



# Opteon™ XP10

## Refrigerant

### Thermodynamic Properties of Opteon™ XP10 (R-513A) SI Units

#### Physical Properties

Molecular Weight	108.4 g/mole
Boiling Point at	
One Atmosphere	-29.2 °C
Critical Temperature	96.5 °C
Critical Pressure	3765.7 kPa
Critical Density	516.75 kg/m <sup>3</sup>
Critical Volume	0.0019 m <sup>3</sup> /kg
Ozone Depletion Potential	0
Global Warming Potential (AR5)	573
ASHRAE Standard 34 Safety Rating	A1

#### Units and Factors

t = temperature in °C  
P = pressure in kiloPascals absolute (kPa [abs])  
 $v_f$  = volume of saturated liquid in m<sup>3</sup>/kg  
 $v_g$  = volume of saturated vapor in m<sup>3</sup>/kg  
V = volume of superheated vapor in m<sup>3</sup>/kg  
 $d_f = 1/v_f$  = density of saturated liquid in kg/m<sup>3</sup>  
 $d_g = 1/v_g$  = density of saturated vapor in kg/m<sup>3</sup>  
 $h_f$  = enthalpy of saturated liquid in kJ/kg  
 $h_{fg}$  = enthalpy of vaporization in kJ/kg  
 $h_g$  = enthalpy of saturated vapor in kJ/kg  
H = enthalpy of superheated vapor in kJ/kg  
 $s_f$  = entropy of saturated liquid in kJ/(kg) (K)  
 $s_g$  = entropy of saturated vapor in kJ/(kg) (K)  
S = entropy of superheated vapor in kJ/(kg) (K)

One atmosphere = 101.325 kPa

Reference point for enthalpy and entropy:

$h_f = 200$  kJ/kg at 0°C

$s_f = 1$  kJ/kg-K at 0°C

This information is based on NIST Standard Database 23, Version 9.1 (Lemmon, E.W.; Huber, M.L.; McLinden, M.O.; REFPROP Reference Fluid Thermodynamic and Transport Properties - National Institute of Standards and Technology, 2013) using Chemours interaction parameters with R-1234yf.

Opteon™ XP10 (R-513A)  
Saturation Properties - Temperature Table

Temp °C	Pressure [kPa]		Volume [m <sup>3</sup> /kg]		Density [kg/m <sup>3</sup> ]		Enthalpy [kJ/kg]			Entropy [kJ/kg-K]		Temp °C
	Liquid P <sub>l</sub>	Vapor P <sub>g</sub>	Liquid v <sub>l</sub>	Vapor v <sub>g</sub>	Liquid d <sub>l</sub>	Vapor d <sub>g</sub>	Liquid h <sub>l</sub>	Latent h <sub>lg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>l</sub>	Vapor s <sub>g</sub>	
-60	20.055	19.646	0.000695	0.8204	1438.8	1.219	126.3	212.5	338.8	0.697	1.695	-60
-59	21.320	20.903	0.000696	0.7742	1436.0	1.292	127.5	212.0	339.4	0.702	1.693	-59
-58	22.651	22.225	0.000698	0.7310	1433.3	1.368	128.6	211.5	340.1	0.708	1.691	-58
-57	24.049	23.614	0.000699	0.6908	1430.5	1.448	129.8	211.0	340.7	0.713	1.690	-57
-56	25.516	25.074	0.000700	0.6531	1427.8	1.531	130.9	210.4	341.4	0.719	1.688	-56
-55	27.056	26.606	0.000702	0.6179	1425.0	1.618	132.1	209.9	342.0	0.724	1.687	-55
-54	28.672	28.214	0.000703	0.5849	1422.2	1.710	133.3	209.4	342.7	0.729	1.685	-54
-53	30.365	29.900	0.000704	0.5540	1419.5	1.805	134.4	208.9	343.3	0.735	1.684	-53
-52	32.138	31.666	0.000706	0.5251	1416.7	1.905	135.6	208.4	344.0	0.740	1.683	-52
-51	33.995	33.517	0.000707	0.4979	1413.9	2.008	136.8	207.9	344.6	0.745	1.681	-51
-50	35.939	35.454	0.000709	0.4724	1411.1	2.117	137.9	207.3	345.3	0.750	1.680	-50
-49	37.971	37.480	0.000710	0.4485	1408.3	2.230	139.1	206.8	345.9	0.756	1.679	-49
-48	40.096	39.599	0.000711	0.4260	1405.5	2.347	140.3	206.3	346.6	0.761	1.678	-48
-47	42.316	41.814	0.000713	0.4049	1402.7	2.470	141.5	205.8	347.3	0.766	1.676	-47
-46	44.634	44.127	0.000714	0.3850	1399.9	2.598	142.7	205.2	347.9	0.771	1.675	-46
-45	47.053	46.542	0.000716	0.3663	1397.0	2.730	143.9	204.7	348.6	0.777	1.674	-45
-44	49.578	49.062	0.000717	0.3486	1394.2	2.869	145.0	204.2	349.2	0.782	1.673	-44
-43	52.210	51.691	0.000719	0.3320	1391.3	3.012	146.2	203.6	349.9	0.787	1.672	-43
-42	54.953	54.431	0.000720	0.3163	1388.5	3.161	147.4	203.1	350.5	0.792	1.671	-42
-41	57.811	57.286	0.000722	0.3015	1385.6	3.316	148.6	202.6	351.2	0.797	1.670	-41
-40	60.788	60.260	0.000723	0.2876	1382.8	3.477	149.8	202.0	351.8	0.802	1.669	-40
-39	63.885	63.356	0.000725	0.2744	1379.9	3.645	151.0	201.5	352.5	0.808	1.668	-39
-38	67.108	66.577	0.000726	0.2619	1377.0	3.818	152.2	200.9	353.1	0.813	1.667	-38
-37	70.459	69.927	0.000728	0.2501	1374.1	3.998	153.4	200.4	353.8	0.818	1.667	-37
-36	73.942	73.410	0.000729	0.2390	1371.2	4.184	154.6	199.8	354.5	0.823	1.666	-36
-35	77.561	77.029	0.000731	0.2284	1368.3	4.378	155.9	199.3	355.1	0.828	1.665	-35
-34	81.320	80.789	0.000732	0.2184	1365.4	4.578	157.1	198.7	355.8	0.833	1.664	-34
-33	85.222	84.692	0.000734	0.2090	1362.5	4.785	158.3	198.1	356.4	0.838	1.663	-33
-32	89.272	88.743	0.000736	0.2000	1359.6	5.000	159.5	197.6	357.1	0.843	1.663	-32
-31	93.472	92.946	0.000737	0.1915	1356.6	5.223	160.7	197.0	357.7	0.848	1.662	-31
-30	97.828	97.304	0.000739	0.1834	1353.7	5.453	161.9	196.4	358.4	0.853	1.661	-30
-29	102.342	101.821	0.000740	0.1757	1350.7	5.690	163.2	195.8	359.0	0.858	1.661	-29
-28	107.020	106.502	0.000742	0.1684	1347.7	5.936	164.4	195.3	359.7	0.863	1.660	-28
-27	111.865	111.351	0.000744	0.1615	1344.8	6.191	165.6	194.7	360.3	0.868	1.659	-27
-26	116.881	116.372	0.000745	0.1550	1341.8	6.454	166.9	194.1	361.0	0.873	1.659	-26
-25	122.072	121.568	0.000747	0.1487	1338.8	6.725	168.1	193.5	361.6	0.878	1.658	-25
-24	127.443	126.945	0.000749	0.1427	1335.8	7.005	169.3	192.9	362.3	0.883	1.658	-24
-23	132.997	132.505	0.000750	0.1371	1332.8	7.295	170.6	192.3	362.9	0.888	1.657	-23
-22	138.740	138.255	0.000752	0.1317	1329.7	7.594	171.8	191.7	363.6	0.893	1.657	-22
-21	144.675	144.197	0.000754	0.1265	1326.7	7.902	173.1	191.1	364.2	0.898	1.656	-21
-20	150.808	150.337	0.000755	0.1217	1323.6	8.220	174.3	190.5	364.9	0.903	1.656	-20
-19	157.141	156.678	0.000757	0.1170	1320.6	8.548	175.6	189.9	365.5	0.908	1.655	-19
-18	163.680	163.226	0.000759	0.1125	1317.5	8.887	176.9	189.3	366.1	0.913	1.655	-18
-17	170.430	169.985	0.000761	0.1083	1314.4	9.235	178.1	188.7	366.8	0.918	1.654	-17
-16	177.395	176.958	0.000763	0.1042	1311.3	9.595	179.4	188.0	367.4	0.923	1.654	-16
-15	184.579	184.152	0.000764	0.1003	1308.2	9.965	180.6	187.4	368.1	0.928	1.654	-15
-14	191.987	191.570	0.000766	0.0966	1305.1	10.347	181.9	186.8	368.7	0.932	1.653	-14
-13	199.623	199.217	0.000768	0.0931	1302.0	10.740	183.2	186.2	369.3	0.937	1.653	-13
-12	207.494	207.098	0.000770	0.0897	1298.8	11.144	184.5	185.5	370.0	0.942	1.653	-12
-11	215.602	215.218	0.000772	0.0865	1295.7	11.561	185.7	184.9	370.6	0.947	1.652	-11
-10	223.954	223.582	0.000774	0.0834	1292.5	11.990	187.0	184.2	371.2	0.952	1.652	-10
-9	232.554	232.193	0.000776	0.0804	1289.3	12.431	188.3	183.6	371.9	0.957	1.652	-9
-8	241.406	241.057	0.000778	0.0776	1286.1	12.885	189.6	182.9	372.5	0.962	1.651	-8
-7	250.517	250.180	0.000779	0.0749	1282.9	13.352	190.9	182.3	373.1	0.966	1.651	-7
-6	259.890	259.565	0.000781	0.0723	1279.7	13.832	192.2	181.6	373.8	0.971	1.651	-6
-5	269.530	269.218	0.000783	0.0698	1276.4	14.326	193.5	180.9	374.4	0.976	1.651	-5
-4	279.444	279.145	0.000785	0.0674	1273.2	14.834	194.8	180.2	375.0	0.981	1.651	-4

Opteon™ XP10 (R-513A)  
Saturation Properties - Temperature Table

Temp °C	Pressure [kPa]		Volume [m <sup>3</sup> /kg]		Density [kg/m <sup>3</sup> ]		Enthalpy [kJ/kg]			Entropy [kJ/kg-K]		Temp °C
	Liquid P <sub>l</sub>	Vapor P <sub>g</sub>	Liquid v <sub>l</sub>	Vapor v <sub>g</sub>	Liquid d <sub>l</sub>	Vapor d <sub>g</sub>	Liquid h <sub>l</sub>	Latent h <sub>g</sub>	Vapor h <sub>g</sub>	Liquid s <sub>l</sub>	Vapor s <sub>g</sub>	
-3	289.635	289.349	0.000787	0.0651	1269.9	15.356	196.1	179.6	375.6	0.986	1.650	-3
-2	300.109	299.836	0.000789	0.0629	1266.6	15.893	197.4	178.9	376.3	0.990	1.650	-2
-1	310.871	310.611	0.000792	0.0608	1263.3	16.444	198.7	178.2	376.9	0.995	1.650	-1
0	321.926	321.680	0.000794	0.0588	1260.0	17.011	200.0	177.5	377.5	1.000	1.650	0
1	333.280	333.047	0.000796	0.0568	1256.7	17.593	201.3	176.8	378.1	1.005	1.650	1
2	344.937	344.717	0.000798	0.0550	1253.3	18.190	202.6	176.1	378.7	1.010	1.650	2
3	356.904	356.697	0.000800	0.0532	1250.0	18.804	204.0	175.4	379.3	1.014	1.649	3
4	369.185	368.991	0.000802	0.0515	1246.6	19.435	205.3	174.7	379.9	1.019	1.649	4
5	381.785	381.604	0.000804	0.0498	1243.2	20.082	206.6	173.9	380.6	1.024	1.649	5
6	394.711	394.543	0.000807	0.0482	1239.8	20.747	207.9	173.2	381.2	1.029	1.649	6
7	407.967	407.812	0.000809	0.0467	1236.3	21.429	209.3	172.5	381.8	1.033	1.649	7
8	421.559	421.416	0.000811	0.0452	1232.9	22.129	210.6	171.7	382.4	1.038	1.649	8
9	435.493	435.362	0.000813	0.0438	1229.4	22.848	212.0	171.0	383.0	1.043	1.649	9
10	449.774	449.655	0.000816	0.0424	1225.9	23.586	213.3	170.2	383.6	1.047	1.649	10
11	464.407	464.299	0.000818	0.0411	1222.4	24.342	214.7	169.5	384.2	1.052	1.649	11
12	479.399	479.302	0.000820	0.0398	1218.9	25.119	216.0	168.7	384.7	1.057	1.649	12
13	494.754	494.668	0.000823	0.0386	1215.3	25.915	217.4	168.0	385.3	1.062	1.649	13
14	510.480	510.404	0.000825	0.0374	1211.8	26.733	218.7	167.2	385.9	1.066	1.649	14
15	526.580	526.514	0.000828	0.0363	1208.2	27.571	220.1	166.4	386.5	1.071	1.649	15
16	543.062	543.005	0.000830	0.0352	1204.5	28.431	221.5	165.6	387.1	1.076	1.648	16
17	559.930	559.882	0.000833	0.0341	1200.9	29.313	222.8	164.8	387.7	1.080	1.648	17
18	577.191	577.151	0.000835	0.0331	1197.2	30.217	224.2	164.0	388.2	1.085	1.648	18
19	594.851	594.818	0.000838	0.0321	1193.6	31.144	225.6	163.2	388.8	1.090	1.648	19
20	612.915	612.889	0.000840	0.0312	1189.9	32.095	227.0	162.4	389.4	1.094	1.648	20
21	631.390	631.370	0.000843	0.0302	1186.1	33.071	228.4	161.6	389.9	1.099	1.648	21
22	650.281	650.267	0.000846	0.0294	1182.4	34.071	229.8	160.7	390.5	1.104	1.648	22
23	669.594	669.585	0.000848	0.0285	1178.6	35.096	231.2	159.9	391.0	1.109	1.648	23
24	689.337	689.331	0.000851	0.0277	1174.8	36.147	232.6	159.0	391.6	1.113	1.648	24
25	709.514	709.510	0.000854	0.0269	1170.9	37.225	234.0	158.2	392.1	1.118	1.648	25
26	730.131	730.130	0.000857	0.0261	1167.1	38.330	235.4	157.3	392.7	1.122	1.648	26
27	751.196	751.196	0.000860	0.0253	1163.2	39.464	236.8	156.4	393.2	1.127	1.648	27
28	772.714	772.714	0.000863	0.0246	1159.3	40.625	238.2	155.6	393.8	1.132	1.648	28
29	794.691	794.690	0.000866	0.0239	1155.3	41.816	239.6	154.7	394.3	1.136	1.648	29
30	817.135	817.132	0.000869	0.0232	1151.3	43.038	241.1	153.8	394.8	1.141	1.648	30
31	840.050	840.044	0.000872	0.0226	1147.3	44.290	242.5	152.9	395.4	1.146	1.648	31
32	863.445	863.435	0.000875	0.0219	1143.3	45.574	243.9	151.9	395.9	1.150	1.648	32
33	887.324	887.309	0.000878	0.0213	1139.2	46.890	245.4	151.0	396.4	1.155	1.648	33
34	911.696	911.674	0.000881	0.0207	1135.1	48.240	246.8	150.1	396.9	1.160	1.648	34
35	936.565	936.536	0.000884	0.0202	1131.0	49.624	248.3	149.1	397.4	1.164	1.648	35
36	961.940	961.902	0.000887	0.0196	1126.8	51.044	249.7	148.2	397.9	1.169	1.648	36
37	987.826	987.778	0.000891	0.0190	1122.6	52.500	251.2	147.2	398.4	1.174	1.648	37
38	1014.231	1014.171	0.000894	0.0185	1118.3	53.993	252.7	146.2	398.9	1.178	1.648	38
39	1041.160	1041.088	0.000898	0.0180	1114.0	55.524	254.1	145.2	399.4	1.183	1.648	39
40	1068.622	1068.536	0.000901	0.0175	1109.7	57.095	255.6	144.2	399.8	1.188	1.648	40
41	1096.623	1096.522	0.000905	0.0170	1105.4	58.707	257.1	143.2	400.3	1.192	1.648	41
42	1125.170	1125.053	0.000908	0.0166	1101.0	60.361	258.6	142.2	400.8	1.197	1.648	42
43	1154.270	1154.135	0.000912	0.0161	1096.5	62.058	260.1	141.1	401.2	1.202	1.648	43
44	1183.930	1183.776	0.000916	0.0157	1092.0	63.799	261.6	140.1	401.7	1.206	1.648	44
45	1214.157	1213.983	0.000920	0.0152	1087.5	65.586	263.1	139.0	402.1	1.211	1.648	45
46	1244.959	1244.764	0.000923	0.0148	1082.9	67.421	264.6	138.0	402.6	1.216	1.648	46
47	1276.343	1276.125	0.000927	0.0144	1078.3	69.305	266.1	136.9	403.0	1.220	1.648	47
48	1308.317	1308.074	0.000931	0.0140	1073.6	71.239	267.6	135.8	403.4	1.225	1.648	48
49	1340.888	1340.620	0.000936	0.0137	1068.9	73.226	269.2	134.6	403.8	1.230	1.647	49
50	1374.063	1373.768	0.000940	0.0133	1064.1	75.266	270.7	133.5	404.2	1.234	1.647	50
51	1407.851	1407.528	0.000944	0.0129	1059.3	77.363	272.3	132.4	404.6	1.239	1.647	51
52	1442.259	1441.906	0.000948	0.0126	1054.4	79.518	273.8	131.2	405.0	1.244	1.647	52
53	1477.295	1476.911	0.000953	0.0122	1049.4	81.733	275.4	130.0	405.4	1.248	1.647	53

Opteon™ XP10 (R-513A)  
Saturation Properties - Temperature Table

Temp °C	Pressure [kPa]		Volume [m <sup>3</sup> /kg]		Density [kg/m <sup>3</sup> ]		Enthalpy [kJ/kg]			Entropy [kJ/kg-K]		Temp °C
	Liquid P <sub>l</sub>	Vapor P <sub>g</sub>	Liquid v <sub>l</sub>	Vapor v <sub>g</sub>	Liquid d <sub>l</sub>	Vapor d <sub>g</sub>	Liquid h <sub>l</sub>	Latent h <sub>lg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>l</sub>	Vapor s <sub>g</sub>	
54	1512.967	1512.551	0.000957	0.0119	1044.4	84.010	276.9	128.8	405.8	1.253	1.647	54
55	1549.283	1548.834	0.000962	0.0116	1039.3	86.352	278.5	127.6	406.1	1.258	1.646	55
56	1586.251	1585.769	0.000967	0.0113	1034.2	88.762	280.1	126.4	406.5	1.262	1.646	56
57	1623.881	1623.362	0.000972	0.0110	1028.9	91.241	281.7	125.1	406.8	1.267	1.646	57
58	1662.179	1661.624	0.000977	0.0107	1023.7	93.794	283.3	123.8	407.1	1.272	1.646	58
59	1701.155	1700.563	0.000982	0.0104	1018.3	96.422	284.9	122.5	407.4	1.277	1.645	59
60	1740.818	1740.187	0.000987	0.0101	1012.8	99.130	286.5	121.2	407.7	1.281	1.645	60
61	1781.175	1780.505	0.000993	0.0098	1007.3	101.921	288.2	119.9	408.0	1.286	1.645	61
62	1822.238	1821.527	0.000998	0.0095	1001.7	104.798	289.8	118.5	408.3	1.291	1.644	62
63	1864.014	1863.262	0.001004	0.0093	996.0	107.766	291.5	117.1	408.6	1.296	1.644	63
64	1906.513	1905.719	0.001010	0.0090	990.2	110.829	293.1	115.7	408.8	1.300	1.644	64
65	1949.744	1948.908	0.001016	0.0088	984.3	113.992	294.8	114.3	409.1	1.305	1.643	65
66	1993.718	1992.839	0.001022	0.0085	978.2	117.260	296.5	112.8	409.3	1.310	1.643	66
67	2038.444	2037.522	0.001029	0.0083	972.1	120.638	298.2	111.3	409.5	1.315	1.642	67
68	2083.932	2082.967	0.001035	0.0081	965.8	124.133	299.9	109.8	409.7	1.320	1.642	68
69	2130.194	2129.184	0.001042	0.0078	959.5	127.750	301.6	108.2	409.8	1.325	1.641	69
70	2177.239	2176.186	0.001049	0.0076	952.9	131.498	303.3	106.6	410.0	1.330	1.640	70
71	2225.079	2223.982	0.001057	0.0074	946.3	135.385	305.1	105.0	410.1	1.335	1.640	71
72	2273.725	2272.585	0.001064	0.0072	939.5	139.418	306.9	103.3	410.2	1.340	1.639	72
73	2323.190	2322.006	0.001072	0.0070	932.5	143.608	308.6	101.6	410.3	1.345	1.638	73
74	2373.484	2372.259	0.001081	0.0068	925.3	147.965	310.5	99.9	410.3	1.350	1.637	74
75	2424.621	2423.354	0.001089	0.0066	918.0	152.502	312.3	98.1	410.3	1.355	1.636	75
76	2476.614	2475.307	0.001098	0.0064	910.5	157.232	314.1	96.2	410.3	1.360	1.636	76
77	2529.476	2528.131	0.001108	0.0062	902.7	162.170	316.0	94.3	410.3	1.365	1.634	77
78	2583.222	2581.840	0.001118	0.0060	894.8	167.334	317.9	92.4	410.2	1.370	1.633	78
79	2637.866	2636.449	0.001128	0.0058	886.5	172.743	319.8	90.4	410.1	1.376	1.632	79
80	2693.424	2691.975	0.001139	0.0056	878.0	178.421	321.7	88.3	410.0	1.381	1.631	80
81	2749.913	2748.435	0.001150	0.0054	869.2	184.393	323.7	86.1	409.8	1.386	1.629	81
82	2807.350	2805.845	0.001163	0.0052	860.1	190.691	325.7	83.9	409.6	1.392	1.628	82
83	2865.753	2864.227	0.001176	0.0051	850.6	197.351	327.7	81.6	409.3	1.397	1.626	83
84	2925.143	2923.599	0.001190	0.0049	840.7	204.418	329.8	79.1	408.9	1.403	1.624	84
85	2985.540	2983.985	0.001204	0.0047	830.3	211.945	331.9	76.6	408.5	1.409	1.622	85
86	3046.969	3045.408	0.001220	0.0045	819.4	219.998	334.1	73.9	408.0	1.414	1.620	86
87	3109.454	3107.895	0.001238	0.0044	807.9	228.661	336.3	71.1	407.4	1.420	1.618	87
88	3173.023	3171.475	0.001257	0.0042	795.7	238.040	338.6	68.1	406.8	1.427	1.615	88
89	3237.708	3236.180	0.001278	0.0040	782.6	248.278	341.0	65.0	405.9	1.433	1.612	89
90	3303.545	3302.050	0.001301	0.0039	768.4	259.569	343.5	61.5	405.0	1.439	1.609	90

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	10			20			30			40			Temp °C
	-70.21 °C			-59.71 °C			-52.94 °C			-47.82 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	1.5429	332.2	1.714	0.8068	339.0	1.694	0.5523	343.4	1.684	0.4220	346.7	1.677	
-70	1.5445	332.3	1.715										-70
-65	1.5838	335.8	1.732										-65
-60	1.6230	339.2	1.748										-60
-55	1.6621	342.7	1.764	0.8256	342.3	1.710							-55
-50	1.7012	346.3	1.781	0.8455	345.9	1.726	0.5602	345.5	1.694				-50
-45	1.7401	349.9	1.797	0.8653	349.6	1.742	0.5736	349.2	1.710	0.4278	348.8	1.687	-45
-40	1.7790	353.6	1.813	0.8850	353.3	1.758	0.5870	352.9	1.726	0.4380	352.6	1.703	-40
-35	1.8179	357.3	1.828	0.9047	357.0	1.774	0.6003	356.7	1.742	0.4481	356.4	1.719	-35
-30	1.8567	361.1	1.844	0.9244	360.8	1.790	0.6136	360.5	1.758	0.4582	360.2	1.735	-30
-25	1.8955	364.9	1.860	0.9440	364.6	1.806	0.6268	364.4	1.774	0.4682	364.1	1.751	-25
-20	1.9342	368.8	1.875	0.9635	368.5	1.821	0.6400	368.3	1.789	0.4782	368.0	1.766	-20
-15	1.9729	372.7	1.890	0.9831	372.5	1.837	0.6531	372.2	1.805	0.4881	372.0	1.782	-15
-10	2.0116	376.7	1.906	1.0026	376.5	1.852	0.6663	376.2	1.820	0.4981	376.0	1.797	-10
-5	2.0502	380.7	1.921	1.0221	380.5	1.867	0.6794	380.3	1.835	0.5080	380.0	1.813	-5
0	2.0889	384.8	1.936	1.0415	384.6	1.882	0.6924	384.4	1.850	0.5179	384.2	1.828	0
5	2.1275	388.9	1.951	1.0610	388.7	1.897	0.7055	388.5	1.865	0.5277	388.3	1.843	5
10	2.1661	393.1	1.966	1.0804	392.9	1.912	0.7185	392.7	1.880	0.5376	392.5	1.858	10
15	2.2046	397.3	1.980	1.0998	397.1	1.927	0.7315	396.9	1.895	0.5474	396.7	1.873	15
20	2.2432	401.5	1.995	1.1192	401.4	1.941	0.7445	401.2	1.910	0.5572	401.0	1.887	20
25	2.2817	405.9	2.010	1.1386	405.7	1.956	0.7575	405.5	1.925	0.5670	405.4	1.902	25
30	2.3203	410.2	2.024	1.1579	410.1	1.971	0.7705	409.9	1.939	0.5768	409.7	1.917	30
35	2.3588	414.6	2.039	1.1773	414.5	1.985	0.7834	414.3	1.954	0.5865	414.2	1.931	35
40	2.3973	419.1	2.053	1.1966	418.9	1.999	0.7964	418.8	1.968	0.5963	418.6	1.946	40
45	2.4358	423.6	2.067	1.2160	423.4	2.014	0.8093	423.3	1.982	0.6060	423.1	1.960	45
50	2.4743	428.1	2.081	1.2353	428.0	2.028	0.8223	427.8	1.996	0.6158	427.7	1.974	50
55	2.5128	432.7	2.095	1.2546	432.6	2.042	0.8352	432.4	2.010	0.6255	432.3	1.988	55
60	2.5512	437.3	2.109	1.2739	437.2	2.056	0.8481	437.1	2.025	0.6352	436.9	2.002	60
65	2.5897	442.0	2.123	1.2932	441.9	2.070	0.8610	441.7	2.038	0.6449	441.6	2.016	65
70	2.6282	446.7	2.137	1.3125	446.6	2.084	0.8739	446.5	2.052	0.6546	446.3	2.030	70
75	2.6666	451.4	2.151	1.3318	451.3	2.097	0.8868	451.2	2.066	0.6643	451.1	2.044	75

  

ABSOLUTE PRESSURE, kPa													
Temp °C	50			60			70			80			Temp °C
	-43.64 °C			-40.09 °C			-36.98 °C			-34.21 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.3425	349.5	1.673	0.2887	351.8	1.669	0.2499	353.8	1.666	0.2205	355.6	1.664	
-40	0.3485	352.2	1.685	0.2889	351.8	1.670							-40
-35	0.3567	356.0	1.701	0.2958	355.7	1.686	0.2523	355.4	1.673				-35
-30	0.3649	359.9	1.717	0.3027	359.6	1.702	0.2583	359.3	1.689	0.2249	358.9	1.678	-30
-25	0.3730	363.8	1.733	0.3096	363.5	1.718	0.2642	363.2	1.705	0.2302	362.9	1.694	-25
-20	0.3811	367.7	1.749	0.3164	367.5	1.734	0.2701	367.2	1.721	0.2354	366.9	1.710	-20
-15	0.3891	371.7	1.764	0.3231	371.5	1.749	0.2760	371.2	1.737	0.2406	370.9	1.726	-15
-10	0.3972	375.7	1.780	0.3299	375.5	1.765	0.2818	375.3	1.752	0.2458	375.0	1.742	-10
-5	0.4051	379.8	1.795	0.3366	379.6	1.780	0.2876	379.4	1.768	0.2509	379.1	1.757	-5
0	0.4131	383.9	1.810	0.3433	383.7	1.796	0.2934	383.5	1.783	0.2560	383.3	1.772	0
5	0.4211	388.1	1.825	0.3499	387.9	1.811	0.2991	387.7	1.798	0.2610	387.5	1.788	5
10	0.4290	392.3	1.840	0.3566	392.1	1.826	0.3049	391.9	1.813	0.2661	391.7	1.803	10
15	0.4369	396.6	1.855	0.3632	396.4	1.841	0.3106	396.2	1.828	0.2711	396.0	1.818	15
20	0.4448	400.9	1.870	0.3698	400.7	1.856	0.3163	400.5	1.843	0.2762	400.3	1.833	20
25	0.4527	405.2	1.885	0.3764	405.0	1.870	0.3220	404.9	1.858	0.2812	404.7	1.847	25
30	0.4605	409.6	1.899	0.3830	409.4	1.885	0.3277	409.3	1.873	0.2861	409.1	1.862	30
35	0.4684	414.0	1.914	0.3896	413.9	1.899	0.3333	413.7	1.887	0.2911	413.6	1.877	35
40	0.4762	418.5	1.928	0.3962	418.3	1.914	0.3390	418.2	1.902	0.2961	418.1	1.891	40
45	0.4840	423.0	1.942	0.4027	422.9	1.928	0.3446	422.7	1.916	0.3010	422.6	1.905	45
50	0.4919	427.6	1.957	0.4092	427.4	1.942	0.3502	427.3	1.930	0.3060	427.2	1.920	50
55	0.4997	432.2	1.971	0.4158	432.0	1.957	0.3559	431.9	1.944	0.3109	431.8	1.934	55
60	0.5075	436.8	1.985	0.4223	436.7	1.971	0.3615	436.6	1.958	0.3159	436.4	1.948	60
65	0.5153	441.5	1.999	0.4288	441.4	1.985	0.3671	441.3	1.972	0.3208	441.1	1.962	65
70	0.5231	446.2	2.013	0.4353	446.1	1.998	0.3727	446.0	1.986	0.3257	445.9	1.976	70
75	0.5308	451.0	2.026	0.4418	450.9	2.012	0.3783	450.8	2.000	0.3306	450.7	1.990	75
80	0.5386	455.8	2.040	0.4483	455.7	2.026	0.3839	455.6	2.014	0.3355	455.5	2.004	80
85	0.5464	460.7	2.054	0.4548	460.6	2.040	0.3894	460.5	2.028	0.3404	460.4	2.017	85
90	0.5542	465.6	2.067	0.4613	465.5	2.053	0.3950	465.4	2.041	0.3453	465.3	2.031	90
95	0.5619	470.5	2.081	0.4678	470.4	2.067	0.4006	470.3	2.055	0.3502	470.2	2.044	95
100	0.5697	475.5	2.094	0.4743	475.4	2.080	0.4062	475.3	2.068	0.3551	475.2	2.058	100
105	0.5774	480.5	2.108	0.4808	480.4	2.094	0.4117	480.3	2.082	0.3599	480.2	2.071	105

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	90			100			101.325			110			Temp °C
	-31.70 °C			-29.40 °C			-29.11 °C			-27.28 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.1974	357.3	1.662	0.1787	358.8	1.661	0.1765	358.9	1.661	0.1634	360.1	1.659	
-30	0.1990	358.6	1.668										-30
-25	0.2037	362.6	1.684	0.1825	362.3	1.675	0.1801	362.3	1.674	0.1652	362.0	1.667	-25
-20	0.2084	366.6	1.700	0.1868	366.3	1.691	0.1843	366.3	1.690	0.1691	366.1	1.683	-20
-15	0.2131	370.7	1.716	0.1911	370.4	1.707	0.1885	370.4	1.706	0.1730	370.1	1.699	-15
-10	0.2177	374.8	1.732	0.1953	374.5	1.723	0.1926	374.5	1.722	0.1769	374.3	1.715	-10
-5	0.2223	378.9	1.747	0.1994	378.7	1.739	0.1967	378.6	1.738	0.1807	378.4	1.731	-5
0	0.2269	383.1	1.763	0.2036	382.9	1.754	0.2008	382.8	1.753	0.1845	382.6	1.746	0
5	0.2314	387.3	1.778	0.2077	387.1	1.769	0.2049	387.0	1.768	0.1883	386.9	1.762	5
10	0.2359	391.5	1.793	0.2118	391.3	1.785	0.2090	391.3	1.784	0.1920	391.1	1.777	10
15	0.2404	395.8	1.808	0.2159	395.6	1.800	0.2130	395.6	1.799	0.1958	395.5	1.792	15
20	0.2449	400.2	1.823	0.2199	400.0	1.815	0.2170	400.0	1.814	0.1995	399.8	1.807	20
25	0.2494	404.5	1.838	0.2240	404.4	1.829	0.2210	404.3	1.828	0.2032	404.2	1.822	25
30	0.2538	408.9	1.853	0.2280	408.8	1.844	0.2250	408.8	1.843	0.2069	408.6	1.836	30
35	0.2583	413.4	1.867	0.2320	413.3	1.859	0.2289	413.2	1.858	0.2105	413.1	1.851	35
40	0.2627	417.9	1.882	0.2360	417.8	1.873	0.2329	417.7	1.872	0.2142	417.6	1.866	40
45	0.2672	422.4	1.896	0.2400	422.3	1.888	0.2368	422.3	1.887	0.2179	422.2	1.880	45
50	0.2716	427.0	1.910	0.2440	426.9	1.902	0.2408	426.9	1.901	0.2215	426.8	1.894	50
55	0.2760	431.7	1.925	0.2480	431.5	1.916	0.2447	431.5	1.915	0.2251	431.4	1.909	55
60	0.2804	436.3	1.939	0.2520	436.2	1.930	0.2486	436.2	1.929	0.2288	436.1	1.923	60
65	0.2848	441.0	1.953	0.2559	440.9	1.944	0.2526	440.9	1.943	0.2324	440.8	1.937	65
70	0.2891	445.8	1.967	0.2599	445.7	1.958	0.2565	445.6	1.957	0.2360	445.6	1.951	70
75	0.2935	450.6	1.981	0.2639	450.5	1.972	0.2604	450.4	1.971	0.2396	450.3	1.965	75
80	0.2979	455.4	1.994	0.2678	455.3	1.986	0.2643	455.3	1.985	0.2432	455.2	1.978	80
85	0.3023	460.3	2.008	0.2717	460.2	2.000	0.2681	460.2	1.999	0.2468	460.1	1.992	85
90	0.3066	465.2	2.022	0.2757	465.1	2.013	0.2720	465.1	2.012	0.2504	465.0	2.006	90
95	0.3110	470.1	2.035	0.2796	470.0	2.027	0.2759	470.0	2.026	0.2539	469.9	2.019	95
100	0.3153	475.1	2.049	0.2835	475.0	2.040	0.2798	475.0	2.039	0.2575	474.9	2.033	100
105	0.3197	480.2	2.062	0.2874	480.1	2.054	0.2837	480.1	2.053	0.2611	480.0	2.046	105
110	0.3240	485.2	2.075	0.2914	485.1	2.067	0.2875	485.1	2.066	0.2647	485.0	2.060	110
115	0.3284	490.3	2.089	0.2953	490.2	2.080	0.2914	490.2	2.079	0.2682	490.2	2.073	115

  

ABSOLUTE PRESSURE, kPa													
Temp °C	120			130			140			150			Temp °C
	-25.30 °C			-23.45 °C			-21.70 °C			-20.05 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.1505	361.4	1.658	0.1396	362.6	1.657	0.1301	363.8	1.656	0.1219	364.8	1.656	
-25	0.1508	361.7	1.659										-25
-20	0.1544	365.8	1.676	0.1419	365.5	1.669	0.1312	365.2	1.662	0.1219	364.9	1.656	-20
-15	0.1580	369.9	1.692	0.1453	369.6	1.685	0.1344	369.3	1.678	0.1249	369.0	1.672	-15
-10	0.1616	374.0	1.708	0.1486	373.8	1.701	0.1375	373.5	1.694	0.1279	373.2	1.688	-10
-5	0.1651	378.2	1.723	0.1519	378.0	1.717	0.1406	377.7	1.710	0.1308	377.5	1.704	-5
0	0.1686	382.4	1.739	0.1552	382.2	1.732	0.1437	382.0	1.726	0.1337	381.7	1.720	0
5	0.1721	386.7	1.754	0.1584	386.4	1.748	0.1467	386.2	1.741	0.1365	386.0	1.736	5
10	0.1756	390.9	1.770	0.1616	390.7	1.763	0.1497	390.5	1.757	0.1394	390.3	1.751	10
15	0.1790	395.3	1.785	0.1648	395.1	1.778	0.1527	394.9	1.772	0.1422	394.7	1.766	15
20	0.1824	399.6	1.800	0.1680	399.4	1.793	0.1557	399.3	1.787	0.1450	399.1	1.781	20
25	0.1859	404.0	1.815	0.1712	403.9	1.808	0.1586	403.7	1.802	0.1477	403.5	1.796	25
30	0.1893	408.5	1.829	0.1743	408.3	1.823	0.1616	408.1	1.817	0.1505	408.0	1.811	30
35	0.1926	412.9	1.844	0.1775	412.8	1.838	0.1645	412.6	1.832	0.1532	412.5	1.826	35
40	0.1960	417.5	1.859	0.1806	417.3	1.852	0.1674	417.2	1.846	0.1560	417.0	1.840	40
45	0.1994	422.0	1.873	0.1837	421.9	1.867	0.1703	421.7	1.861	0.1587	421.6	1.855	45
50	0.2027	426.6	1.887	0.1868	426.5	1.881	0.1732	426.4	1.875	0.1614	426.2	1.869	50
55	0.2061	431.3	1.902	0.1899	431.1	1.895	0.1761	431.0	1.889	0.1641	430.9	1.884	55
60	0.2094	436.0	1.916	0.1930	435.8	1.909	0.1790	435.7	1.903	0.1668	435.6	1.898	60
65	0.2127	440.7	1.930	0.1961	440.6	1.923	0.1818	440.4	1.918	0.1695	440.3	1.912	65
70	0.2160	445.4	1.944	0.1992	445.3	1.937	0.1847	445.2	1.932	0.1722	445.1	1.926	70
75	0.2194	450.2	1.958	0.2022	450.1	1.951	0.1876	450.0	1.945	0.1748	449.9	1.940	75
80	0.2227	455.1	1.972	0.2053	455.0	1.965	0.1904	454.9	1.959	0.1775	454.8	1.954	80
85	0.2260	460.0	1.985	0.2084	459.9	1.979	0.1933	459.8	1.973	0.1802	459.7	1.968	85
90	0.2293	464.9	1.999	0.2114	464.8	1.993	0.1961	464.7	1.987	0.1828	464.6	1.981	90
95	0.2325	469.8	2.013	0.2144	469.7	2.006	0.1989	469.7	2.000	0.1855	469.6	1.995	95
100	0.2358	474.8	2.026	0.2175	474.8	2.020	0.2018	474.7	2.014	0.1881	474.6	2.008	100
105	0.2391	479.9	2.039	0.2205	479.8	2.033	0.2046	479.7	2.027	0.1908	479.6	2.022	105
110	0.2424	485.0	2.053	0.2236	484.9	2.046	0.2074	484.8	2.041	0.1934	484.7	2.035	110
115	0.2457	490.1	2.066	0.2266	490.0	2.060	0.2102	489.9	2.054	0.1961	489.8	2.048	115
120	0.2489	495.2	2.079	0.2296	495.2	2.073	0.2131	495.1	2.067	0.1987	495.0	2.062	120

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	160			170			180			190			Temp °C
	-18.49 °C			-17.00 °C			-15.57 °C			-14.21 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.1147	365.8	1.655	0.1083	366.8	1.654	0.1025	367.7	1.654	0.0974	368.6	1.653	
-15	0.1167	368.8	1.666	0.1093	368.5	1.661	0.1028	368.2	1.656				-15
-10	0.1194	373.0	1.683	0.1120	372.7	1.677	0.1054	372.5	1.672	0.0995	372.2	1.667	-10
-5	0.1222	377.2	1.699	0.1146	377.0	1.693	0.1079	376.7	1.688	0.1018	376.5	1.683	-5
0	0.1249	381.5	1.714	0.1172	381.3	1.709	0.1103	381.0	1.704	0.1042	380.8	1.699	0
5	0.1276	385.8	1.730	0.1198	385.6	1.725	0.1128	385.4	1.720	0.1065	385.1	1.715	5
10	0.1303	390.1	1.745	0.1223	389.9	1.740	0.1152	389.7	1.735	0.1088	389.5	1.731	10
15	0.1329	394.5	1.761	0.1248	394.3	1.756	0.1176	394.1	1.751	0.1111	393.9	1.746	15
20	0.1356	398.9	1.776	0.1273	398.7	1.771	0.1199	398.5	1.766	0.1134	398.3	1.761	20
25	0.1382	403.3	1.791	0.1298	403.2	1.786	0.1223	403.0	1.781	0.1156	402.8	1.776	25
30	0.1408	407.8	1.806	0.1322	407.6	1.801	0.1246	407.5	1.796	0.1178	407.3	1.791	30
35	0.1434	412.3	1.821	0.1347	412.2	1.816	0.1270	412.0	1.811	0.1200	411.8	1.806	35
40	0.1460	416.9	1.835	0.1371	416.7	1.830	0.1293	416.6	1.825	0.1222	416.4	1.821	40
45	0.1485	421.5	1.850	0.1395	421.3	1.845	0.1316	421.2	1.840	0.1244	421.0	1.836	45
50	0.1511	426.1	1.864	0.1420	425.9	1.859	0.1339	425.8	1.854	0.1266	425.7	1.850	50
55	0.1536	430.7	1.878	0.1444	430.6	1.874	0.1361	430.5	1.869	0.1288	430.4	1.864	55
60	0.1562	435.4	1.893	0.1468	435.3	1.888	0.1384	435.2	1.883	0.1309	435.1	1.879	60
65	0.1587	440.2	1.907	0.1491	440.1	1.902	0.1407	439.9	1.897	0.1331	439.8	1.893	65
70	0.1612	445.0	1.921	0.1515	444.9	1.916	0.1429	444.7	1.911	0.1352	444.6	1.907	70
75	0.1637	449.8	1.935	0.1539	449.7	1.930	0.1452	449.6	1.925	0.1374	449.5	1.921	75
80	0.1662	454.7	1.949	0.1563	454.5	1.944	0.1474	454.4	1.939	0.1395	454.3	1.935	80
85	0.1687	459.5	1.962	0.1586	459.4	1.958	0.1497	459.3	1.953	0.1416	459.2	1.949	85
90	0.1712	464.5	1.976	0.1610	464.4	1.971	0.1519	464.3	1.967	0.1437	464.2	1.962	90
95	0.1737	469.5	1.990	0.1633	469.4	1.985	0.1541	469.3	1.980	0.1459	469.2	1.976	95
100	0.1762	474.5	2.003	0.1657	474.4	1.998	0.1563	474.3	1.994	0.1480	474.2	1.989	100
105	0.1787	479.5	2.017	0.1680	479.4	2.012	0.1586	479.3	2.007	0.1501	479.2	2.003	105
110	0.1812	484.6	2.030	0.1704	484.5	2.025	0.1608	484.4	2.021	0.1522	484.3	2.016	110
115	0.1837	489.7	2.043	0.1727	489.7	2.039	0.1630	489.6	2.034	0.1543	489.5	2.030	115
120	0.1861	494.9	2.057	0.1750	494.8	2.052	0.1652	494.7	2.047	0.1564	494.7	2.043	120
125	0.1886	500.1	2.070	0.1774	500.0	2.065	0.1674	499.9	2.060	0.1585	499.9	2.056	125
130	0.1911	505.3	2.083	0.1797	505.3	2.078	0.1696	505.2	2.073	0.1606	505.1	2.069	130
ABSOLUTE PRESSURE, kPa													
Temp °C	200			210			220			230			Temp °C
	-12.90 °C			-11.64 °C			-10.42 °C			-9.25 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0928	369.4	1.653	0.0885	370.2	1.652	0.0847	371.0	1.652	0.0812	371.7	1.652	
-10	0.0941	371.9	1.662	0.0893	371.6	1.658	0.0849	371.3	1.654				-10
-5	0.0964	376.2	1.679	0.0915	376.0	1.674	0.0870	375.7	1.670	0.0829	375.4	1.666	-5
0	0.0987	380.6	1.695	0.0937	380.3	1.690	0.0891	380.1	1.686	0.0849	379.8	1.682	0
5	0.1009	384.9	1.711	0.0958	384.7	1.706	0.0912	384.5	1.702	0.0869	384.2	1.698	5
10	0.1031	389.3	1.726	0.0979	389.1	1.722	0.0932	388.9	1.718	0.0889	388.7	1.714	10
15	0.1053	393.7	1.742	0.1000	393.5	1.737	0.0952	393.3	1.733	0.0908	393.1	1.729	15
20	0.1074	398.2	1.757	0.1021	398.0	1.753	0.0972	397.8	1.749	0.0927	397.6	1.745	20
25	0.1096	402.6	1.772	0.1041	402.5	1.768	0.0992	402.3	1.764	0.0946	402.1	1.760	25
30	0.1117	407.1	1.787	0.1062	407.0	1.783	0.1011	406.8	1.779	0.0965	406.6	1.775	30
35	0.1138	411.7	1.802	0.1082	411.5	1.798	0.1031	411.4	1.794	0.0984	411.2	1.790	35
40	0.1159	416.3	1.817	0.1102	416.1	1.813	0.1050	416.0	1.809	0.1002	415.8	1.805	40
45	0.1180	420.9	1.831	0.1122	420.7	1.827	0.1069	420.6	1.823	0.1021	420.4	1.820	45
50	0.1201	425.5	1.846	0.1142	425.4	1.842	0.1088	425.3	1.838	0.1039	425.1	1.834	50
55	0.1221	430.2	1.860	0.1162	430.1	1.856	0.1107	430.0	1.852	0.1057	429.8	1.849	55
60	0.1242	434.9	1.874	0.1181	434.8	1.870	0.1126	434.7	1.867	0.1075	434.6	1.863	60
65	0.1263	439.7	1.889	0.1201	439.6	1.885	0.1145	439.5	1.881	0.1093	439.3	1.877	65
70	0.1283	444.5	1.903	0.1220	444.4	1.899	0.1163	444.3	1.895	0.1111	444.2	1.891	70
75	0.1303	449.3	1.917	0.1240	449.2	1.913	0.1182	449.1	1.909	0.1129	449.0	1.905	75
80	0.1324	454.2	1.931	0.1259	454.1	1.927	0.1201	454.0	1.923	0.1147	453.9	1.919	80
85	0.1344	459.1	1.944	0.1279	459.0	1.940	0.1219	458.9	1.937	0.1165	458.8	1.933	85
90	0.1364	464.1	1.958	0.1298	464.0	1.954	0.1238	463.9	1.950	0.1182	463.8	1.947	90
95	0.1384	469.1	1.972	0.1317	469.0	1.968	0.1256	468.9	1.964	0.1200	468.8	1.961	95
100	0.1404	474.1	1.985	0.1336	474.0	1.981	0.1274	473.9	1.978	0.1218	473.8	1.974	100
105	0.1424	479.2	1.999	0.1355	479.1	1.995	0.1293	479.0	1.991	0.1235	478.9	1.988	105
110	0.1445	484.3	2.012	0.1375	484.2	2.008	0.1311	484.1	2.005	0.1253	484.0	2.001	110
115	0.1464	489.4	2.026	0.1394	489.3	2.022	0.1329	489.2	2.018	0.1270	489.1	2.014	115
120	0.1484	494.6	2.039	0.1413	494.5	2.035	0.1347	494.4	2.031	0.1288	494.3	2.028	120
125	0.1504	499.8	2.052	0.1432	499.7	2.048	0.1366	499.6	2.044	0.1305	499.5	2.041	125
130	0.1524	505.0	2.065	0.1451	505.0	2.061	0.1384	504.9	2.058	0.1323	504.8	2.054	130
135	0.1544	510.3	2.078	0.1470	510.2	2.074	0.1402	510.2	2.071	0.1340	510.1	2.067	135

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	240			250			260			270			Temp °C
	-8.12 °C			-7.02 °C			-5.95 °C			-4.92 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0779	372.4	1.651	0.0749	373.1	1.651	0.0722	373.8	1.651	0.0696	374.4	1.651	
-5	0.0792	375.2	1.662	0.0757	374.9	1.658	0.0725	374.6	1.654				-5
0	0.0811	379.6	1.678	0.0776	379.3	1.674	0.0744	379.1	1.671	0.0714	378.8	1.667	0
5	0.0831	384.0	1.694	0.0795	383.8	1.690	0.0762	383.6	1.687	0.0731	383.3	1.683	5
10	0.0849	388.5	1.710	0.0813	388.2	1.706	0.0780	388.0	1.703	0.0748	387.8	1.699	10
15	0.0868	392.9	1.726	0.0831	392.7	1.722	0.0797	392.5	1.718	0.0765	392.3	1.715	15
20	0.0887	397.4	1.741	0.0849	397.2	1.737	0.0814	397.0	1.734	0.0782	396.8	1.731	20
25	0.0905	401.9	1.756	0.0867	401.7	1.753	0.0831	401.6	1.749	0.0799	401.4	1.746	25
30	0.0923	406.5	1.771	0.0884	406.3	1.768	0.0848	406.1	1.764	0.0815	406.0	1.761	30
35	0.0941	411.0	1.786	0.0901	410.9	1.783	0.0865	410.7	1.780	0.0831	410.6	1.776	35
40	0.0959	415.7	1.801	0.0919	415.5	1.798	0.0882	415.3	1.794	0.0847	415.2	1.791	40
45	0.0977	420.3	1.816	0.0936	420.1	1.812	0.0898	420.0	1.809	0.0863	419.9	1.806	45
50	0.0994	425.0	1.831	0.0953	424.8	1.827	0.0915	424.7	1.824	0.0879	424.5	1.821	50
55	0.1012	429.7	1.845	0.0970	429.5	1.842	0.0931	429.4	1.838	0.0895	429.3	1.835	55
60	0.1029	434.4	1.859	0.0986	434.3	1.856	0.0947	434.2	1.853	0.0911	434.0	1.849	60
65	0.1046	439.2	1.874	0.1003	439.1	1.870	0.0963	439.0	1.867	0.0926	438.8	1.864	65
70	0.1064	444.0	1.888	0.1020	443.9	1.884	0.0979	443.8	1.881	0.0942	443.7	1.878	70
75	0.1081	448.9	1.902	0.1036	448.8	1.898	0.0995	448.7	1.895	0.0957	448.5	1.892	75
80	0.1098	453.8	1.916	0.1053	453.7	1.912	0.1011	453.6	1.909	0.0973	453.5	1.906	80
85	0.1115	458.7	1.930	0.1069	458.6	1.926	0.1027	458.5	1.923	0.0988	458.4	1.920	85
90	0.1132	463.7	1.943	0.1086	463.6	1.940	0.1043	463.5	1.937	0.1003	463.4	1.934	90
95	0.1149	468.7	1.957	0.1102	468.6	1.954	0.1058	468.5	1.951	0.1018	468.4	1.947	95
100	0.1166	473.7	1.971	0.1118	473.6	1.967	0.1074	473.5	1.964	0.1033	473.4	1.961	100
105	0.1183	478.8	1.984	0.1134	478.7	1.981	0.1090	478.6	1.978	0.1048	478.5	1.975	105
110	0.1200	483.9	1.998	0.1151	483.8	1.994	0.1105	483.7	1.991	0.1064	483.6	1.988	110
115	0.1216	489.1	2.011	0.1167	489.0	2.008	0.1121	488.9	2.005	0.1079	488.8	2.001	115
120	0.1233	494.2	2.024	0.1183	494.2	2.021	0.1137	494.1	2.018	0.1094	494.0	2.015	120
125	0.1250	499.5	2.037	0.1199	499.4	2.034	0.1152	499.3	2.031	0.1109	499.2	2.028	125
130	0.1267	504.7	2.051	0.1215	504.6	2.047	0.1167	504.6	2.044	0.1123	504.5	2.041	130
135	0.1283	510.0	2.064	0.1231	509.9	2.060	0.1183	509.9	2.057	0.1138	509.8	2.054	135
140	0.1300	515.3	2.077	0.1247	515.3	2.073	0.1198	515.2	2.070	0.1153	515.1	2.067	140
ABSOLUTE PRESSURE, kPa													
Temp °C	280			290			300			310			Temp °C
	-3.92 °C			-2.94 °C			-1.98 °C			-1.06 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0672	375.1	1.651	0.0650	375.7	1.650	0.0629	376.3	1.650	0.0609	376.8	1.650	
0	0.0686	378.6	1.664	0.0660	378.3	1.660	0.0635	378.1	1.657	0.0613	377.8	1.654	0
5	0.0703	383.1	1.680	0.0676	382.8	1.676	0.0652	382.6	1.673	0.0629	382.4	1.670	5
10	0.0720	387.6	1.696	0.0693	387.4	1.693	0.0668	387.1	1.689	0.0644	386.9	1.686	10
15	0.0736	392.1	1.712	0.0709	391.9	1.708	0.0683	391.7	1.705	0.0659	391.5	1.702	15
20	0.0752	396.6	1.727	0.0725	396.4	1.724	0.0699	396.2	1.721	0.0674	396.0	1.718	20
25	0.0768	401.2	1.743	0.0740	401.0	1.740	0.0714	400.8	1.736	0.0689	400.6	1.734	25
30	0.0784	405.8	1.758	0.0756	405.6	1.755	0.0729	405.4	1.752	0.0704	405.3	1.749	30
35	0.0800	410.4	1.773	0.0771	410.2	1.770	0.0744	410.1	1.767	0.0718	409.9	1.764	35
40	0.0816	415.0	1.788	0.0786	414.9	1.785	0.0758	414.7	1.782	0.0732	414.6	1.779	40
45	0.0831	419.7	1.803	0.0801	419.6	1.800	0.0773	419.4	1.797	0.0747	419.3	1.794	45
50	0.0846	424.4	1.817	0.0816	424.3	1.814	0.0787	424.1	1.812	0.0761	424.0	1.809	50
55	0.0862	429.1	1.832	0.0831	429.0	1.829	0.0802	428.9	1.826	0.0775	428.7	1.823	55
60	0.0877	433.9	1.846	0.0845	433.8	1.843	0.0816	433.7	1.841	0.0788	433.5	1.838	60
65	0.0892	438.7	1.861	0.0860	438.6	1.858	0.0830	438.5	1.855	0.0802	438.3	1.852	65
70	0.0907	443.6	1.875	0.0874	443.4	1.872	0.0844	443.3	1.869	0.0816	443.2	1.866	70
75	0.0922	448.4	1.889	0.0889	448.3	1.886	0.0858	448.2	1.883	0.0829	448.1	1.881	75
80	0.0937	453.3	1.903	0.0903	453.2	1.900	0.0872	453.1	1.897	0.0843	453.0	1.895	80
85	0.0951	458.3	1.917	0.0918	458.2	1.914	0.0886	458.1	1.911	0.0856	458.0	1.908	85
90	0.0966	463.3	1.931	0.0932	463.2	1.928	0.0900	463.1	1.925	0.0870	463.0	1.922	90
95	0.0981	468.3	1.944	0.0946	468.2	1.942	0.0914	468.1	1.939	0.0883	468.0	1.936	95
100	0.0996	473.3	1.958	0.0960	473.2	1.955	0.0927	473.1	1.952	0.0897	473.0	1.950	100
105	0.1010	478.4	1.972	0.0974	478.3	1.969	0.0941	478.2	1.966	0.0910	478.1	1.963	105
110	0.1025	483.6	1.985	0.0988	483.5	1.982	0.0955	483.4	1.979	0.0923	483.3	1.977	110
115	0.1039	488.7	1.999	0.1003	488.6	1.996	0.0968	488.5	1.993	0.0936	488.4	1.990	115
120	0.1054	493.9	2.012	0.1017	493.8	2.009	0.0982	493.7	2.006	0.0949	493.6	2.004	120
125	0.1068	499.1	2.025	0.1031	499.1	2.022	0.0995	499.0	2.019	0.0963	498.9	2.017	125
130	0.1083	504.4	2.038	0.1044	504.3	2.035	0.1009	504.3	2.033	0.0976	504.2	2.030	130
135	0.1097	509.7	2.051	0.1058	509.6	2.048	0.1022	509.6	2.046	0.0989	509.5	2.043	135
140	0.1111	515.0	2.064	0.1072	515.0	2.061	0.1036	514.9	2.059	0.1002	514.8	2.056	140
145	0.1126	520.4	2.077	0.1086	520.4	2.074	0.1049	520.3	2.072	0.1015	520.2	2.069	145



**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	320			330			340			350			Temp °C
	-0.15 °C			0.73 °C			1.60 °C			2.44 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0591	377.4	1.650	0.0574	377.9	1.650	0.0557	378.5	1.650	0.0542	379.0	1.649	
0	0.0591	377.5	1.650										0
5	0.0607	382.1	1.667	0.0586	381.9	1.664	0.0567	381.6	1.661	0.0549	381.4	1.658	5
10	0.0622	386.7	1.683	0.0601	386.5	1.680	0.0582	386.2	1.677	0.0563	386.0	1.675	10
15	0.0637	391.3	1.699	0.0616	391.0	1.696	0.0596	390.8	1.694	0.0577	390.6	1.691	15
20	0.0652	395.8	1.715	0.0630	395.6	1.712	0.0610	395.4	1.709	0.0591	395.2	1.707	20
25	0.0666	400.5	1.731	0.0644	400.3	1.728	0.0624	400.1	1.725	0.0604	399.9	1.722	25
30	0.0680	405.1	1.746	0.0658	404.9	1.743	0.0637	404.7	1.740	0.0618	404.5	1.738	30
35	0.0694	409.7	1.761	0.0672	409.6	1.758	0.0651	409.4	1.756	0.0631	409.2	1.753	35
40	0.0708	414.4	1.776	0.0685	414.2	1.774	0.0664	414.1	1.771	0.0644	413.9	1.768	40
45	0.0722	419.1	1.791	0.0699	418.9	1.788	0.0677	418.8	1.786	0.0656	418.6	1.783	45
50	0.0736	423.8	1.806	0.0712	423.7	1.803	0.0690	423.5	1.801	0.0669	423.4	1.798	50
55	0.0749	428.6	1.821	0.0725	428.5	1.818	0.0703	428.3	1.815	0.0682	428.2	1.813	55
60	0.0763	433.4	1.835	0.0738	433.3	1.832	0.0716	433.1	1.830	0.0694	433.0	1.827	60
65	0.0776	438.2	1.849	0.0751	438.1	1.847	0.0728	438.0	1.844	0.0706	437.8	1.842	65
70	0.0789	443.1	1.864	0.0764	443.0	1.861	0.0741	442.8	1.859	0.0719	442.7	1.856	70
75	0.0803	448.0	1.878	0.0777	447.9	1.875	0.0753	447.7	1.873	0.0731	447.6	1.870	75
80	0.0816	452.9	1.892	0.0790	452.8	1.889	0.0766	452.7	1.887	0.0743	452.6	1.884	80
85	0.0829	457.9	1.906	0.0803	457.8	1.903	0.0778	457.6	1.901	0.0755	457.5	1.898	85
90	0.0842	462.9	1.920	0.0815	462.8	1.917	0.0791	462.6	1.915	0.0767	462.5	1.912	90
95	0.0855	467.9	1.933	0.0828	467.8	1.931	0.0803	467.7	1.928	0.0779	467.6	1.926	95
100	0.0868	473.0	1.947	0.0841	472.9	1.945	0.0815	472.8	1.942	0.0791	472.7	1.940	100
105	0.0881	478.1	1.961	0.0853	478.0	1.958	0.0827	477.9	1.956	0.0803	477.8	1.953	105
110	0.0893	483.2	1.974	0.0866	483.1	1.972	0.0839	483.0	1.969	0.0815	482.9	1.967	110
115	0.0906	488.4	1.988	0.0878	488.3	1.985	0.0852	488.2	1.983	0.0827	488.1	1.980	115
120	0.0919	493.6	2.001	0.0890	493.5	1.998	0.0864	493.4	1.996	0.0838	493.3	1.994	120
125	0.0932	498.8	2.014	0.0903	498.7	2.012	0.0876	498.7	2.009	0.0850	498.6	2.007	125
130	0.0944	504.1	2.027	0.0915	504.0	2.025	0.0888	503.9	2.022	0.0862	503.9	2.020	130
135	0.0957	509.4	2.040	0.0928	509.3	2.038	0.0900	509.3	2.036	0.0873	509.2	2.033	135
140	0.0970	514.8	2.053	0.0940	514.7	2.051	0.0912	514.6	2.049	0.0885	514.5	2.046	140
145	0.0982	520.1	2.066	0.0952	520.1	2.064	0.0923	520.0	2.062	0.0897	519.9	2.059	145
ABSOLUTE PRESSURE, kPa													
Temp °C	360			370			380			390			Temp °C
	3.27 °C			4.08 °C			4.87 °C			5.65 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0527	379.5	1.649	0.0513	380.0	1.649	0.0500	380.5	1.649	0.0487	381.0	1.649	
5	0.0532	381.1	1.655	0.0516	380.9	1.652	0.0500	380.6	1.650				5
10	0.0546	385.8	1.672	0.0529	385.5	1.669	0.0514	385.3	1.666	0.0499	385.0	1.664	10
15	0.0560	390.4	1.688	0.0543	390.2	1.685	0.0527	390.0	1.683	0.0512	389.7	1.680	15
20	0.0573	395.0	1.704	0.0556	394.8	1.701	0.0540	394.6	1.699	0.0525	394.4	1.696	20
25	0.0586	399.7	1.720	0.0569	399.5	1.717	0.0552	399.3	1.715	0.0537	399.1	1.712	25
30	0.0599	404.4	1.735	0.0582	404.2	1.733	0.0565	404.0	1.730	0.0549	403.8	1.728	30
35	0.0612	409.0	1.751	0.0594	408.9	1.748	0.0577	408.7	1.746	0.0561	408.5	1.743	35
40	0.0624	413.8	1.766	0.0606	413.6	1.763	0.0589	413.4	1.761	0.0573	413.3	1.758	40
45	0.0637	418.5	1.781	0.0619	418.3	1.778	0.0601	418.2	1.776	0.0585	418.0	1.774	45
50	0.0649	423.3	1.796	0.0631	423.1	1.793	0.0613	423.0	1.791	0.0596	422.8	1.788	50
55	0.0662	428.0	1.810	0.0643	427.9	1.808	0.0625	427.8	1.806	0.0608	427.6	1.803	55
60	0.0674	432.9	1.825	0.0655	432.7	1.822	0.0636	432.6	1.820	0.0619	432.5	1.818	60
65	0.0686	437.7	1.839	0.0666	437.6	1.837	0.0648	437.5	1.835	0.0630	437.3	1.832	65
70	0.0698	442.6	1.854	0.0678	442.5	1.851	0.0659	442.3	1.849	0.0641	442.2	1.847	70
75	0.0710	447.5	1.868	0.0690	447.4	1.865	0.0671	447.3	1.863	0.0653	447.2	1.861	75
80	0.0722	452.4	1.882	0.0701	452.3	1.880	0.0682	452.2	1.877	0.0664	452.1	1.875	80
85	0.0733	457.4	1.896	0.0713	457.3	1.894	0.0693	457.2	1.891	0.0675	457.1	1.889	85
90	0.0745	462.4	1.910	0.0724	462.3	1.908	0.0704	462.2	1.905	0.0685	462.1	1.903	90
95	0.0757	467.5	1.924	0.0735	467.4	1.921	0.0715	467.3	1.919	0.0696	467.2	1.917	95
100	0.0768	472.6	1.937	0.0747	472.5	1.935	0.0726	472.4	1.933	0.0707	472.3	1.931	100
105	0.0780	477.7	1.951	0.0758	477.6	1.949	0.0737	477.5	1.946	0.0718	477.4	1.944	105
110	0.0791	482.8	1.964	0.0769	482.7	1.962	0.0748	482.7	1.960	0.0729	482.6	1.958	110
115	0.0803	488.0	1.978	0.0781	487.9	1.976	0.0759	487.8	1.973	0.0739	487.8	1.971	115
120	0.0814	493.2	1.991	0.0792	493.2	1.989	0.0770	493.1	1.987	0.0750	493.0	1.985	120
125	0.0826	498.5	2.005	0.0803	498.4	2.002	0.0781	498.3	2.000	0.0760	498.2	1.998	125
130	0.0837	503.8	2.018	0.0814	503.7	2.016	0.0792	503.6	2.013	0.0771	503.5	2.011	130
135	0.0848	509.1	2.031	0.0825	509.0	2.029	0.0803	508.9	2.026	0.0782	508.9	2.024	135
140	0.0860	514.5	2.044	0.0836	514.4	2.042	0.0813	514.3	2.040	0.0792	514.2	2.037	140
145	0.0871	519.8	2.057	0.0847	519.8	2.055	0.0824	519.7	2.053	0.0803	519.6	2.050	145
150	0.0882	525.3	2.070	0.0858	525.2	2.068	0.0835	525.1	2.065	0.0813	525.1	2.063	150

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	400			425			450			475			Temp °C
	6.41 °C			8.26 °C			10.02 °C			11.72 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0476	381.4	1.649	0.0448	382.5	1.649	0.0424	383.6	1.649	0.0402	384.6	1.649	
10	0.0485	384.8	1.661	0.0452	384.2	1.655							10
15	0.0498	389.5	1.678	0.0465	388.9	1.671	0.0435	388.4	1.666	0.0409	387.8	1.660	15
20	0.0510	394.2	1.694	0.0477	393.7	1.688	0.0447	393.1	1.682	0.0420	392.6	1.676	20
25	0.0522	398.9	1.710	0.0488	398.4	1.704	0.0458	397.9	1.698	0.0431	397.4	1.693	25
30	0.0534	403.6	1.725	0.0500	403.2	1.720	0.0469	402.7	1.714	0.0442	402.2	1.709	30
35	0.0546	408.4	1.741	0.0511	407.9	1.735	0.0480	407.5	1.730	0.0452	407.0	1.724	35
40	0.0557	413.1	1.756	0.0522	412.7	1.750	0.0490	412.3	1.745	0.0462	411.9	1.740	40
45	0.0569	417.9	1.771	0.0533	417.5	1.766	0.0501	417.1	1.760	0.0472	416.7	1.755	45
50	0.0580	422.7	1.786	0.0544	422.3	1.781	0.0511	421.9	1.775	0.0482	421.5	1.770	50
55	0.0591	427.5	1.801	0.0554	427.1	1.795	0.0521	426.8	1.790	0.0492	426.4	1.785	55
60	0.0603	432.3	1.816	0.0565	432.0	1.810	0.0531	431.6	1.805	0.0501	431.3	1.800	60
65	0.0614	437.2	1.830	0.0575	436.9	1.825	0.0541	436.5	1.820	0.0511	436.2	1.815	65
70	0.0625	442.1	1.844	0.0586	441.8	1.839	0.0551	441.5	1.834	0.0520	441.2	1.829	70
75	0.0635	447.0	1.859	0.0596	446.7	1.854	0.0561	446.4	1.848	0.0530	446.1	1.844	75
80	0.0646	452.0	1.873	0.0606	451.7	1.868	0.0571	451.4	1.863	0.0539	451.1	1.858	80
85	0.0657	457.0	1.887	0.0616	456.7	1.882	0.0581	456.4	1.877	0.0548	456.2	1.872	85
90	0.0668	462.0	1.901	0.0627	461.8	1.896	0.0590	461.5	1.891	0.0558	461.2	1.886	90
95	0.0678	467.1	1.915	0.0637	466.8	1.910	0.0600	466.6	1.905	0.0567	466.3	1.900	95
100	0.0689	472.2	1.929	0.0647	471.9	1.923	0.0609	471.7	1.919	0.0576	471.4	1.914	100
105	0.0699	477.3	1.942	0.0657	477.1	1.937	0.0619	476.8	1.932	0.0585	476.6	1.928	105
110	0.0710	482.5	1.956	0.0666	482.2	1.951	0.0628	482.0	1.946	0.0594	481.8	1.941	110
115	0.0720	487.7	1.969	0.0676	487.4	1.964	0.0637	487.2	1.959	0.0603	487.0	1.955	115
120	0.0731	492.9	1.983	0.0686	492.7	1.978	0.0647	492.5	1.973	0.0611	492.3	1.968	120
125	0.0741	498.2	1.996	0.0696	498.0	1.991	0.0656	497.7	1.986	0.0620	497.5	1.982	125
130	0.0751	503.5	2.009	0.0706	503.3	2.004	0.0665	503.1	1.999	0.0629	502.9	1.995	130
135	0.0762	508.8	2.022	0.0715	508.6	2.017	0.0675	508.4	2.013	0.0638	508.2	2.008	135
140	0.0772	514.2	2.035	0.0725	514.0	2.030	0.0684	513.8	2.026	0.0647	513.6	2.021	140
145	0.0782	519.6	2.048	0.0735	519.4	2.043	0.0693	519.2	2.039	0.0655	519.0	2.034	145
150	0.0792	525.0	2.061	0.0744	524.8	2.056	0.0702	524.6	2.052	0.0664	524.5	2.047	150
155	0.0802	530.5	2.074	0.0754	530.3	2.069	0.0711	530.1	2.064	0.0673	529.9	2.060	155

  

ABSOLUTE PRESSURE, kPa													
Temp °C	500			525			550			575			Temp °C
	13.34 °C			14.91 °C			16.42 °C			17.88 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0382	385.5	1.649	0.0364	386.4	1.649	0.0347	387.3	1.648	0.0332	388.2	1.648	
15	0.0385	387.2	1.654	0.0364	386.5	1.649							15
20	0.0396	392.0	1.671	0.0374	391.5	1.666	0.0355	390.9	1.661	0.0336	390.3	1.656	20
25	0.0407	396.9	1.687	0.0385	396.4	1.682	0.0364	395.8	1.677	0.0346	395.3	1.673	25
30	0.0417	401.7	1.704	0.0394	401.2	1.699	0.0374	400.7	1.694	0.0355	400.2	1.689	30
35	0.0427	406.6	1.719	0.0404	406.1	1.715	0.0383	405.7	1.710	0.0365	405.2	1.705	35
40	0.0437	411.4	1.735	0.0414	411.0	1.730	0.0393	410.6	1.726	0.0373	410.1	1.721	40
45	0.0446	416.3	1.750	0.0423	415.9	1.746	0.0402	415.5	1.741	0.0382	415.0	1.737	45
50	0.0456	421.2	1.766	0.0432	420.8	1.761	0.0410	420.4	1.756	0.0391	420.0	1.752	50
55	0.0465	426.0	1.781	0.0441	425.7	1.776	0.0419	425.3	1.772	0.0399	424.9	1.767	55
60	0.0474	431.0	1.795	0.0450	430.6	1.791	0.0428	430.3	1.787	0.0407	429.9	1.782	60
65	0.0484	435.9	1.810	0.0459	435.6	1.806	0.0436	435.2	1.801	0.0416	434.9	1.797	65
70	0.0493	440.9	1.825	0.0468	440.5	1.820	0.0445	440.2	1.816	0.0424	439.9	1.812	70
75	0.0502	445.8	1.839	0.0476	445.5	1.835	0.0453	445.2	1.831	0.0432	444.9	1.827	75
80	0.0511	450.9	1.853	0.0485	450.6	1.849	0.0461	450.3	1.845	0.0440	450.0	1.841	80
85	0.0519	455.9	1.868	0.0493	455.6	1.863	0.0469	455.3	1.859	0.0448	455.1	1.855	85
90	0.0528	461.0	1.882	0.0502	460.7	1.877	0.0477	460.4	1.873	0.0455	460.2	1.869	90
95	0.0537	466.1	1.896	0.0510	465.8	1.891	0.0485	465.6	1.887	0.0463	465.3	1.883	95
100	0.0546	471.2	1.909	0.0518	471.0	1.905	0.0493	470.7	1.901	0.0471	470.5	1.897	100
105	0.0554	476.4	1.923	0.0526	476.1	1.919	0.0501	475.9	1.915	0.0478	475.6	1.911	105
110	0.0563	481.6	1.937	0.0535	481.3	1.933	0.0509	481.1	1.929	0.0486	480.9	1.925	110
115	0.0571	486.8	1.950	0.0543	486.6	1.946	0.0517	486.3	1.942	0.0493	486.1	1.938	115
120	0.0580	492.0	1.964	0.0551	491.8	1.960	0.0525	491.6	1.956	0.0501	491.4	1.952	120
125	0.0588	497.3	1.977	0.0559	497.1	1.973	0.0533	496.9	1.969	0.0508	496.7	1.965	125
130	0.0597	502.7	1.991	0.0567	502.5	1.986	0.0540	502.3	1.983	0.0516	502.1	1.979	130
135	0.0605	508.0	2.004	0.0575	507.8	2.000	0.0548	507.6	1.996	0.0523	507.4	1.992	135
140	0.0613	513.4	2.017	0.0583	513.2	2.013	0.0556	513.0	2.009	0.0531	512.8	2.005	140
145	0.0622	518.8	2.030	0.0591	518.6	2.026	0.0563	518.5	2.022	0.0538	518.3	2.018	145
150	0.0630	524.3	2.043	0.0599	524.1	2.039	0.0571	523.9	2.035	0.0545	523.7	2.031	150
155	0.0638	529.8	2.056	0.0607	529.6	2.052	0.0578	529.4	2.048	0.0553	529.2	2.044	155
160	0.0646	535.3	2.069	0.0615	535.1	2.065	0.0586	534.9	2.061	0.0560	534.8	2.057	160

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	600			625			650			675			Temp °C
	19.29 °C			20.66 °C			21.99 °C			23.28 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0318	389.0	1.648	0.0305	389.7	1.648	0.0294	390.5	1.648	0.0283	391.2	1.648	
20	0.0320	389.7	1.651										20
25	0.0329	394.7	1.668	0.0314	394.2	1.663	0.0299	393.6	1.659	0.0286	393.0	1.654	25
30	0.0338	399.7	1.685	0.0322	399.2	1.680	0.0308	398.7	1.676	0.0294	398.1	1.671	30
35	0.0347	404.7	1.701	0.0331	404.2	1.696	0.0316	403.7	1.692	0.0303	403.2	1.688	35
40	0.0356	409.7	1.717	0.0340	409.2	1.713	0.0325	408.7	1.708	0.0311	408.3	1.704	40
45	0.0364	414.6	1.733	0.0348	414.2	1.728	0.0333	413.8	1.724	0.0319	413.3	1.720	45
50	0.0373	419.6	1.748	0.0356	419.2	1.744	0.0341	418.8	1.740	0.0326	418.4	1.736	50
55	0.0381	424.6	1.763	0.0364	424.2	1.759	0.0348	423.8	1.755	0.0334	423.4	1.752	55
60	0.0389	429.5	1.778	0.0372	429.2	1.774	0.0356	428.8	1.771	0.0341	428.5	1.767	60
65	0.0397	434.5	1.793	0.0379	434.2	1.789	0.0363	433.9	1.786	0.0348	433.5	1.782	65
70	0.0405	439.6	1.808	0.0387	439.2	1.804	0.0371	438.9	1.800	0.0356	438.6	1.797	70
75	0.0412	444.6	1.823	0.0394	444.3	1.819	0.0378	444.0	1.815	0.0363	443.7	1.812	75
80	0.0420	449.7	1.837	0.0402	449.4	1.833	0.0385	449.1	1.830	0.0370	448.8	1.826	80
85	0.0428	454.8	1.851	0.0409	454.5	1.848	0.0392	454.2	1.844	0.0377	453.9	1.841	85
90	0.0435	459.9	1.866	0.0416	459.6	1.862	0.0399	459.3	1.858	0.0383	459.1	1.855	90
95	0.0443	465.0	1.880	0.0424	464.8	1.876	0.0406	464.5	1.872	0.0390	464.2	1.869	95
100	0.0450	470.2	1.894	0.0431	469.9	1.890	0.0413	469.7	1.886	0.0397	469.4	1.883	100
105	0.0457	475.4	1.907	0.0438	475.2	1.904	0.0420	474.9	1.900	0.0404	474.7	1.897	105
110	0.0465	480.6	1.921	0.0445	480.4	1.918	0.0427	480.2	1.914	0.0410	479.9	1.911	110
115	0.0472	485.9	1.935	0.0452	485.7	1.931	0.0434	485.4	1.928	0.0417	485.2	1.924	115
120	0.0479	491.2	1.948	0.0459	491.0	1.945	0.0440	490.7	1.941	0.0423	490.5	1.938	120
125	0.0486	496.5	1.962	0.0466	496.3	1.958	0.0447	496.1	1.955	0.0430	495.9	1.952	125
130	0.0493	501.8	1.975	0.0473	501.6	1.972	0.0454	501.4	1.968	0.0436	501.2	1.965	130
135	0.0501	507.2	1.988	0.0480	507.0	1.985	0.0460	506.8	1.982	0.0443	506.6	1.978	135
140	0.0508	512.6	2.002	0.0487	512.5	1.998	0.0467	512.3	1.995	0.0449	512.1	1.992	140
145	0.0515	518.1	2.015	0.0493	517.9	2.011	0.0474	517.7	2.008	0.0455	517.5	2.005	145
150	0.0522	523.6	2.028	0.0500	523.4	2.024	0.0480	523.2	2.021	0.0462	523.0	2.018	150
155	0.0529	529.1	2.041	0.0507	528.9	2.037	0.0487	528.7	2.034	0.0468	528.5	2.031	155
160	0.0536	534.6	2.053	0.0514	534.4	2.050	0.0493	534.3	2.047	0.0474	534.1	2.044	160
165	0.0543	540.2	2.066	0.0520	540.0	2.063	0.0500	539.9	2.060	0.0480	539.7	2.056	165
ABSOLUTE PRESSURE, kPa													
Temp °C	700			725			750			775			Temp °C
	24.53 °C			25.75 °C			26.94 °C			28.11 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0272	391.9	1.648	0.0263	392.6	1.648	0.0254	393.2	1.648	0.0245	393.8	1.648	
25	0.0273	392.4	1.650										25
30	0.0282	397.6	1.667	0.0270	397.0	1.663	0.0259	396.4	1.659	0.0248	395.8	1.655	30
35	0.0290	402.7	1.684	0.0278	402.2	1.680	0.0267	401.7	1.676	0.0256	401.1	1.672	35
40	0.0298	407.8	1.700	0.0286	407.3	1.697	0.0274	406.8	1.693	0.0264	406.3	1.689	40
45	0.0305	412.9	1.717	0.0293	412.4	1.713	0.0282	412.0	1.709	0.0271	411.5	1.706	45
50	0.0313	418.0	1.732	0.0301	417.5	1.729	0.0289	417.1	1.725	0.0278	416.7	1.722	50
55	0.0320	423.0	1.748	0.0308	422.6	1.744	0.0296	422.2	1.741	0.0285	421.8	1.737	55
60	0.0328	428.1	1.763	0.0315	427.7	1.760	0.0303	427.3	1.756	0.0292	427.0	1.753	60
65	0.0335	433.2	1.778	0.0322	432.8	1.775	0.0310	432.5	1.772	0.0298	432.1	1.768	65
70	0.0342	438.3	1.793	0.0329	437.9	1.790	0.0316	437.6	1.787	0.0305	437.2	1.783	70
75	0.0348	443.4	1.808	0.0335	443.0	1.805	0.0323	442.7	1.801	0.0311	442.4	1.798	75
80	0.0355	448.5	1.823	0.0342	448.2	1.819	0.0329	447.9	1.816	0.0318	447.6	1.813	80
85	0.0362	453.6	1.837	0.0348	453.3	1.834	0.0336	453.0	1.831	0.0324	452.7	1.828	85
90	0.0369	458.8	1.851	0.0355	458.5	1.848	0.0342	458.2	1.845	0.0330	457.9	1.842	90
95	0.0375	464.0	1.866	0.0361	463.7	1.862	0.0348	463.4	1.859	0.0336	463.2	1.856	95
100	0.0382	469.2	1.880	0.0368	468.9	1.877	0.0354	468.7	1.873	0.0342	468.4	1.870	100
105	0.0388	474.4	1.894	0.0374	474.2	1.891	0.0360	473.9	1.887	0.0348	473.7	1.884	105
110	0.0395	479.7	1.908	0.0380	479.5	1.904	0.0367	479.2	1.901	0.0354	479.0	1.898	110
115	0.0401	485.0	1.921	0.0386	484.8	1.918	0.0373	484.5	1.915	0.0360	484.3	1.912	115
120	0.0407	490.3	1.935	0.0392	490.1	1.932	0.0378	489.9	1.929	0.0365	489.6	1.926	120
125	0.0414	495.7	1.948	0.0398	495.4	1.945	0.0384	495.2	1.942	0.0371	495.0	1.939	125
130	0.0420	501.0	1.962	0.0405	500.8	1.959	0.0390	500.6	1.956	0.0377	500.4	1.953	130
135	0.0426	506.4	1.975	0.0411	506.2	1.972	0.0396	506.0	1.969	0.0383	505.8	1.966	135
140	0.0432	511.9	1.988	0.0417	511.7	1.985	0.0402	511.5	1.982	0.0388	511.3	1.980	140
145	0.0438	517.3	2.002	0.0422	517.2	1.999	0.0408	517.0	1.996	0.0394	516.8	1.993	145
150	0.0444	522.8	2.015	0.0428	522.7	2.012	0.0414	522.5	2.009	0.0400	522.3	2.006	150
155	0.0451	528.4	2.028	0.0434	528.2	2.025	0.0419	528.0	2.022	0.0405	527.8	2.019	155
160	0.0457	533.9	2.040	0.0440	533.8	2.038	0.0425	533.6	2.035	0.0411	533.4	2.032	160
165	0.0463	539.5	2.053	0.0446	539.4	2.050	0.0431	539.2	2.047	0.0416	539.0	2.045	165
170	0.0469	545.1	2.066	0.0452	545.0	2.063	0.0436	544.8	2.060	0.0422	544.7	2.057	170

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	800			900			1000			1100			Temp °C
	29.24 °C			33.52 °C			37.47 °C			41.12 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0238	394.4	1.648	0.0210	396.7	1.648	0.0188	398.6	1.648	0.0170	400.4	1.648	
30	0.0239	395.2	1.651										30
35	0.0246	400.6	1.669	0.0212	398.3	1.654							35
40	0.0254	405.8	1.685	0.0219	403.8	1.671	0.0192	401.5	1.657				40
45	0.0261	411.1	1.702	0.0226	409.1	1.688	0.0198	407.1	1.675	0.0175	404.9	1.662	45
50	0.0268	416.2	1.718	0.0233	414.5	1.705	0.0204	412.6	1.692	0.0181	410.6	1.680	50
55	0.0275	421.4	1.734	0.0239	419.7	1.721	0.0211	418.0	1.709	0.0187	416.1	1.697	55
60	0.0281	426.6	1.750	0.0245	425.0	1.737	0.0216	423.4	1.725	0.0192	421.7	1.714	60
65	0.0288	431.7	1.765	0.0251	430.3	1.753	0.0222	428.7	1.741	0.0198	427.1	1.730	65
70	0.0294	436.9	1.780	0.0257	435.5	1.768	0.0228	434.0	1.757	0.0203	432.5	1.746	70
75	0.0300	442.1	1.795	0.0263	440.7	1.783	0.0233	439.4	1.772	0.0208	438.0	1.762	75
80	0.0307	447.2	1.810	0.0269	446.0	1.798	0.0238	444.7	1.787	0.0213	443.4	1.777	80
85	0.0313	452.4	1.824	0.0274	451.2	1.813	0.0243	450.0	1.802	0.0218	448.7	1.792	85
90	0.0319	457.7	1.839	0.0280	456.5	1.828	0.0249	455.3	1.817	0.0223	454.1	1.807	90
95	0.0325	462.9	1.853	0.0285	461.8	1.842	0.0254	460.7	1.832	0.0228	459.5	1.822	95
100	0.0330	468.2	1.867	0.0290	467.1	1.856	0.0259	466.0	1.846	0.0232	464.9	1.837	100
105	0.0336	473.4	1.882	0.0296	472.4	1.870	0.0263	471.4	1.860	0.0237	470.3	1.851	105
110	0.0342	478.7	1.895	0.0301	477.8	1.885	0.0268	476.8	1.875	0.0241	475.8	1.865	110
115	0.0348	484.1	1.909	0.0306	483.1	1.898	0.0273	482.2	1.889	0.0246	481.2	1.879	115
120	0.0353	489.4	1.923	0.0311	488.5	1.912	0.0278	487.6	1.902	0.0250	486.7	1.893	120
125	0.0359	494.8	1.937	0.0316	493.9	1.926	0.0282	493.0	1.916	0.0255	492.2	1.907	125
130	0.0364	500.2	1.950	0.0321	499.4	1.939	0.0287	498.5	1.930	0.0259	497.7	1.921	130
135	0.0370	505.6	1.963	0.0326	504.8	1.953	0.0292	504.0	1.943	0.0263	503.2	1.935	135
140	0.0376	511.1	1.977	0.0331	510.3	1.966	0.0296	509.5	1.957	0.0267	508.7	1.948	140
145	0.0381	516.6	1.990	0.0336	515.8	1.980	0.0301	515.1	1.970	0.0272	514.3	1.961	145
150	0.0386	522.1	2.003	0.0341	521.4	1.993	0.0305	520.6	1.983	0.0276	519.9	1.975	150
155	0.0392	527.7	2.016	0.0346	527.0	2.006	0.0310	526.2	1.997	0.0280	525.5	1.988	155
160	0.0397	533.2	2.029	0.0351	532.6	2.019	0.0314	531.9	2.010	0.0284	531.2	2.001	160
165	0.0403	538.9	2.042	0.0356	538.2	2.032	0.0319	537.5	2.023	0.0288	536.8	2.014	165
170	0.0408	544.5	2.055	0.0361	543.8	2.045	0.0323	543.2	2.035	0.0292	542.5	2.027	170
175	0.0413	550.2	2.067	0.0366	549.5	2.057	0.0327	548.9	2.048	0.0296	548.2	2.040	175
ABSOLUTE PRESSURE, kPa													
Temp °C	1200			1300			1400			1500			Temp °C
	44.54 °C			47.75 °C			50.78 °C			53.65 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0154	401.9	1.648	0.0141	403.3	1.648	0.0130	404.5	1.647	0.0120	405.6	1.647	
45	0.0155	402.5	1.650										45
50	0.0161	408.4	1.668	0.0144	406.1	1.656							50
55	0.0167	414.2	1.686	0.0150	412.1	1.675	0.0135	409.8	1.664	0.0122	407.4	1.652	55
60	0.0172	419.9	1.703	0.0155	418.0	1.692	0.0140	415.9	1.682	0.0127	413.8	1.671	60
65	0.0178	425.4	1.720	0.0160	423.7	1.710	0.0145	421.9	1.700	0.0132	419.9	1.690	65
70	0.0183	431.0	1.736	0.0165	429.4	1.726	0.0150	427.7	1.717	0.0137	425.9	1.707	70
75	0.0188	436.5	1.752	0.0170	435.0	1.742	0.0155	433.4	1.733	0.0142	431.8	1.724	75
80	0.0192	442.0	1.768	0.0175	440.6	1.758	0.0159	439.1	1.749	0.0146	437.6	1.741	80
85	0.0197	447.4	1.783	0.0179	446.1	1.774	0.0164	444.7	1.765	0.0150	443.3	1.757	85
90	0.0202	452.9	1.798	0.0183	451.6	1.789	0.0168	450.3	1.781	0.0154	449.0	1.773	90
95	0.0206	458.4	1.813	0.0188	457.2	1.804	0.0172	455.9	1.796	0.0158	454.7	1.788	95
100	0.0210	463.8	1.828	0.0192	462.7	1.819	0.0176	461.5	1.811	0.0162	460.3	1.803	100
105	0.0215	469.3	1.842	0.0196	468.2	1.834	0.0180	467.1	1.826	0.0166	465.9	1.818	105
110	0.0219	474.7	1.857	0.0200	473.7	1.848	0.0184	472.6	1.841	0.0169	471.6	1.833	110
115	0.0223	480.2	1.871	0.0204	479.2	1.863	0.0187	478.2	1.855	0.0173	477.2	1.848	115
120	0.0227	485.7	1.885	0.0208	484.8	1.877	0.0191	483.8	1.869	0.0177	482.8	1.862	120
125	0.0231	491.3	1.899	0.0212	490.3	1.891	0.0195	489.4	1.884	0.0180	488.5	1.876	125
130	0.0235	496.8	1.913	0.0215	495.9	1.905	0.0198	495.0	1.898	0.0184	494.1	1.891	130
135	0.0239	502.3	1.926	0.0219	501.5	1.919	0.0202	500.6	1.911	0.0187	499.8	1.905	135
140	0.0243	507.9	1.940	0.0223	507.1	1.932	0.0205	506.3	1.925	0.0190	505.4	1.918	140
145	0.0247	513.5	1.953	0.0227	512.7	1.946	0.0209	511.9	1.939	0.0194	511.1	1.932	145
150	0.0251	519.1	1.967	0.0230	518.4	1.959	0.0212	517.6	1.952	0.0197	516.8	1.946	150
155	0.0255	524.8	1.980	0.0234	524.0	1.973	0.0216	523.3	1.966	0.0200	522.5	1.959	155
160	0.0259	530.4	1.993	0.0237	529.7	1.986	0.0219	529.0	1.979	0.0203	528.3	1.972	160
165	0.0263	536.1	2.006	0.0241	535.4	1.999	0.0222	534.8	1.992	0.0206	534.1	1.986	165
170	0.0266	541.9	2.019	0.0244	541.2	2.012	0.0226	540.5	2.005	0.0210	539.8	1.999	170
175	0.0270	547.6	2.032	0.0248	547.0	2.025	0.0229	546.3	2.018	0.0213	545.6	2.012	175
180	0.0274	553.4	2.045	0.0251	552.7	2.038	0.0232	552.1	2.031	0.0216	551.5	2.025	180
185	0.0277	559.2	2.058	0.0255	558.6	2.051	0.0236	557.9	2.044	0.0219	557.3	2.038	185
190	0.0281	565.0	2.070	0.0258	564.4	2.063	0.0239	563.8	2.057	0.0222	563.2	2.050	190

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	1600			1700			1800			1900			Temp °C
	56.38 °C			58.99 °C			61.48 °C			63.87 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0111	406.6	1.646	0.0104	407.4	1.645	0.0097	408.2	1.645	0.0091	408.8	1.644	
60	0.0116	411.4	1.661	0.0105	408.9	1.650							60
65	0.0121	417.8	1.680	0.0110	415.6	1.670	0.0101	413.2	1.660	0.0092	410.5	1.649	65
70	0.0126	424.0	1.698	0.0115	422.0	1.689	0.0106	419.9	1.679	0.0097	417.6	1.670	70
75	0.0130	430.1	1.715	0.0120	428.3	1.707	0.0110	426.4	1.698	0.0102	424.3	1.689	75
80	0.0134	436.0	1.732	0.0124	434.3	1.724	0.0114	432.6	1.716	0.0106	430.8	1.708	80
85	0.0138	441.8	1.749	0.0128	440.3	1.741	0.0119	438.7	1.733	0.0110	437.1	1.725	85
90	0.0142	447.6	1.765	0.0132	446.2	1.757	0.0122	444.7	1.750	0.0114	443.2	1.742	90
95	0.0146	453.4	1.781	0.0136	452.0	1.773	0.0126	450.7	1.766	0.0117	449.2	1.759	95
100	0.0150	459.1	1.796	0.0139	457.8	1.789	0.0130	456.5	1.782	0.0121	455.2	1.775	100
105	0.0154	464.8	1.811	0.0143	463.6	1.804	0.0133	462.4	1.797	0.0124	461.1	1.791	105
110	0.0157	470.5	1.826	0.0146	469.3	1.819	0.0136	468.2	1.813	0.0128	467.0	1.806	110
115	0.0161	476.1	1.841	0.0149	475.1	1.834	0.0140	474.0	1.828	0.0131	472.9	1.821	115
120	0.0164	481.8	1.855	0.0153	480.8	1.849	0.0143	479.8	1.842	0.0134	478.7	1.836	120
125	0.0167	487.5	1.870	0.0156	486.5	1.863	0.0146	485.5	1.857	0.0137	484.5	1.851	125
130	0.0171	493.2	1.884	0.0159	492.3	1.878	0.0149	491.3	1.871	0.0140	490.4	1.865	130
135	0.0174	498.9	1.898	0.0162	498.0	1.892	0.0152	497.1	1.886	0.0143	496.2	1.880	135
140	0.0177	504.6	1.912	0.0165	503.7	1.906	0.0155	502.9	1.900	0.0146	502.0	1.894	140
145	0.0180	510.3	1.926	0.0168	509.5	1.919	0.0158	508.7	1.914	0.0148	507.8	1.908	145
150	0.0183	516.0	1.939	0.0171	515.2	1.933	0.0161	514.4	1.927	0.0151	513.6	1.922	150
155	0.0186	521.8	1.953	0.0174	521.0	1.947	0.0163	520.3	1.941	0.0154	519.5	1.935	155
160	0.0189	527.6	1.966	0.0177	526.8	1.960	0.0166	526.1	1.955	0.0157	525.3	1.949	160
165	0.0192	533.3	1.979	0.0180	532.6	1.974	0.0169	531.9	1.968	0.0159	531.2	1.963	165
170	0.0195	539.2	1.993	0.0183	538.5	1.987	0.0172	537.8	1.981	0.0162	537.1	1.976	170
175	0.0198	545.0	2.006	0.0186	544.3	2.000	0.0174	543.6	1.994	0.0164	543.0	1.989	175
180	0.0201	550.8	2.019	0.0189	550.2	2.013	0.0177	549.5	2.007	0.0167	548.9	2.002	180
185	0.0204	556.7	2.032	0.0191	556.1	2.026	0.0180	555.4	2.020	0.0170	554.8	2.015	185
190	0.0207	562.6	2.044	0.0194	562.0	2.039	0.0182	561.4	2.033	0.0172	560.8	2.028	190
195	0.0210	568.5	2.057	0.0197	567.9	2.051	0.0185	567.3	2.046	0.0175	566.7	2.041	195
200	0.0213	574.5	2.070	0.0200	573.9	2.064	0.0188	573.3	2.059	0.0177	572.7	2.054	200
205	0.0216	580.4	2.082	0.0202	579.9	2.077	0.0190	579.3	2.071	0.0180	578.7	2.066	205
ABSOLUTE PRESSURE, kPa													
Temp °C	2000			2100			2200			2300			Temp °C
	66.16 °C			68.37 °C			70.50 °C			72.56 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0085	409.3	1.643	0.0080	409.7	1.641	0.0075	410.0	1.640	0.0071	410.2	1.639	
70	0.0089	415.1	1.660	0.0082	412.3	1.649							70
75	0.0094	422.2	1.680	0.0087	419.8	1.671	0.0080	417.3	1.661	0.0073	414.4	1.651	75
80	0.0098	428.9	1.699	0.0091	426.8	1.691	0.0084	424.7	1.682	0.0078	422.3	1.673	80
85	0.0102	435.3	1.717	0.0095	433.5	1.710	0.0089	431.6	1.702	0.0083	429.6	1.694	85
90	0.0106	441.6	1.735	0.0099	440.0	1.727	0.0093	438.2	1.720	0.0087	436.4	1.713	90
95	0.0110	447.8	1.752	0.0103	446.3	1.745	0.0096	444.7	1.738	0.0090	443.1	1.731	95
100	0.0113	453.9	1.768	0.0106	452.5	1.761	0.0100	451.0	1.755	0.0094	449.5	1.748	100
105	0.0116	459.9	1.784	0.0109	458.6	1.778	0.0103	457.2	1.771	0.0097	455.8	1.765	105
110	0.0120	465.8	1.800	0.0112	464.6	1.793	0.0106	463.3	1.787	0.0100	462.1	1.781	110
115	0.0123	471.8	1.815	0.0115	470.6	1.809	0.0109	469.4	1.803	0.0103	468.2	1.797	115
120	0.0126	477.6	1.830	0.0118	476.6	1.824	0.0112	475.4	1.819	0.0106	474.3	1.813	120
125	0.0129	483.5	1.845	0.0121	482.5	1.839	0.0115	481.4	1.834	0.0108	480.4	1.828	125
130	0.0132	489.4	1.860	0.0124	488.4	1.854	0.0117	487.4	1.849	0.0111	486.4	1.843	130
135	0.0134	495.2	1.874	0.0127	494.3	1.869	0.0120	493.4	1.863	0.0114	492.4	1.858	135
140	0.0137	501.1	1.888	0.0130	500.2	1.883	0.0123	499.3	1.878	0.0116	498.4	1.873	140
145	0.0140	507.0	1.902	0.0132	506.1	1.897	0.0125	505.2	1.892	0.0119	504.3	1.887	145
150	0.0143	512.8	1.916	0.0135	512.0	1.911	0.0128	511.2	1.906	0.0121	510.3	1.901	150
155	0.0145	518.7	1.930	0.0137	517.9	1.925	0.0130	517.1	1.920	0.0124	516.3	1.915	155
160	0.0148	524.6	1.944	0.0140	523.8	1.939	0.0133	523.0	1.934	0.0126	522.3	1.929	160
165	0.0150	530.5	1.957	0.0142	529.7	1.952	0.0135	529.0	1.947	0.0128	528.2	1.943	165
170	0.0153	536.4	1.971	0.0145	535.7	1.966	0.0137	534.9	1.961	0.0131	534.2	1.956	170
175	0.0155	542.3	1.984	0.0147	541.6	1.979	0.0140	540.9	1.974	0.0133	540.2	1.970	175
180	0.0158	548.2	1.997	0.0150	547.6	1.992	0.0142	546.9	1.988	0.0135	546.2	1.983	180
185	0.0160	554.2	2.010	0.0152	553.5	2.005	0.0144	552.9	2.001	0.0137	552.2	1.996	185
190	0.0163	560.1	2.023	0.0154	559.5	2.018	0.0147	558.9	2.014	0.0140	558.3	2.009	190
195	0.0165	566.1	2.036	0.0157	565.5	2.031	0.0149	564.9	2.027	0.0142	564.3	2.022	195
200	0.0168	572.1	2.049	0.0159	571.6	2.044	0.0151	571.0	2.040	0.0144	570.4	2.035	200
205	0.0170	578.2	2.062	0.0161	577.6	2.057	0.0153	577.0	2.052	0.0146	576.5	2.048	205
210	0.0172	584.2	2.074	0.0163	583.7	2.070	0.0155	583.1	2.065	0.0148	582.6	2.061	210
215	0.0175	590.3	2.087	0.0166	589.8	2.082	0.0158	589.2	2.078	0.0150	588.7	2.073	215

**Opteon™ XP10 (R-513A)**  
**Superheated Vapor - Constant Pressure Tables**

V = Volume in m<sup>3</sup>/kg

H = Enthalpy in kJ/kg

S = Entropy in kJ/kg-K

Saturation Properties in Light Blue

ABSOLUTE PRESSURE, kPa													
Temp °C	2400			2600			2800			3000			Temp °C
	74.54 °C			78.33 °C			81.90 °C			85.26 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0066	410.3	1.637	0.0059	410.2	1.633	0.0053	409.6	1.628	0.0047	408.4	1.622	
75	0.0067	411.2	1.639										75
80	0.0072	419.7	1.664	0.0061	413.6	1.643							80
85	0.0077	427.4	1.685	0.0066	422.5	1.668	0.0057	416.4	1.647				85
90	0.0081	434.5	1.705	0.0071	430.4	1.689	0.0062	425.5	1.672	0.0053	419.6	1.653	90
95	0.0085	441.3	1.724	0.0075	437.7	1.709	0.0066	433.6	1.694	0.0058	428.9	1.678	95
100	0.0088	448.0	1.742	0.0078	444.7	1.728	0.0069	441.1	1.715	0.0062	437.1	1.700	100
105	0.0091	454.4	1.759	0.0081	451.4	1.746	0.0073	448.2	1.734	0.0065	444.7	1.721	105
110	0.0094	460.7	1.775	0.0084	458.0	1.763	0.0076	455.0	1.752	0.0068	451.9	1.740	110
115	0.0097	467.0	1.791	0.0087	464.4	1.780	0.0079	461.7	1.769	0.0071	458.8	1.758	115
120	0.0100	473.1	1.807	0.0090	470.7	1.796	0.0081	468.2	1.786	0.0074	465.6	1.775	120
125	0.0103	479.3	1.823	0.0093	477.0	1.812	0.0084	474.7	1.802	0.0076	472.2	1.792	125
130	0.0105	485.3	1.838	0.0095	483.2	1.828	0.0086	481.0	1.818	0.0079	478.7	1.808	130
135	0.0108	491.4	1.853	0.0098	489.4	1.843	0.0089	487.3	1.833	0.0081	485.2	1.824	135
140	0.0110	497.4	1.868	0.0100	495.5	1.858	0.0091	493.6	1.848	0.0084	491.5	1.839	140
145	0.0113	503.5	1.882	0.0102	501.6	1.873	0.0094	499.8	1.863	0.0086	497.9	1.855	145
150	0.0115	509.5	1.896	0.0105	507.7	1.887	0.0096	506.0	1.878	0.0088	504.1	1.869	150
155	0.0118	515.5	1.910	0.0107	513.8	1.901	0.0098	512.1	1.893	0.0090	510.4	1.884	155
160	0.0120	521.5	1.924	0.0109	519.9	1.915	0.0100	518.3	1.907	0.0092	516.6	1.899	160
165	0.0122	527.5	1.938	0.0111	526.0	1.929	0.0102	524.4	1.921	0.0094	522.8	1.913	165
170	0.0124	533.5	1.952	0.0114	532.0	1.943	0.0104	530.5	1.935	0.0096	529.0	1.927	170
175	0.0127	539.5	1.965	0.0116	538.1	1.957	0.0106	536.7	1.949	0.0098	535.2	1.941	175
180	0.0129	545.5	1.979	0.0118	544.2	1.970	0.0108	542.8	1.962	0.0100	541.4	1.955	180
185	0.0131	551.6	1.992	0.0120	550.3	1.984	0.0110	548.9	1.976	0.0102	547.6	1.968	185
190	0.0133	557.6	2.005	0.0122	556.4	1.997	0.0112	555.1	1.989	0.0104	553.8	1.982	190
195	0.0135	563.7	2.018	0.0124	562.5	2.010	0.0114	561.2	2.002	0.0105	560.0	1.995	195
200	0.0137	569.8	2.031	0.0126	568.6	2.023	0.0116	567.4	2.015	0.0107	566.2	2.008	200
205	0.0139	575.9	2.044	0.0128	574.7	2.036	0.0118	573.6	2.028	0.0109	572.4	2.021	205
210	0.0141	582.0	2.057	0.0130	580.9	2.049	0.0119	579.8	2.041	0.0111	578.6	2.034	210
215	0.0143	588.2	2.069	0.0131	587.1	2.061	0.0121	586.0	2.054	0.0112	584.9	2.047	215
220	0.0145	594.3	2.082	0.0133	593.3	2.074	0.0123	592.2	2.067	0.0114	591.1	2.060	220
ABSOLUTE PRESSURE, kPa													
Temp °C	3200			3400			3600			3700			Temp °C
	88.44 °C			91.45 °C			94.30 °C			95.66 °C			
	V	H	S	V	H	S	V	H	S	V	H	S	
	0.0041	406.4	1.614	0.0036	403.2	1.603	0.0030	397.6	1.586	0.0026	392.1	1.570	
90	0.0044	411.5	1.628										90
95	0.0050	423.2	1.660	0.0042	415.9	1.638	0.0033	403.2	1.601				95
100	0.0054	432.5	1.685	0.0048	427.2	1.668	0.0041	420.6	1.648	0.0038	416.5	1.636	100
105	0.0058	440.8	1.707	0.0052	436.5	1.693	0.0046	431.6	1.677	0.0043	428.8	1.669	105
110	0.0061	448.5	1.727	0.0055	444.8	1.715	0.0050	440.7	1.701	0.0047	438.5	1.694	110
115	0.0064	455.8	1.746	0.0058	452.5	1.735	0.0053	449.0	1.723	0.0050	447.1	1.717	115
120	0.0067	462.8	1.764	0.0061	459.9	1.754	0.0056	456.8	1.743	0.0053	455.1	1.737	120
125	0.0070	469.7	1.782	0.0064	467.0	1.772	0.0058	464.2	1.761	0.0056	462.7	1.756	125
130	0.0072	476.4	1.798	0.0066	473.9	1.789	0.0061	471.3	1.779	0.0058	470.0	1.774	130
135	0.0074	483.0	1.815	0.0068	480.7	1.806	0.0063	478.3	1.796	0.0061	477.1	1.792	135
140	0.0077	489.5	1.830	0.0071	487.3	1.822	0.0065	485.1	1.813	0.0063	484.0	1.809	140
145	0.0079	495.9	1.846	0.0073	493.9	1.837	0.0067	491.8	1.829	0.0065	490.7	1.825	145
150	0.0081	502.3	1.861	0.0075	500.4	1.853	0.0069	498.4	1.845	0.0067	497.4	1.841	150
155	0.0083	508.6	1.876	0.0077	506.8	1.868	0.0071	505.0	1.860	0.0069	504.0	1.856	155
160	0.0085	514.9	1.891	0.0079	513.2	1.883	0.0073	511.5	1.875	0.0071	510.6	1.872	160
165	0.0087	521.2	1.905	0.0081	519.6	1.898	0.0075	517.9	1.890	0.0073	517.1	1.887	165
170	0.0089	527.5	1.919	0.0083	525.9	1.912	0.0077	524.3	1.905	0.0074	523.5	1.901	170
175	0.0091	533.7	1.933	0.0084	532.2	1.926	0.0079	530.7	1.919	0.0076	530.0	1.916	175
180	0.0093	540.0	1.947	0.0086	538.6	1.940	0.0080	537.1	1.933	0.0078	536.4	1.930	180
185	0.0094	546.2	1.961	0.0088	544.9	1.954	0.0082	543.5	1.947	0.0079	542.8	1.944	185
190	0.0096	552.5	1.974	0.0090	551.1	1.968	0.0084	549.8	1.961	0.0081	549.1	1.958	190
195	0.0098	558.7	1.988	0.0091	557.4	1.981	0.0085	556.2	1.975	0.0083	555.5	1.971	195
200	0.0100	565.0	2.001	0.0093	563.7	1.994	0.0087	562.5	1.988	0.0084	561.9	1.985	200
205	0.0101	571.2	2.014	0.0095	570.0	2.008	0.0089	568.8	2.001	0.0086	568.2	1.998	205
210	0.0103	577.5	2.027	0.0096	576.3	2.021	0.0090	575.2	2.015	0.0087	574.6	2.012	210
215	0.0105	583.8	2.040	0.0098	582.7	2.034	0.0092	581.5	2.028	0.0089	581.0	2.025	215
220	0.0106	590.1	2.053	0.0099	589.0	2.047	0.0093	587.9	2.041	0.0090	587.3	2.038	220
225	0.0108	596.4	2.066	0.0101	595.3	2.060	0.0095	594.3	2.053	0.0092	593.7	2.051	225
230	0.0109	602.7	2.078	0.0102	601.7	2.072	0.0096	600.6	2.066	0.0093	600.1	2.063	230
235	0.0111	609.0	2.091	0.0104	608.0	2.085	0.0098	607.0	2.079	0.0095	606.5	2.076	235

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