lb/ft <sup>3</sup> )	Vapor Volume (ft <sup>3</sup> /lb)	Enthalpy (Btu/lb)		Entropy (Btu/lb°F)	
				Liquid	Vapor	Liquid	Vapor
-130.00	0.696	96.46	58.544	-23.150	89.864	-0.06198	0.28082
-120.00	1.080	95.53	38.833	-20.594	91.040	-0.05435	0.27430
-110.00	1.626	94.60	26.494	-18.038	92.218	-0.04694	0.26838
-100.00	2.384	93.66	18.540	-15.481	93.397	-0.03973	0.26298
-90.00	3.413	92.71	13.275	-12.921	94.572	-0.03271	0.25807
-80.00	4.778	91.75	9.7044	-10.355	95.741	-0.02587	0.25357
-70.00	6.555	90.79	7.2285	-7.783	96.901	-0.01919	0.24945
-60.00	8.830	89.81	5.4766	-5.201	98.049	-0.01266	0.24567
-50.00	11.696	88.83	4.2138	-2.608	99.182	-0.00627	0.24220
-45.00	13.383	88.33	3.7160	-1.306	99.742	-0.00312	0.24056
-41.44 <sup>b</sup>	14.696	87.97	3.4048	-0.377	100.138	-0.00090	0.23944
-40.00	15.255	87.82	3.2880	0.000	100.296	0.00000	0.23899
-35.00	17.329	87.32	2.9185	1.310	100.847	0.00309	0.23748
-30.00	19.617	86.81	2.5984	2.624	101.391	0.00616	0.23602
-25.00	22.136	86.29	2.3202	3.944	101.928	0.00920	0.23462
-20.00	24.899	85.77	2.0774	5.268	102.461	0.01222	0.23327
-15.00	27.924	85.25	1.8650	6.598	102.986	0.01521	0.23197
-10.00	31.226	84.72	1.6784	7.934	103.503	0.01818	0.23071
-5.00	34.821	84.18	1.5142	9.276	104.013	0.02113	0.22949
0.00	38.726	83.64	1.3691	10.624	104.515	0.02406	0.22832
5.00	42.960	83.09	1.2406	11.979	105.009	0.02697	0.22718
10.00	47.538	82.54	1.1265	13.342	105.493	0.02987	0.22607
15.00	52.480	81.98	1.0250	14.712	105.968	0.03275	0.22500
20.00	57.803	81.41	0.9343	16.090	106.434	0.03561	0.22395
25.00	63.526	80.84	0.8532	17.476	106.891	0.03846	0.22294
30.00	69.667	80.26	0.7804	18.871	107.336	0.04129	0.22195
35.00	76.245	79.67	0.7150	20.275	107.769	0.04411	0.22098
40.00	83.280	79.07	0.6561	21.688	108.191	0.04692	0.22004
45.00	90.791	78.46	0.6029	23.111	108.600	0.04972	0.21912
50.00	98.799	77.84	0.5548	24.544	108.997	0.05251	0.21821
55.00	107.32	77.22	0.5111	25.988	109.379	0.05529	0.21732
60.00	116.38	76.58	0.4715	27.443	109.748	0.05806	0.21644
65.00	126.00	75.93	0.4355	28.909	110.103	0.06082	0.21557
70.00	136.19	75.27	0.4026	30.387	110.441	0.06358	0.21472
75.00	146.98	74.60	0.3726	31.877	110.761	0.06633	0.21387
80.00	158.40	73.92	0.3451	33.381	111.066	0.06907	0.21302
85.00	170.45	73.22	0.3199	34.898	111.350	0.07182	0.21218
90.00	183.17	72.51	0.2968	36.430	111.616	0.07456	0.21134

Temperature (°F)	Pressure (psia)	Liquid Density (lb/ft³)	Vapor Volume (ft³/lb)	Enthalpy (Btu/lb)		Entropy (Btu/lb°F)	
				Liquid	Vapor	Liquid	Vapor
95.00	196.57	71.79	0.2756	37.977	111.859	0.07730	0.21050
100.00	210.69	71.05	0.2560	39.538	112.081	0.08003	0.20965
105.00	225.53	70.29	0.2379	41.119	112.278	0.08277	0.20879
110.00	241.14	69.51	0.2212	42.717	112.448	0.08552	0.20793
115.00	257.52	68.71	0.2058	44.334	112.591	0.08827	0.20705
120.00	274.71	67.89	0.1914	45.972	112.704	0.09103	0.20615
125.00	292.73	67.05	0.1781	47.633	112.783	0.09379	0.20522
130.00	311.61	66.17	0.1657	49.319	112.825	0.09657	0.20427
135.00	331.38	65.27	0.1542	51.032	112.826	0.09937	0.20329
140.00	352.07	64.33	0.1434	52.775	112.784	0.10220	0.20227
145.00	373.71	63.35	0.1332	54.553	112.692	0.10504	0.20119
150.00	396.32	62.33	0.1237	56.370	112.541	0.10793	0.20006
160.00	444.65	60.12	0.1063	60.145	112.035	0.11383	0.19757
170.00	497.35	57.59	0.0907	64.175	111.165	0.12001	0.19464
180.00	554.82	54.57	0.0763	68.597	109.753	0.12668	0.19102
190.00	617.53	50.62	0.0625	73.742	107.398	0.13432	0.18613
200.00	686.11	44.44	0.0478	80.558	102.809	0.14432	0.17805
205.06 °)	723.74	32.70	0.0306	91.052	91.052	0.15989	0.15989

### Refrigerant 22 Properties in Metric Units

Temperature (°C)	Pressure (MPa)	Liquid Density (kg/m³)	Vapor Volume (m³/kg)	Enthalpy (kJ/kg)		Entropy (kJ/kgK)	
				Liquid	Vapor	Liquid	Vapor
-100	0.00200	1571.7	8.2980	90.24	358.93	0.5027	2.0545
-90	0.00480	1545.1	3.6548	100.95	363.82	0.5629	1.9982
-80	0.01035	1518.3	1.7816	111.66	368.75	0.6197	1.9508
-70	0.02044	1491.1	0.94476	122.36	373.68	0.6738	1.9109
-60	0.03747	1463.6	0.53734	133.11	378.58	0.7253	1.8770
-50	0.06449	1435.5	0.32405	143.91	383.39	0.7748	1.8480
-48	0.07140	1429.8	0.29469	146.08	384.35	0.7844	1.8427
-46	0.07890	1424.1	0.26849	148.25	385.29	0.7940	1.8376
-44	0.08700	1418.4	0.24507	150.43	386.23	0.8035	1.8326
-42	0.09575	1412.6	0.22410	152.61	387.17	0.8130	1.8277
-40 °)	0.10132	1409.1	0.21256	153.93	387.72	0.8186	1.8249
-40	0.10518	1406.8	0.20526	154.80	388.09	0.8224	1.8230
-38	0.11533	1401.0	0.18832	156.99	389.01	0.8317	1.8184
-36	0.12623	1395.1	0.17306	159.19	389.93	0.8410	1.8140
-34	0.13793	1389.2	0.15927	161.40	390.84	0.8502	1.8096
-32	0.15045	1383.3	0.14680	163.61	391.74	0.8594	1.8054
-30	0.16384	1377.3	0.13551	165.82	392.63	0.8685	1.8013
-28	0.17815	1371.3	0.12525	168.04	393.52	0.8776	1.7973
-26	0.19340	1365.2	0.11593	170.27	394.39	0.8866	1.7934
-24	0.20965	1359.1	0.10744	172.51	395.26	0.8955	1.7896
-22	0.22693	1352.9	0.09970	174.75	396.12	0.9044	1.7859
-20	0.24529	1346.8	0.09262	177.00	396.67	0.9133	1.7822
-18	0.26477	1340.5	0.08615	179.26	397.81	0.9222	1.7787
-16	0.28542	1334.2	0.08023	181.53	398.64	0.9309	1.7752
-14	0.30728	1327.9	0.07479	183.81	399.46	0.9397	1.7719
-12	0.33040	1321.5	0.06979	186.09	400.27	0.9484	1.7686
-10	0.35482	1315.0	0.06520	188.38	401.07	0.9571	1.7653
-8	0.38059	1308.5	0.06096	190.69	401.85	0.9657	1.7621
-6	0.40775	1301.9	0.05706	193.00	402.63	0.9743	1.7590
-4	0.43636	1295.3	0.05345	195.32	403.39	0.9829	1.7560
-2	0.46646	1288.6	0.05012	197.66	404.14	0.9915	1.7530
0	0.49811	1281.8	0.04703	200.00	404.87	1.0000	1.7500
2	0.53134	1275.0	0.04417	202.35	405.59	1.0085	1.7471
4	0.56622	1268.1	0.04152	204.72	406.30	1.0170	1.7443
6	0.60279	1261.1	0.03906	207.10	406.99	1.0254	1.7415
8	0.64109	1254.0	0.03676	209.49	407.67	1.0338	1.7387
10	0.68119	1246.9	0.03463	211.89	408.33	1.0422	1.7360
12	0.72314	1239.7	0.03265	214.31	408.97	1.0506	1.7333
14	0.76698	1232.4	0.03079	216.74	409.60	1.0590	1.7306
16	0.81277	1225.0	0.02906	219.18	410.21	1.0673	1.7280
18	0.86056	1217.6	0.02744	221.63	410.80	1.0756	1.7254
20	0.91041	1210.0	0.02593	224.10	411.38	1.0840	1.7228
22	0.96236	1202.4	0.02451	226.59	411.93	1.0923	1.7202
24	1.0165	1194.6	0.02319	229.09	412.46	1.1006	1.7177
26	1.0728	1186.8	0.02194	231.60	412.98	1.1088	1.7151
28	1.1314	1178.8	0.02077	234.14	413.46	1.1171	1.7126

Temperature (°C)	Pressure (MPa)	Liquid Density (kg/m <sup>3</sup> )	Vapor Volume (m <sup>3</sup> /kg)	Enthalpy (kJ/kg)		Entropy (kJ/kgK)	
				Liquid	Vapor	Liquid	Vapor
30	1.1924	1170.7	0.01968	236.69	413.93	1.1254	1.7101
32	1.2557	1162.5	0.01864	239.25	414.37	1.1336	1.7075
34	1.3215	1154.2	0.01767	241.84	414.79	1.1419	1.7050
36	1.3898	1145.7	0.01675	244.44	415.18	1.1501	1.7024
38	1.4606	1137.1	0.01589	247.06	415.54	1.1584	1.6999
40	1.5341	1128.4	0.01507	249.71	415.87	1.1667	1.6973
42	1.6103	1119.5	0.01430	252.37	416.17	1.1749	1.6947
44	1.6892	1110.4	0.01357	255.06	416.44	1.1832	1.6921
46	1.7709	1101.2	0.01288	257.77	416.68	1.1915	1.6894
48	1.8555	1091.8	0.01223	260.51	416.87	1.1998	1.6867
50	1.9431	1082.1	0.01161	263.27	417.03	1.2081	1.6840
55	2.1753	1057.1	0.01020	270.31	417.24	1.2291	1.6768
60	2.4274	1030.5	0.00895	277.56	417.14	1.2503	1.6692
65	2.7008	1001.8	0.00784	285.06	416.65	1.2718	1.6610
70	2.9967	970.4	0.00684	292.90	415.69	1.2940	1.6518
75	3.3168	935.3	0.00594	301.18	414.09	1.3169	1.6413
80	3.6627	894.8	0.00511	310.10	411.60	1.3413	1.6287
85	4.0368	845.1	0.00433	320.05	407.72	1.3680	1.6128
90	4.4416	777.5	0.00355	331.98	401.33	1.3998	1.5907
95	4.8820	665.4	0.00264	348.86	387.46	1.4442	1.5491
96.14 <sup>c)</sup>	4.9900	523.8	0.00191	366.59	366.59	1.4918	1.4918

Note! <sup>b)</sup> = boiling point and <sup>c)</sup> = critical point

R417A is the zero *ODP*<sup>1)</sup> replacement for R22 suitable for new equipment and as a drop-in replacement for existing systems.

<sup>1)</sup> *ODP* - The *ODP* or Ozone Depletion Potential. The potential for a single molecule of the refrigerant to destroy the Ozone Layer. All refrigerants use R11 as a datum reference where R11 has an *ODP* of 1.0. The less the value of the *ODP* - the better the refrigerant is for the ozone layer and the environment.

<sup>2)</sup> *GWP* - The *GWP*, or Global Warming Potential. A measurement (usually measured over a 100-year period) of how much effect a refrigerant will have on Global Warming in relation to Carbon Dioxide. *CO*<sub>2</sub> has a *GWP* of 1. The lower the value of *GWP* - the better the refrigerant is for the environment.

### Related Topics

- **Air Conditioning** - Air Conditioning systems - heating, cooling and dehumidification of indoor air for thermal comfort
- **Material Properties** - Material properties for gases, fluids and solids - densities, specific heats, viscosities and more

### Related Documents

- **R-12 Dichlorodifluoromethane Properties** - Thermodynamic properties of saturated and superheated - Dichlorodifluoromethane - *CF*<sub>2</sub>*Cl*<sub>2</sub> - specific volume, enthalpy and entropy
- **Refrigerant Compressors - Evaporation Temperature, Condensing Temperature and Capacity** - Evaporation temperature, condensing temperature and refrigerant compressor capacity
- **Refrigerants** - Commonly used refrigerants - methane series, ethane series, propane series, cyclic organic compounds, zeotropic blends, azeotropic blends and organic compounds
- **Refrigerants - Color Codes** - Refrigerants and their color codes
- **Refrigerants - Environmental Properties** - Physical and environmental properties of some common refrigerants
- **Refrigerants - Environmental Properties** - Refrigerants - Ozone Depletion (*ODP*) and Global Warming Potential (*GWP*)
- **Refrigerants - Physical Properties** - Physical properties of refrigerants - molecular weight, boiling, freezing and critical points
- **Refrigerants - Temperature and Pressure at Constant Boiling** - Temperature and pressure diagram for constant boiling refrigerants - imperial and SI units
- **Refrigerants - Temperature and Pressure Charts** - Temperature and pressure chart for refrigerants R22, R410A, R12, R134A, R401A, R409A, R502, R404A, R507A, R408A and R402A

**Lampiran 2. Proses Pemasangan dan Pengisian Refrigeran AC *Split* Dengan Variasi Jarak Katup Ekspansi Dengan Evaporator.**



Gambar 1. Pengelasan Katup Ekspansi



Gambar 2. Pemasangan Pipa Penghubung Pada Sisi *Indoor*



Gambar 3. Pemasangan Pipa Penghubung Pada Sisi *Outdoor*



Gambar 4. Pemvakuman Unit AC *Split*



Gambar 5. Pengisian Refrigeran Tipe R22

**Lampiran 3. Proses Pengambilan Data Laju Pendinginan Ruangan dan *COP***  
**(*Coefficient Of Performance*)**



Gambar 6. Menghidupkan *Stopwatch*



Gambar 7. Pengujian Pada Pipa Tekan Sebelum Masuk Kondensor ( $T_2$ )



Gambar 8. Pengujian Pada Pipa Tekan Setelah Katup Ekspansi ( $T_4$ )



Gambar 9. Pengujian Pada Pipa Hisap Setelah Evaporator ( $T_1$ )



Gambar 10. Mematikan *Stopwatch*



## BIOGRAFI PENULIS



Handi Alfian, lahir di Br. Dinas Nyuling, Desa Tegallingham, Kec/Kab Karangasem, Bali, pada tanggal 02 Agustus 1999. Peneliti lahir dari pasangan suami istri, Bapak Rahman dan Ibu Nurdiah. Peneliti berkebangsaan Indonesia dan beragama Islam. Peneliti tinggal bersama kedua orangtua di Br. Dinas Nyuling, Desa Tegallingham, Kec/Kab Karangasem, Provinsi Bali. Peneliti mengenyam pendidikan Sekolah Dasar di SD Negeri 3 Tegallingham dari tahun 2005 - 2011, kemudian berlanjut ke jenjang Sekolah Menengah Pertama di MTs Negeri Amlapura dari tahun 2011 - 2014, pada jenjang selanjutnya peneliti melanjutkan pendidikan di MAN Amlapura pada tahun 2014 - 2017, dan saat ini melanjutkan pendidikan perguruan tinggi di Universitas Pendidikan Ganesha pada tahun 2017 dengan mengambil Program Studi S1 Pendidikan Teknik Mesin, Jurusan Teknologi Industri, Fakultas Teknik dan Kejuruan.

