

# R-744

## Carbon dioxide CO<sub>2</sub>

Molecular weight (g/mol) .....	44.01
Melting point (°C) .....	-56.55
Sublimation temperature (at 1 atm) in °C .....	-78.46
Temperature glide at 1.013 bar (K) .....	N/A
Critical temperature (°C) .....	31.0
Critical pressure (bar absolute) .....	73.77
Specific heat (liquid) at + 25°C (kJ/kg.K) .....	6.467
Specific heat (vapour) at 1.013 bar and + 25°C (kJ/kg.K) .....	0.851
Thermal capacity ratio (Cp/Cv) at + 25°C and 1.013 bar .....	1.294
Viscosity (liquid) at + 25°C in Centipoise (10 <sup>-3</sup> Pa.s) .....	0.057
Surface tension at + 25°C in dyne per centimetre (10 <sup>-3</sup> N/m) .....	0.57
Classification NF-EN 378 .....	A1
GWP (IPCC 4) .....	0

### 🔍 Main applications

R-744 (carbon dioxide) is a refrigerant designed for industrial and commercial refrigeration applications. It can be used in direct expansion systems, in cascade refrigeration (sub-critical) with HFC or NH<sub>3</sub> or HFO booster systems (trans-critical).

### 🔍 Commercial specifications

Purity: ≥ 99.9 % weight.

Water content: ≤ 5 ppm weight.

### 🔍 Oils

CO<sub>2</sub> has its own behaviour characteristics with oils, particularly in terms of miscibility and solubility. The selection of oils should be made depending on the application or system and those specified by the compressor manufacturer. Specialist polyolester miscible oils (POE), polyalphaolefin (PAO) and polyalkylene glycol (PAG) immiscible oils are available. Check with **Cimalife** regarding the viscosity of the oil selected for your application, and the miscibility with the fluid under consideration.

## Thermodynamic properties of R-744 - Saturated state

Absolute pressure	LIQUID					VAPOUR					Latent heat
	Bubble point	Volume	Density	Enthalpy	Entropy	Dew point	Volume	Density	Enthalpy	Entropy	
P	t'	v'	p'	h'	s'	t''	v''	p''	h''	s''	Lv
(bar)	(°C)	(dm <sup>3</sup> /kg)	(kg/dm <sup>3</sup> )	(kJ/kg)	(kJ/kg.K)	(°C)	(m <sup>3</sup> /kg)	(kg/m <sup>3</sup> )	(kJ/kg)	(kJ/kg.K)	(kJ/kg)
5.540	-55	0.853	1.173	83.091	0.535	-55.0	0.068	14.673	430.987	2.130	347.896
6.823	-50	0.866	1.155	92.943	0.579	-50.0	0.056	17.925	432.676	2.102	339.733
8.318	-45	0.880	1.136	102.874	0.623	-45.0	0.046	21.717	434.128	2.075	331.255
10.045	-40	0.896	1.116	112.903	0.666	-40.0	0.038	26.121	435.322	2.049	322.419
12.024	-35	0.912	1.096	123.050	0.708	-35.0	0.032	31.216	436.230	2.023	313.180
14.278	-30	0.930	1.076	133.337	0.750	-30.0	0.027	37.098	436.820	1.998	303.483
16.827	-25	0.949	1.054	143.793	0.791	-25.0	0.023	43.880	437.055	1.973	293.262
19.696	-20	0.969	1.032	154.448	0.833	-20.0	0.019	51.700	436.891	1.949	282.443
22.908	-15	0.992	1.008	165.342	0.874	-15.0	0.016	60.728	436.274	1.924	270.932
26.487	-10	1.017	0.983	176.521	0.916	-10.0	0.014	71.185	435.135	1.898	258.615
30.459	-5	1.046	0.956	188.046	0.958	-5.0	0.012	83.359	433.384	1.872	245.338
34.851	0	1.078	0.927	200.000	1.000	0.0	0.010	97.647	430.893	1.845	230.893
39.695	5	1.116	0.896	212.502	1.043	5.0	0.009	114.621	427.485	1.816	214.983
45.022	10	1.161	0.861	225.730	1.088	10.0	0.007	135.156	422.884	1.785	197.154
50.871	15	1.218	0.821	239.989	1.136	15.0	0.006	160.730	416.636	1.749	176.646
57.291	20	1.293	0.773	255.869	1.188	20.0	0.005	194.202	407.865	1.706	151.997
64.342	25	1.407	0.711	274.784	1.248	25.0	0.004	242.732	394.429	1.650	119.645
72.137	30	1.685	0.593	304.553	1.343	30.0	0.003	345.102	365.129	1.543	60.575

## Thermodynamic properties of R-744 - (superheated vapour) - Volume (dm<sup>3</sup>/kg)

Sat. Temp. °C	Sat. Pressure bar	Superheat (°C)																				
		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
-55	5.540	68.151	70.233	72.277	74.290	76.275	78.235	80.175	82.096	84.002	85.892	87.770	89.637	91.493	93.339	95.177	97.008	98.831	100.647	102.458	104.263	106.063
-50	6.823	55.789	57.534	59.243	60.920	62.571	64.200	65.808	67.398	68.974	70.535	72.084	73.623	75.151	76.671	78.183	79.687	81.184	82.676	84.161	85.642	87.117
-45	8.318	46.046	47.530	48.977	50.394	51.786	53.155	54.505	55.838	57.156	58.461	59.755	61.038	62.312	63.577	64.835	66.086	67.330	68.568	69.801	71.029	72.252
-40	10.045	38.284	39.561	40.803	42.016	43.202	44.367	45.514	46.644	47.760	48.864	49.956	51.038	52.112	53.177	54.235	55.286	56.331	57.370	58.404	59.433	60.458
-35	12.024	32.035	33.150	34.229	35.278	36.302	37.305	38.289	39.258	40.213	41.156	42.088	43.010	43.924	44.830	45.728	46.621	47.507	48.388	49.264	50.135	51.003
-30	14.278	26.956	27.942	28.890	29.809	30.702	31.574	32.429	33.268	34.093	34.907	35.710	36.504	37.289	38.067	38.838	39.602	40.361	41.115	41.864	42.608	43.349
-25	16.827	22.789	23.673	24.517	25.330	26.118	26.884	27.633	28.367	29.087	29.796	30.494	31.183	31.864	32.538	33.205	33.866	34.522	35.172	35.818	36.460	37.097
-20	19.696	19.343	20.144	20.904	21.632	22.333	23.014	23.676	24.324	24.958	25.581	26.193	26.797	27.393	27.982	28.564	29.140	29.711	30.277	30.838	31.395	31.949
-15	22.908	16.467	17.204	17.896	18.554	19.186	19.796	20.387	20.963	21.527	22.079	22.620	23.154	23.679	24.197	24.709	25.215	25.716	26.212	26.704	27.192	27.676
-10	26.487	14.048	14.736	15.374	15.975	16.549	17.100	17.633	18.151	18.655	19.148	19.631	20.105	20.571	21.031	21.484	21.932	22.375	22.813	23.247	23.677	24.103
-5	30.459	11.996	12.648	13.243	13.799	14.326	14.828	15.312	15.780	16.235	16.679	17.112	17.537	17.954	18.365	18.769	19.168	19.562	19.951	20.336	20.717	21.095
0	34.851	10.241	10.869	11.432	11.951	12.438	12.901	13.344	13.771	14.184	14.586	14.978	15.361	15.736	16.105	16.468	16.825	17.178	17.526	17.870	18.210	18.547
5	39.695	8.724	9.343	9.883	10.373	10.828	11.257	11.665	12.057	12.435	12.801	13.157	13.505	13.845	14.179	14.506	14.828	15.146	15.458	15.767	16.073	16.374
10	45.022	7.399	8.024	8.549	9.016	9.445	9.846	10.225	10.587	10.935	11.271	11.597	11.914	12.224	12.527	12.824	13.116	13.403	13.685	13.964	14.240	14.512
15	50.871	6.222	6.875	7.394	7.845	8.252	8.629	8.984	9.320	9.642	9.952	10.251	10.542	10.826	11.102	11.373	11.639	11.900	12.156	12.409	12.659	12.905
20	57.291	5.149	5.866	6.388	6.828	7.218	7.575	7.908	8.222	8.521	8.808	9.085	9.353	9.613	9.867	10.115	10.358	10.596	10.830	11.060	11.287	11.510
25	64.342	4.120	4.974	5.509	5.941	6.317	6.656	6.971	7.265	7.544	7.811	8.067	8.315	8.555	8.789	9.016	9.239	9.457	9.671	9.881	10.088	10.292
30	72.137	2.898	4.179	4.733	5.160	5.524	5.848	6.145	6.422	6.684	6.932	7.170	7.400	7.622	7.837	8.047	8.251	8.451	8.648	8.840	9.029	9.216

## Thermodynamic properties of R-744 - (superheated vapour) - Enthalpy (kJ/kg)

Sat. Temp. °C	Sat. Pressure bar	Superheat (°C)																				
		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
-55	5.540	430.987	435.550	440.059	444.523	448.954	453.359	457.745	462.120	466.487	470.852	475.217	479.585	483.958	488.340	492.731	497.132	501.546	505.973	510.414	514.870	519.341
-50	6.823	432.676	437.397	442.050	446.645	451.195	455.711	460.201	464.672	469.130	473.580	478.026	482.472	486.919	491.371	495.829	500.296	504.771	509.258	513.757	518.268	522.793
-45	8.318	434.128	439.029	443.841	448.580	453.262	457.899	462.501	467.077	471.633	476.175	480.709	485.237	489.763	494.290	498.820	503.355	507.897	512.447	517.006	521.577	526.158
-40	10.045	435.322	440.425	445.416	450.315	455.141	459.910	464.634	469.323	473.985	478.627	483.255	487.871	492.482	497.089	501.695	506.304	510.915	515.533	520.157	524.789	529.430
-35	12.024	436.230	441.563	446.754	451.831	456.817	461.731	466.588	471.401	476.177	480.927	485.655	490.367	495.067	499.760	504.448	509.134	513.820	518.509	523.201	527.899	532.604
-30	14.278	436.820	442.418	447.836	453.112	458.274	463.348	468.351	473.297	478.198	483.064	487.900	492.714	497.512	502.296	507.071	511.840	516.605	521.369	526.134	530.902	535.674
-25	16.827	437.055	442.961	448.638	454.137	459.497	464.747	469.909	475.002	480.038	485.028	489.982	494.906	499.807	504.689	509.557	514.414	519.263	524.108	528.949	533.791	538.633
-20	19.696	436.891	443.160	449.134	454.886	460.466	465.911	471.249	476.502	481.685	486.811	491.891	496.934	501.945	506.932	511.899	516.850	521.789	526.718	531.642	536.561	541.478
-15	22.908	436.274	442.975	449.294	455.334	461.161	466.824	472.356	477.784	483.127	488.402	493.619	498.788	503.919	509.018	514.090	519.141	524.175	529.196	534.205	539.207	544.204
-10	26.487	435.135	442.359	449.083	455.453	461.561	467.467	473.215	478.836	484.355	489.790	495.154	500.462	505.721	510.939	516.125	521.283	526.418	531.534	536.635	541.725	546.805
-5	30.459	433.384	441.254	448.460	455.214	461.642	467.822	473.809	479.644	485.355	490.964	496.490	501.945	507.342	512.689	517.996	523.268	528.510	533.729	538.927	544.109	549.277
0	34.851	430.893	439.586	447.376	454.581	461.376	467.866	474.122	480.193	486.114	491.914	497.614	503.229	508.774	514.260	519.696	525.090	530.447	535.774	541.075	546.355	551.617
5	39.695	427.485	437.262	445.773	453.515	460.735	467.577	474.133	480.466	486.620	492.629	498.517	504.306	510.011	515.645	521.220	526.743	532.222	537.664	543.075	548.458	553.818
10	45.022	422.884	434.164	443.584	451.969	459.685	466.930	473.824	480.448	486.858	493.094	499.188	505.165	511.042	516.836	522.558	528.220	533.829	539.394	544.920	550.413	555.877
15	50.871	416.636	430.132	440.725	449.893	458.191	465.896	473.171	480.119	486.811	493.297	499.615	505.795	511.858	517.823	523.704	529.513	535.261	540.955	546.604	552.212	557.787
20	57.291	407.865	424.958	437.101	447.227	456.210	464.444	472.149	478.458	484.461	493.220	499.782	506.182	512.445	518.593	524.644	530.611	536.505	542.338	548.116	553.848	559.538
25	64.342	394.429	418.364	432.592	443.898	453.688	462.530	470.720	478.432	485.778	492.837	499.665	506.302	512.781	519.127	525.359	531.495	537.546	543.526	549.442	555.303	561.117
30	72.137	365.129	409.972	427.018	439.780	450.524	460.067	468.806	476.969	484.697	492.086	499.205	506.102	512.816	519.375	525.803	532.120	538.340	544.477	550.540	556.541	562.486

## Thermodynamic properties of R-744 - (superheated vapour) - Entropy (kJ/kg.K)

Sat. Temp. °C	Sat. Pressure bar	Superheat (°C)																				
		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
-55	5.540	2.130	2.151	2.171	2.190	2.209	2.227	2.245	2.262	2.280	2.296	2.313	2.329	2.345	2.360	2.376	2.391	2.406	2.420	2.435	2.449	2.464
-50	6.823	2.102	2.123	2.143	2.162	2.181	2.200	2.218	2.235	2.252	2.269	2.285	2.302	2.317	2.333	2.348	2.363	2.378	2.393	2.407	2.422	2.436
-45	8.318	2.075	2.096	2.116	2.136	2.155	2.174	2.192	2.209	2.226	2.243	2.260	2.276	2.292	2.307	2.322	2.338	2.352	2.367	2.382	2.396	2.410
-40	10.045	2.049	2.070	2.091	2.111	2.130	2.149	2.167	2.185	2.202	2.219	2.235	2.251	2.267	2.283	2.298	2.313	2.328	2.343	2.357	2.371	2.385
-35	12.024	2.023	2.045	2.066	2.087	2.106	2.125	2.143	2.161	2.178	2.195	2.212	2.228	2.244	2.259	2.275	2.290	2.305	2.319	2.334	2.348	2.362
-30	14.278	1.998	2.021	2.042	2.063	2.083	2.102	2.120	2.138	2.156	2.173	2.189	2.206	2.222	2.237	2.253	2.268	2.283	2.297	2.312	2.326	2.340
-25	16.827	1.973	1.997	2.019	2.040	2.060	2.080	2.098	2.117	2.134	2.151	2.168	2.184	2.201	2.216	2.232	2.247	2.262	2.276	2.291	2.305	2.319
-20	19.696	1.949	1.973	1.996	2.018	2.038	2.058	2.077	2.095	2.113	2.131	2.147	2.164	2.180	2.196	2.211	2.227	2.242	2.256	2.271	2.285	2.299
-15	22.908	1.924	1.949	1.973	1.996	2.017	2.037	2.056	2.075	2.093	2.111	2.128	2.144	2.160	2.176	2.192	2.207	2.222	2.237	2.251	2.266	2.280
-10	26.487	1.898	1.926	1.951	1.974	1.995	2.016	2.036	2.055	2.073	2.091	2.108	2.125	2.141	2.158	2.173	2.189	2.204	2.218	2.233	2.247	2.261
-5	30.459	1.872	1.902	1.928	1.952	1.974	1.996	2.016	2.035	2.054	2.072	2.089	2.106	2.123	2.139	2.155	2.171	2.186	2.201	2.215	2.230	2.244
0	34.851	1.845	1.877	1.905	1.930	1.953	1.975	1.996	2.016	2.035	2.053	2.071	2.088	2.105	2.121	2.137	2.153	2.168	2.183	2.198	2.212	2.227
5	39.695	1.816	1.851	1.881	1.908	1.932	1.955	1.976	1.997	2.016	2.035	2.053	2.070	2.087	2.104	2.120	2.136	2.151	2.166	2.181	2.196	2.210
10	45.022	1.785	1.824	1.857	1.885	1.911	1.934	1.957	1.978	1.998	2.017	2.035	2.053	2.070	2.087	2.103	2.119	2.135	2.150	2.165	2.179	2.194
15	50.871	1.749	1.795	1.831	1.862	1.889	1.914	1.937	1.958	1.979	1.999	2.017	2.036	2.053	2.070	2.087	2.103	2.118	2.134	2.149	2.164	2.178
20	57.291	1.706	1.764	1.804	1.838	1.867	1.893	1.917	1.939	1.960	1.980	2.000	2.018	2.036	2.053	2.070	2.086	2.102	2.118	2.133	2.148	2.162
25	64.342	1.650	1.729	1.776	1.812	1.843	1.871	1.896	1.920	1.941	1.962	1.982	2.001	2.019	2.037	2.054	2.070	2.086	2.102	2.117	2.132	2.147
30	72.137	1.543	1.690	1.745	1.786	1.819	1.849	1.875	1.899	1.922	1.943	1.964	1.983	2.002	2.020	2.037	2.054	2.070	2.086	2.102	2.117	2.132