

# R-449A

**Zetropic blend (24.3 % R-32 - 24.7 % R-125 - 25.3 % R-1234yf - 25.7 % R-134a)**

Molecular weight (g/mol) .....	87.21
Melting point (°C) .....	N/A
Boiling point (at 1.013 bar) .....	-45.72
Temperature glide at 1.013 bar (K) .....	5.72
Critical temperature (°C) .....	83.9
Critical pressure (bar absolute) .....	46.62
Specific heat (liquid) at + 25°C (kJ/kg.K) .....	1.550
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 .....	1.139
Viscosity (liquid) at + 25°C in Centipoise (10 <sup>-3</sup> Pa.s) .....	0.139
Surface tension at + 25°C in dyne per centimetre (10 <sup>-3</sup> N/m) .....	6.59
Classification NF-EN 378 .....	A1
GWP (IPCC 4) .....	1397

## ◆ Main applications

R-449A (Opteon™ XP40) is a "non azeotropic" blend containing refrigerants from the hydrofluoro-olefin (HFO) family. It has been designed to replace R-404A in medium and low temperature commercial and industrial refrigeration applications. It is suitable for supermarkets and hypermarkets including centralised pack systems, chill and frozen cold stores, and refrigerated transport. It can be used as a replacement for R-22, but must be in accordance with conversion guidelines.

## ◆ Commercial specifications

Composition: 25.7 % R-134a - 25.3 % R-1234yf - 24.7 % R-125 - 24.3 % R-32 (±1 %-0.2 % / ±0.2 %-1 % / ±1 %-0.2 % / ±0.2 %-1 %).

Purity: ≥ 99.5 % weight.

Water content: ≤ 10 ppm weight.

Chlorine ion test (silver nitrate test): negative.

Total Acidity (HCL): ≤ 1 ppm weight.

Non-condensable content (gas phase): ≤ 1.5 % volume.

## ◆ Oils

Use a polyol ester (POE) oil.

Consult **Climalife** regarding the viscosity of the oil selected for your application and the most suitable for your application.

## ◆ Regulation

The use and implementation of R-448A are governed by the European Regulation N° 517/2014.

The recovery of R-448A is mandatory under the European Regulation N° 517/2014.

(Refer to regulations enforced in each country).

## Thermodynamic properties of R-449A - Saturated state

Absolute pressure P (bar)	LIQUID					VAPOUR					Latent heat Lv (kJ/kg)
	Bubble point t' (°C)	Volume v' (dm <sup>3</sup> /kg)	Density ρ' (kg/dm <sup>3</sup> )	Enthalpy h' (kJ/kg)	Entropy s' (kJ/kg.K)	Dew point t" (°C)	Volume v" (m <sup>3</sup> /kg)	Density ρ" (kg/m <sup>3</sup> )	Enthalpy h" (kJ/kg)	Entropy s" (kJ/kg.K)	
0.027	-100	0.666	1.502	69.145	0.408	-93.81	6.296	0.159	344.304	1.973	275.159
0.042	-95	0.672	1.489	75.546	0.444	-88.86	4.146	0.241	347.306	1.947	271.760
0.064	-90	0.678	1.475	81.905	0.479	-83.91	2.806	0.356	350.324	1.924	268.419
0.094	-85	0.684	1.462	88.239	0.514	-78.95	1.947	0.514	353.354	1.903	265.115
0.136	-80	0.691	1.448	94.560	0.547	-73.99	1.382	0.724	356.389	1.884	261.829
0.192	-75	0.698	1.434	100.880	0.579	-69.04	1.001	0.999	359.425	1.867	258.546
0.265	-70	0.704	1.420	107.207	0.610	-64.08	0.739	1.353	362.457	1.851	255.250
0.360	-65	0.712	1.405	113.549	0.641	-59.12	0.555	1.802	365.478	1.836	251.929
0.481	-60	0.719	1.391	119.914	0.671	-54.16	0.423	2.363	368.484	1.823	248.570
0.632	-55	0.727	1.376	126.307	0.701	-49.2	0.327	3.055	371.468	1.811	245.161
0.820	-50	0.735	1.361	132.734	0.730	-44.25	0.256	3.899	374.426	1.801	241.692
1.013	-45.72	0.742	1.349	138.262	0.755	-40.01	0.210	4.758	376.930	1.792	238.667
1.049	-45	0.743	1.346	139.201	0.759	-39.29	0.203	4.917	377.351	1.791	238.150
1.326	-40	0.751	1.331	145.712	0.787	-34.33	0.163	6.133	380.238	1.782	234.526
1.657	-35	0.760	1.316	152.272	0.815	-29.38	0.132	7.574	383.080	1.773	230.809
2.050	-30	0.769	1.300	158.886	0.842	-24.42	0.108	9.270	385.873	1.766	226.987
2.511	-25	0.779	1.284	165.559	0.869	-19.47	0.089	11.250	388.609	1.759	223.050
3.048	-20	0.789	1.267	172.297	0.896	-14.52	0.074	13.550	391.281	1.752	218.985
3.669	-15	0.800	1.251	179.103	0.922	-9.58	0.062	16.207	393.882	1.746	214.779
4.382	-10	0.811	1.233	185.985	0.948	-4.64	0.052	19.263	396.403	1.740	210.418
5.196	-5	0.823	1.216	192.948	0.974	0.29	0.044	22.766	398.834	1.735	205.886
6.119	0	0.835	1.198	200.000	1.000	5.22	0.037	26.767	401.166	1.730	201.166
7.159	5	0.848	1.179	207.148	1.026	10.15	0.032	31.328	403.383	1.725	196.236
8.327	10	0.862	1.160	214.400	1.051	15.06	0.027	36.517	405.473	1.720	191.073
9.630	15	0.878	1.140	221.767	1.076	19.97	0.024	42.416	407.418	1.716	185.651
11.080	20	0.894	1.119	229.259	1.102	24.86	0.020	49.121	409.197	1.711	179.938
12.685	25	0.912	1.097	236.891	1.127	29.74	0.018	56.747	410.789	1.706	173.897
14.456	30	0.931	1.074	244.678	1.153	34.61	0.015	65.436	412.164	1.701	167.486
16.403	35	0.952	1.050	252.641	1.178	39.47	0.013	75.363	413.290	1.696	160.649
18.536	40	0.976	1.025	260.804	1.204	44.3	0.012	86.755	414.124	1.690	153.320
20.867	45	1.002	0.998	269.203	1.229	49.12	0.010	99.910	414.611	1.684	145.408
23.407	50	1.032	0.969	277.884	1.256	53.9	0.009	115.234	414.677	1.677	136.793
26.168	55	1.068	0.937	286.913	1.283	58.66	0.008	133.313	414.214	1.668	127.301
29.163	60	1.110	0.901	296.391	1.310	63.38	0.006	155.036	413.064	1.659	116.673
32.403	65	1.162	0.860	306.484	1.339	68.04	0.005	181.883	410.964	1.647	104.480
35.901	70	1.232	0.811	317.511	1.370	72.62	0.005	216.648	407.428	1.631	89.917
39.662	75	1.338	0.748	330.235	1.406	77.07	0.004	265.978	401.324	1.609	71.089
43.635	80	1.563	0.640	347.942	1.455	81.16	0.003	358.058	388.045	1.568	40.103

## Thermodynamic properties of R-449A - (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
-100	0.015	11074.200	11397.311	11720.010	12042.384	12364.494	12686.390	13008.108	13329.677	13651.122	13972.460	14293.708	14614.878	14935.980	15257.024	15578.016	15898.964	16219.872	16540.745	16861.588	17182.400	17503.193
-95	0.024	6988.951	7187.947	7386.607	7585.000	7783.175	7981.171	8179.018	8376.740	8574.354	8771.878	8969.324	9166.703	9364.022	9561.291	9758.514	9955.698	10152.847	10349.965	10547.056	10744.122	10941.166
-90	0.038	4552.842	4679.589	4806.057	4932.304	5058.368	5184.281	5310.068	5435.748	5561.337	5686.847	5812.289	5937.673	6063.005	6188.292	6313.540	6438.752	6563.934	6689.088	6814.218	6939.325	7064.413
-85	0.058	3052.089	3135.335	3218.348	3301.172	3383.843	3466.386	3548.820	3631.163	3713.426	3795.622	3877.758	3959.843	4041.883	4123.883	4205.848	4287.781	4369.688	4451.569	4533.429	4615.269	4697.091
-80	0.087	2099.996	2156.031	2212.067	2267.943	2323.687	2379.321	2434.862	2490.324	2545.716	2601.050	2656.331	2711.567	2766.763	2821.925	2877.054	2932.157	2987.234	3042.290	3097.325	3152.343	3207.345
-75	0.126	1479.711	1517.994	1556.806	1595.479	1634.039	1672.503	1710.886	1749.200	1787.454	1825.656	1863.812	1901.928	1940.009	1978.058	2016.080	2054.077	2092.051	2130.006	2167.942	2205.863	2243.769
-70	0.180	1064.243	1091.818	1119.443	1146.848	1174.154	1201.377	1228.529	1255.621	1282.659	1309.652	1336.603	1363.520	1390.405	1417.261	1444.093	1470.903	1497.692	1524.464	1551.219	1577.960	1604.687
-65	0.250	780.805	800.889	820.841	840.688	860.448	880.135	899.759	919.330	938.854	958.337	977.784	997.199	1016.586	1035.948	1055.288	1074.607	1093.908	1113.193	1132.464	1151.720	1170.965
-60	0.341	583.069	597.943	612.701	627.366	641.954	656.478	670.946	685.366	699.745	714.087	728.397	742.679	756.935	771.168	785.381	799.576	813.756	827.918	842.069	856.207	870.334
-55	0.458	442.477	453.703	464.826	475.865	486.836	497.750	508.614	519.436	530.220	540.972	551.694	562.391	573.065	583.719	594.354	604.973	615.576	626.166	636.744	647.311	657.867
-50	0.606	340.752	349.375	357.904	366.360	374.754	383.097	391.395	399.655	407.881	416.078	424.249	432.397	440.523	448.632	456.723	464.799	472.862	480.912	488.951	496.980	504.999
-45	0.789	265.954	272.685	279.333	285.915	292.441	298.920	305.360	311.765	318.140	324.488	330.812	337.115	343.399	349.666	355.918	362.156	368.381	374.595	380.799	386.993	393.178
-40.01	1.013	210.178	215.515	220.777	225.978	231.129	236.238	241.311	246.352	251.368	256.356	261.323	266.272	271.203	276.118	281.019	285.908	290.785	295.652	300.509	305.357	310.197
-40	1.013	210.129	215.465	220.726	225.926	231.076	236.183	241.255	246.295	251.308	256.296	261.262	266.210	271.139	276.054	280.954	285.841	290.717	295.583	300.439	305.286	310.125
-35	1.286	167.887	172.178	176.399	180.566	184.687	188.770	192.819	196.840	200.832	204.809	208.763	212.698	216.618	220.524	224.416	228.297	232.167	236.028	239.879	243.722	247.558
-30	1.612	135.512	139.008	142.441	145.824	149.165	152.471	155.747	158.996	162.222	165.427	168.615	171.785	174.941	178.084	181.215	184.335	187.445	190.546	193.639	196.724	199.802
-25	2.001	110.403	113.288	116.115	118.896	121.638	124.347	127.029	129.686	132.322	134.939	137.539	140.124	142.695	145.254	147.802	150.339	152.868	155.388	157.900	160.405	162.904
-20	2.458	90.713	93.122	95.477	97.790	100.066	102.313	104.533	106.731	108.909	111.071	113.214	115.345	117.463	119.569	121.665	123.752	125.830	127.900	129.963	132.019	134.069
-15	2.993	75.113	77.147	79.131	81.075	82.986	84.869	86.728	88.565	90.384	92.186	93.974	95.749	97.511	99.263	101.005	102.738	104.464	106.181	107.892	109.597	111.296
-10	3.613	62.634	64.370	66.059	67.711	69.331	70.925	72.497	74.048	75.582	77.101	78.606	80.098	81.580	83.051	84.513	85.966	87.412	88.851	90.284	91.710	93.132
-5	4.327	52.560	54.058	55.511	56.928	58.315	59.678	61.020	62.342	63.648	64.940	66.219	67.485	68.742	69.988	71.226	72.456	73.679	74.895	76.106	77.310	78.510
0	5.144	44.360	45.664	46.926	48.154	49.353	50.529	51.685	52.822	53.944	55.052	56.148	57.233	58.307	59.373	60.430	61.480	62.523	63.560	64.591	65.616	66.637
5	6.074	37.632	38.778	39.884	40.957	42.004	43.027	44.031	45.018	45.990	46.949	47.896	48.832	49.759	50.677	51.587	52.491	53.387	54.278	55.163	56.043	56.918
10	7.126	32.068	33.086	34.065	35.011	35.932	36.830	37.710	38.573	39.420	40.258	41.089	41.913	42.730	43.540	44.290	45.072	45.849	46.620	47.385	48.143	48.902
15	8.311	27.436	28.348	29.221	30.063	30.880	31.675	32.452	33.213	33.960	34.694	35.418	36.132	36.837	37.534	38.224	38.907	39.585	40.257	40.923	41.586	42.244
20	9.640	23.552	24.377	25.164	25.919	26.649	27.358	28.050	28.725	29.387	30.037	30.677	31.307	31.928	32.542	33.149	33.749	34.344	34.934	35.518	36.099	36.675
25	11.123	20.274	21.028	21.743	22.426	23.084	23.721	24.341	24.945	25.536	26.115	26.684	27.243	27.795	28.339	28.876	29.407	29.933	30.453	30.969	31.480	31.988
30	12.774	17.490	18.186	18.841	19.464	20.062	20.639	21.198	21.742	22.272	22.792	23.301	23.801	24.294	24.779	25.257	25.730	26.197	26.659	27.117	27.570	28.020
35	14.604	15.111	15.760	16.366	16.939	17.486	18.012	18.520	19.012	19.492	19.961	20.420	20.869	21.311	21.746	22.175	22.598	23.015	23.428	23.836	24.241	24.641
40	16.628	13.065	13.677	14.243	14.774	15.278	15.761	16.225	16.675	17.111	17.536	17.952	18.359	18.758	19.150	19.536	19.916	20.291	20.662	21.028	21.390	21.749
45	18.861	11.294	11.879	12.412	12.909	13.377	13.823	14.250	14.662	15.062	15.450	15.828	16.198	16.560	16.915	17.264	17.608	17.947	18.281	18.611	18.937	19.260
50	21.319	9.751	10.317	10.825	11.293	11.731	12.145	12.541	12.921	13.289	13.645	13.991	14.329	14.659	14.983	15.300	15.612	15.919	16.222	16.521	16.816	17.107
55	24.022	8.395	8.952	9.441	9.886	10.299	10.687	11.055	11.408	11.748	12.076	12.394	12.704	13.007	13.303	13.593	13.877	14.157	14.433	14.704	14.972	15.236
60	26.991	7.192	7.751	8.228	8.655	9.046	9.412	9.757	10.086	10.402	10.706	11.000	11.286	11.564	11.836	12.102	12.362	12.617	12.869	13.117	13.361	13.602
65	30.257	6.110	6.687	7.158	7.571	7.946	8.292	8.617	8.926	9.220	9.503	9.776	10.040	10.297	10.547	10.792	11.031	11.266	11.496	11.723	11.946	12.166
70	33.857	5.116	5.734	6.207	6.611	6.972	7.302	7.610	7.900	8.175	8.439	8.693	8.939	9.176	9.408	9.634	9.854	10.070	10.282	10.490	10.694	10.896
75	37.857	4.164	4.866	5.352	5.751	6.100	6.417	6.709	6.983	7.242	7.489	7.726	7.954	8.175	8.390	8.599	8.802	9.001	9.196	9.388	9.576	9.760
80	42.420	3.122	4.044	4.554	4.953	5.295	5.599	5.878	6.138	6.382	6.614	6.836	7.048	7.254	7.453	7.646	7.834	8.018	8.197	8.373	8.546	8.716

## Thermodynamic properties of R-449A - (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
-100	0.015	340.586	343.690	346.835	350.024	353.256	356.531	359.851	363.215	366.623	370.076	373.572	377.114	380.699	384.328	388.002	391.720	395.481	399.286	403.135	407.027	410.963
-95	0.024	343.589	346.747	349.946	353.186	356.469	359.795	363.164	366.577	370.033	373.533	377.078	380.666	384.298	387.973	391.693	395.456	399.263	403.113	407.007	410.944	414.924
-90	0.038	346.614	349.829	353.082	356.376	359.711	363.088	366.507	369.970	373.475	377.024	380.616	384.251	387.930	391.653	395.418	399.228	403.080	406.976	410.914	414.896	418.921
-85	0.058	349.657	352.930	356.239	359.588	362.977	366.406	369.877	373.390	376.946	380.544	384.184	387.868	391.595	395.364	399.177	403.032	406.931	410.872	414.856	418.883	422.952
-80	0.087	352.712	356.045	359.414	362.819	366.263	369.746	373.270	376.835	380.442	384.090	387.780	391.512	395.287	399.105	402.965	406.867	410.812	414.799	418.829	422.901	427.016
-75	0.126	355.773	359.171	362.600	366.064	369.565	373.104	376.682	380.300	383.958	387.658	391.399	395.181	398.905	402.671	406.479	410.329	414.221	418.155	422.131	426.149	431.109
-70	0.180	358.836	362.301	365.794	369.319	372.878	376.475	380.109	383.781	387.493	391.245	395.038	398.871	402.745	406.660	410.617	414.615	418.655	422.736	426.859	431.023	435.229
-65	0.250	361.895	365.429	368.989	372.577	376.198	379.854	383.545	387.274	391.041	394.847	398.692	402.577	406.502	410.468	414.474	418.522	422.610	426.739	430.909	435.120	439.373
-60	0.341	364.944	368.552	372.181	375.835	379.520	383.237	386.988	390.775	394.598	398.459	402.358	406.297	410.274	414.291	418.348	422.445	426.583	430.761	434.979	439.238	443.537
-55	0.458	367.978	371.663	375.364	379.088	382.838	386.619	390.431	394.278	398.160	402.078	406.033	410.025	414.056	418.126	422.235	426.383	430.570	434.798	439.065	443.372	447.719
-50	0.606	370.991	374.757	378.534	382.329	386.148	389.995	393.871	397.780	401.721	405.698	409.710	413.759	417.845	421.968	426.130	430.330	434.569	438.846	443.163	447.519	451.915
-45	0.789	373.978	377.829	381.685	385.555	389.446	393.360	397.303	401.275	405.279	409.316	413.387	417.493	421.635	425.814	430.029	434.283	438.574	442.903	447.270	451.676	456.121
-40.01	1.013	376.930	380.870	384.809	388.757	392.722	396.708	400.718	404.757	408.824	412.923	417.055	421.220	425.420	429.655	433.926	438.234	442.578	446.960	451.379	455.836	460.330
-40	1.013	376.933	380.873	384.812	388.760	392.725	396.711	400.722	404.760	408.828	412.927	417.059	421.224	425.424	429.659	433.930	438.238	442.582	446.964	451.383	455.840	460.334
-35	1.286	379.850	383.884	387.910	391.939	395.981	400.041	404.123	408.230	412.364	416.527	420.721	424.947	429.207	433.500	437.828	442.191	446.590	451.025	455.497	460.006	464.551
-30	1.612	382.725	386.856	390.972	395.087	399.210	403.346	407.502	411.680	415.882	420.112	424.370	428.659	432.979	437.332	441.718	446.138	450.593	455.083	459.609	464.171	468.768
-25	2.001	385.550	389.784	393.995	398.199	402.405	406.622	410.854	415.105	419.378	423.676	428.001	432.354	436.738	441.152	445.598	450.076	454.589	459.135	463.715	468.331	472.981
-20	2.458	388.320	392.661	396.972	401.268	405.562	409.862	414.173	418.501	422.847	432.216	431.610	436.030	440.478	444.955	449.462	454.000	458.572	463.175	467.812	472.483	477.188
-15	2.993	391.027	395.482	399.866	404.290	408.675	413.062	417.456	421.862	426.285	430.728	435.192	439.681	444.195	448.737	453.300	457.908	462.539	467.202	471.896	476.623	481.383
-10	3.613	393.664	398.238	402.762	407.258	411.739	416.216	420.696	425.185	429.687	434.205	438.743	443.303	447.886	452.495	457.131	461.795	466.489	471.210	475.964	480.748	485.565
-5	4.327	396.222	400.923	405.562	410.165	414.747	419.318	423.889	428.463	433.047	437.645	442.259	446.892	451.546	456.224	460.927	465.656	470.412	475.197	480.011	484.855	489.729
0	5.144	398.692	403.527	408.289	413.005	417.692	422.363	427.028	431.692	436.362	441.041	445.734	450.444	455.172	459.921	464.693	469.489	474.310	479.159	484.035	488.939	493.873
5	6.074	401.062	406.041	410.934	415.769	420.568	425.344	430.108	434.866	439.625	444.390	449.165	453.953	458.758	463.580	468.423	473.289	478.178	483.092	488.031	492.998	497.993
10	7.126	403.319	408.454	413.466	418.450	423.368	428.255	433.122	437.979	442.832	447.686	452.546	457.417	462.300	467.199	472.116	477.052	482.011	486.992	491.998	497.028	502.085
15	8.311	405.448	410.752	415.936	421.038	426.083	431.087	436.065	441.025	445.976	450.924	455.873	460.829	465.794	470.772	475.765	480.776	485.806	490.856	495.929	501.026	506.147
20	9.640	407.431	412.922	423.253	428.704	433.834	438.928	443.998	449.052	454.098	459.140	464.185	469.236	474.296	479.368	484.455	489.559	494.681	499.824	504.988	510.174	
25	11.123	409.245	414.947	424.480	429.894	435.121	440.368	445.541	450.645	455.680	460.746	465.822	470.909	476.007	481.117	486.241	491.380	496.535	501.706	506.895	512.103	
30	12.774	410.866	416.808	422.545	428.137	433.625	439.034	444.386	449.695	454.974	460.230	465.473	470.709	475.941	481.175	486.415	491.664	496.923	502.196	507.485	512.790	
35	14.604	412.263	418.482	424.449	430.240	435.902	441.468	446.963	452.404	457.805	463.176	468.527	473.865	479.195	484.522	489.851	495.184	500.526	505.878	511.240	516.624	
40	16.628	413.297	419.841	426.172	432.184	438.039	443.776	449.425	455.008	460.539	466.032	471.497	476.943	482.375	487.799	493.221	498.643	504.071	509.505	514.945	520.400	
45	18.861	414.218	421.153	427.688	433.951	440.020	445.945	451.762	457.496	463.167	468.790	474.376	479.935	485.475	491.001	496.520	502.035	507.552	513.072	518.599	524.135	
50	21.319	414.658	422.075	428.668	435.517	442.268	448.958	455.585	462.179	471.441	477.155	482.835	488.488	494.121	499.742	505.355	510.964	516.573	522.186	527.804	533.432	
55	24.022	414.622	422.651	429.974	436.855	443.435	449.798	456.000	462.079	468.063	473.973	479.825	485.632	491.405	497.152	502.880	508.594	514.300	520.002	525.704	531.409	
60	26.991	413.967	422.806	430.656	437.928	444.819	451.442	457.867	464.143	470.303	476.374	482.373	488.317	494.217	500.083	505.924	511.745	517.553	523.353	529.147	534.941	
65	30.257	412.462	422.334	430.951	438.690	445.942	452.859	459.534	466.027	472.380	478.624	484.783	490.873	496.909	502.902	508.862	514.796	520.711	526.613	532.505	538.392	
70	33.857	409.679	421.377	430.763	439.075	446.752	454.007	460.964	467.698	474.264	480.698	487.029	493.277	499.458	505.587	511.675	517.729	523.757	529.766	535.761	541.746	
75	37.857	404.649	419.359	429.936	438.968	447.156	454.807	462.087	468.995	475.899	482.544	489.064	495.484	501.824	508.100	514.324	520.506	526.656	532.780	538.883	544.972	
80	42.420	393.673	415.671	428.038	438.042	446.884	455.026	462.696	470.030	477.113	484.001	490.739	497.355	503.875	510.316	516.693	523.018	529.302	535.552	541.775	547.978	

## Thermodynamic properties of R-449A - (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
-100	0.015	2.009	2.026	2.044	2.061	2.078	2.095	2.111	2.128	2.144	2.160	2.176	2.191	2.207	2.222	2.237	2.253	2.268	2.283	2.297	2.312	2.326
-95	0.024	1.979	1.997	2.014	2.031	2.048	2.064	2.081	2.097	2.113	2.129	2.145	2.160	2.176	2.191	2.206	2.221	2.236	2.251	2.265	2.280	2.294
-90	0.038	1.953	1.970	1.987	2.004	2.021	2.037	2.053	2.069	2.085	2.101	2.117	2.132	2.147	2.163	2.178	2.192	2.207	2.222	2.236	2.251	2.265
-85	0.058	1.929	1.946	1.963	1.980	1.996	2.013	2.029	2.045	2.060	2.076	2.091	2.107	2.122	2.137	2.152	2.167	2.181	2.196	2.210	2.225	2.239
-80	0.087	1.907	1.924	1.941	1.958	1.974	1.990	2.006	2.022	2.038	2.053	2.068	2.084	2.099	2.114	2.128	2.143	2.158	2.172	2.186	2.201	2.215
-75	0.126	1.888	1.905	1.921	1.938	1.954	1.970	1.986	2.001	2.017	2.032	2.048	2.063	2.078	2.093	2.107	2.122	2.137	2.151	2.165	2.179	2.193
-70	0.180	1.870	1.887	1.903	1.920	1.936	1.952	1.967	1.983	1.998	2.014	2.029	2.044	2.059	2.073	2.088	2.103	2.117	2.131	2.145	2.159	2.173
-65	0.250	1.854	1.870	1.887	1.903	1.919	1.935	1.951	1.966	1.982	2.012	2.027	2.041	2.056	2.071	2.085	2.099	2.114	2.128	2.142	2.156	2.170
-60	0.341	1.839	1.856	1.872	1.888	1.904	1.920	1.936	1.951	1.966	1.981	1.996	2.011	2.026	2.040	2.055	2.069	2.083	2.098	2.112	2.126	2.139
-55	0.458	1.826	1.842	1.859	1.875	1.891	1.906	1.922	1.937	1.952	1.967	1.982	1.997	2.012	2.026	2.041	2.055	2.069	2.083	2.097	2.111	2.125
-50	0.606	1.813	1.830	1.846	1.862	1.878	1.894	1.909	1.925	1.940	1.955	1.970	1.984	1.999	2.013	2.028	2.042	2.056	2.070	2.084	2.098	2.111
-45	0.789	1.802	1.819	1.835	1.851	1.867	1.883	1.898	1.913	1.929	1.943	1.958	1.973	1.987	2.002	2.016	2.030	2.044	2.058	2.072	2.086	2.099
-40.01	1.013	1.792	1.809	1.825	1.841	1.857	1.873	1.888	1.903	1.918	1.933	1.948	1.962	1.977	1.991	2.005	2.020	2.034	2.047	2.061	2.075	2.088
-40	1.013	1.792	1.809	1.825	1.841	1.857	1.873	1.888	1.903	1.918	1.933	1.948	1.962	1.977	1.991	2.005	2.020	2.034	2.047	2.061	2.075	2.088
-35	1.286	1.783	1.800	1.816	1.832	1.848	1.863	1.879	1.894	1.909	1.924	1.938	1.953	1.967	1.982	1.996	2.010	2.024	2.038	2.051	2.065	2.079
-30	1.612	1.774	1.791	1.808	1.824	1.839	1.855	1.870	1.886	1.901	1.915	1.930	1.944	1.959	1.973	1.987	2.001	2.015	2.029	2.043	2.056	2.070
-25	2.001	1.766	1.783	1.800	1.816	1.832	1.847	1.863	1.878	1.893	1.908	1.922	1.937	1.951	1.965	1.979	1.993	2.007	2.021	2.035	2.048	2.062
-20	2.458	1.759	1.776	1.793	1.809	1.825	1.840	1.856	1.871	1.886	1.901	1.915	1.930	1.944	1.958	1.972	1.986	2.000	2.014	2.027	2.041	2.054
-15	2.993	1.753	1.770	1.786	1.803	1.819	1.834	1.850	1.865	1.880	1.894	1.909	1.923	1.938	1.952	1.966	1.980	1.994	2.007	2.021	2.034	2.048
-10	3.613	1.746	1.764	1.780	1.797	1.813	1.828	1.844	1.859	1.874	1.889	1.903	1.918	1.932	1.946	1.960	1.974	1.988	2.002	2.015	2.029	2.042
-5	4.327	1.741	1.758	1.775	1.791	1.807	1.823	1.839	1.854	1.869	1.884	1.898	1.913	1.927	1.941	1.955	1.969	1.983	1.996	2.010	2.023	2.037
0	5.144	1.735	1.753	1.770	1.786	1.802	1.818	1.834	1.849	1.864	1.879	1.893	1.908	1.922	1.936	1.950	1.964	1.978	1.992	2.005	2.019	2.032
5	6.074	1.730	1.748	1.765	1.782	1.798	1.814	1.829	1.845	1.860	1.875	1.889	1.904	1.918	1.932	1.946	1.960	1.974	1.987	2.001	2.014	2.028
10	7.126	1.725	1.743	1.760	1.777	1.794	1.810	1.825	1.841	1.856	1.871	1.885	1.900	1.914	1.928	1.942	1.956	1.970	1.984	1.997	2.011	2.024
15	8.311	1.720	1.739	1.756	1.773	1.790	1.806	1.821	1.837	1.852	1.867	1.882	1.896	1.911	1.925	1.939	1.953	1.967	1.980	1.994	2.007	2.020
20	9.640	1.715	1.734	1.752	1.769	1.786	1.802	1.818	1.833	1.849	1.864	1.879	1.893	1.908	1.922	1.936	1.950	1.964	1.977	1.991	2.004	2.017
25	11.123	1.711	1.730	1.748	1.765	1.782	1.798	1.814	1.830	1.846	1.861	1.876	1.890	1.905	1.919	1.933	1.947	1.961	1.974	1.988	2.001	2.015
30	12.774	1.706	1.725	1.744	1.761	1.778	1.795	1.811	1.827	1.843	1.858	1.873	1.887	1.902	1.916	1.930	1.944	1.958	1.972	1.985	1.999	2.012
35	14.604	1.701	1.721	1.739	1.758	1.775	1.792	1.808	1.824	1.840	1.855	1.870	1.885	1.899	1.914	1.928	1.942	1.956	1.970	1.983	1.997	2.010
40	16.628	1.695	1.716	1.735	1.754	1.771	1.789	1.805	1.821	1.837	1.852	1.868	1.883	1.897	1.912	1.926	1.940	1.954	1.968	1.981	1.995	2.008
45	18.861	1.689	1.711	1.731	1.750	1.768	1.785	1.802	1.818	1.834	1.850	1.865	1.880	1.895	1.909	1.924	1.938	1.952	1.966	1.979	1.993	2.006
50	21.319	1.682	1.705	1.726	1.746	1.764	1.782	1.799	1.816	1.832	1.849	1.863	1.878	1.893	1.907	1.922	1.936	1.950	1.964	1.977	1.991	2.004
55	24.022	1.675	1.699	1.721	1.741	1.760	1.778	1.796	1.813	1.829	1.845	1.860	1.876	1.891	1.905	1.920	1.934	1.948	1.962	1.976	1.989	2.003
60	26.991	1.666	1.692	1.715	1.736	1.756	1.775	1.792	1.810	1.826	1.842	1.858	1.873	1.889	1.903	1.918	1.932	1.946	1.960	1.974	1.988	2.001
65	30.257	1.655	1.684	1.709	1.731	1.751	1.770	1.789	1.806	1.823	1.840	1.856	1.871	1.886	1.901	1.916	1.930	1.945	1.959	1.973	1.986	2.000
70	33.857	1.641	1.675	1.701	1.725	1.746	1.766	1.785	1.803	1.820	1.837	1.853	1.869	1.884	1.899	1.914	1.929	1.943	1.957	1.971	1.985	1.998
75	37.857	1.621	1.663	1.693	1.718	1.740	1.761	1.780	1.799	1.816	1.833	1.850	1.866	1.881	1.897	1.912	1.926	1.941	1.955	1.969	1.983	1.996
80	42.420	1.585	1.647	1.681	1.708	1.732	1.754	1.774	1.793	1.811	1.829	1.846	1.862	1.878	1.893	1.908	1.923	1.938	1.952	1.966	1.980	1.994