

R-23

TRIFLUOROMETHANE - CHF₃

Molecular weight (g/mol)	70.01
Melting point (°C)	-155.13
Boiling point (at 1.013 bar)	-82.0
Temperature glide at 1.013 bar (K)	0
Critical temperature (°C)	26.14
Critical pressure (bar absolute)	48.32
Specific heat (liquid) at + 25°C (kJ/kg.K)	18.871
Specific heat (vapour) at 1.013 bar and + 25°C (kJ/kg.K)	0.737
Thermal capacity ratio (Cp/Cv) at + 25°C and 1.013 bar	1.201
Viscosity (liquid) at + 25°C in Centipoise (10 ⁻³ Pa.s)	0.044
Surface tension at + 25°C in dyne per centimetre (10 ⁻³ N/m)	0.04
Classification NF-EN 378	A1
GWP (IPCC 4)	14800

🔍 Main applications

R-23 is a hydrofluorocarbon (HFC) suited for very low temperature systems (-60°C to -100°C) fitted with piston or rotary compressors.

This refrigerant is suited for use in the second stage of a cascade refrigeration system. The first stage of such a system is often R-448A or R-407F which are replacement refrigerants for R-404A and R-507A (temperature conditioning cabinets, freeze-drying systems).

🔍 Commercial specifications

Purity: ≥ 99.5 % weight.

Water content: ≤ 10 ppm weight.

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

Acidity (HCl): ≤ 1 ppm weight.

Chloride ion test: negative

High boiling residue: ≤ 0.01 % volume.

🔍 Oils

Use a polyol ester (POE) oil.

Check with **Climalife** regarding the viscosity of the oil selected for your application, and the miscibility with the fluid under consideration.

🔍 Regulation

The use and implementation of R-23 are governed by EU Regulation n° 517/2014.

The recovery of R-23 is mandatory under EU Regulation n°517/2014.

(Refer to the regulations in each country).

Thermodynamic properties of R-23 - Saturated state

Absolute pressure P (bar)	LIQUID					VAPOUR					Latent heat Lv (kJ/kg)
	Bubble point t' (°C)	Volume v' (dm ³ /kg)	Density ρ' (kg/dm ³)	Enthalpy h' (kJ/kg)	Entropy s' (kJ/kg.K)	Dew point t'' (°C)	Volume v'' (m ³ /kg)	Density ρ'' (kg/m ³)	Enthalpy h'' (kJ/kg)	Entropy s'' (kJ/kg.K)	
0.006	-140	0.605	1.652	14.530	0.075	-140.0	26.330	0.038	296.646	2.193	282.115
0.011	-135	0.612	1.635	20.505	0.119	-135.0	14.346	0.070	299.106	2.135	278.601
0.021	-130	0.618	1.618	26.480	0.161	-130.0	8.219	0.122	301.564	2.083	275.084
0.036	-125	0.625	1.601	32.461	0.202	-125.0	4.924	0.203	304.014	2.035	271.553
0.059	-120	0.632	1.583	38.450	0.242	-120.0	3.070	0.326	306.453	1.992	268.003
0.094	-115	0.639	1.566	44.452	0.281	-115.0	1.983	0.504	308.875	1.952	264.423
0.145	-110	0.646	1.548	50.468	0.318	-110.0	1.322	0.757	311.274	1.917	260.806
0.217	-105	0.653	1.530	56.503	0.354	-105.0	0.907	1.103	313.645	1.884	257.142
0.316	-100	0.661	1.512	62.561	0.390	-100.0	0.638	1.567	315.979	1.853	253.419
0.449	-95	0.669	1.494	68.644	0.424	-95.0	0.459	2.177	318.271	1.826	249.627
0.624	-90	0.678	1.476	74.759	0.458	-90.0	0.338	2.962	320.512	1.800	245.752
0.850	-85	0.686	1.457	80.911	0.491	-85.0	0.253	3.955	322.693	1.776	241.782
1.103	-82.02	0.692	1.446	84.594	0.511	-82.02	0.215	4.662	323.961	1.763	239.366
1.137	-80	0.695	1.438	87.104	0.524	-80.0	0.192	5.195	324.807	1.754	237.702
1.495	-75	0.705	1.419	93.345	0.555	-75.0	0.149	6.723	326.844	1.734	233.498
1.937	-70	0.715	1.399	99.641	0.587	-70.0	0.117	8.582	328.794	1.715	229.153
2.474	-65	0.725	1.379	105.999	0.617	-65.0	0.092	10.824	330.649	1.697	224.650
3.119	-60	0.736	1.358	112.426	0.648	-60.0	0.074	13.503	332.396	1.680	219.969
3.886	-55	0.748	1.337	118.932	0.678	-55.0	0.060	16.682	334.023	1.664	215.091
4.789	-50	0.760	1.315	125.526	0.707	-50.0	0.049	20.430	335.517	1.648	209.991
5.844	-45	0.773	1.293	132.219	0.736	-45.0	0.040	24.830	336.863	1.633	204.644
7.065	-40	0.788	1.270	139.024	0.766	-40.0	0.033	29.972	338.043	1.619	199.019
8.470	-35	0.803	1.246	145.954	0.794	-35.0	0.028	35.969	339.036	1.605	193.082
10.074	-30	0.819	1.221	153.026	0.823	-30.0	0.023	42.950	339.817	1.592	186.790
11.896	-25	0.837	1.194	160.261	0.852	-25.0	0.020	51.079	340.356	1.578	180.095
13.953	-20	0.857	1.167	167.682	0.881	-20.0	0.017	60.556	340.616	1.564	172.933
16.265	-15	0.879	1.137	175.320	0.910	-15.0	0.014	71.639	340.548	1.550	165.228
18.853	-10	0.904	1.106	183.214	0.940	-10.0	0.012	84.672	340.092	1.536	156.878
21.739	-5	0.933	1.072	191.416	0.969	-5.0	0.010	100.124	339.163	1.520	147.747
24.947	0	0.966	1.035	200.000	1.000	-0.0	0.008	118.669	337.643	1.504	137.643
28.503	5	1.006	0.994	209.079	1.032	5.0	0.007	141.340	335.356	1.486	126.276
32.438	10	1.056	0.947	218.840	1.065	10.0	0.006	169.865	332.010	1.465	113.170
36.791	15	1.123	0.890	229.637	1.101	15.0	0.005	207.577	327.059	1.439	97.421
41.610	20	1.225	0.816	242.364	1.143	20.0	0.004	262.790	319.169	1.405	76.805
46.986	25	1.470	0.680	261.942	1.207	25.0	0.003	379.913	301.549	1.340	39.607

Thermodynamic properties of R-23 - (superheated vapour) - Volume (dm³/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
-140	0.006	26330.359	27331.084	28329.033	29325.078	30319.794	31313.562	32306.644	33299.220	34291.491	35283.327	36275.016	37266.530	38257.908	39249.175	40240.354	41231.460	42222.505	43213.500	44204.453	45195.369	46186.255
-135	0.011	14346.267	14874.332	15400.468	15925.259	16449.094	16972.237	17494.872	18017.126	18539.091	19060.833	19582.402	20103.833	20625.154	21146.385	21667.544	22188.642	22709.690	23230.695	23751.664	24272.602	24793.513
-130	0.021	8219.365	8513.125	8805.514	9096.932	9387.650	9677.854	9967.674	10257.202	10546.507	10835.636	11124.628	11413.508	11702.300	11991.018	12279.675	12568.282	12856.846	13145.374	13433.872	13722.342	14010.790
-125	0.036	4924.030	5095.360	5265.695	5435.314	5604.410	5773.117	5941.528	6109.714	6277.723	6445.572	6613.315	6781.019	6948.614	7116.148	7283.631	7451.072	7618.476	7785.850	7953.196	8120.520	8287.823
-120	0.059	3069.511	3173.776	3277.303	3380.292	3482.883	3585.173	3687.233	3789.115	3890.855	3992.483	4094.021	4195.484	4296.886	4398.237	4499.545	4600.816	4702.057	4803.271	4904.461	5005.632	5106.784
-115	0.094	1982.587	2048.522	2113.897	2178.860	2243.514	2307.932	2372.168	2436.261	2500.239	2564.126	2627.937	2691.687	2755.385	2819.040	2882.659	2946.246	3009.806	3073.343	3136.859	3200.358	3263.841
-110	0.145	1321.852	1365.023	1407.761	1450.178	1492.350	1534.334	1576.172	1617.892	1659.519	1701.070	1742.558	1783.994	1825.387	1866.742	1908.066	1949.363	1990.637	2031.890	2073.125	2114.344	2155.549
-105	0.217	906.745	935.920	964.753	993.330	1021.711	1049.940	1078.048	1106.061	1133.995	1161.866	1189.683	1217.456	1245.192	1272.896	1300.573	1328.226	1355.858	1383.472	1411.070	1438.655	1466.226
-100	0.316	638.070	658.363	678.382	698.193	717.844	737.370	756.797	776.142	795.423	814.649	833.830	852.972	872.083	891.165	910.224	929.262	948.281	967.285	986.274	1005.251	1024.216
-95	0.449	459.413	473.905	488.174	502.272	516.237	530.098	543.875	557.584	571.236	584.843	598.410	611.945	625.451	638.933	652.393	665.835	679.261	692.673	706.071	719.459	732.836
-90	0.624	337.662	348.267	358.685	368.960	379.124	389.200	399.204	409.150	419.047	428.905	438.728	448.522	458.292	468.040	477.769	487.482	497.180	506.865	516.539	526.202	535.856
-85	0.850	252.819	260.753	268.530	276.187	283.748	291.233	298.657	306.031	313.362	320.658	327.925	335.165	342.384	349.583	356.766	363.934	371.088	378.231	385.364	392.487	399.602
-82.02	1.013	214.511	221.253	227.852	234.341	240.743	247.075	253.350	259.579	265.769	271.926	278.056	284.162	290.247	296.314	302.365	308.402	314.427	320.441	326.445	332.440	338.427
-80	1.137	192.476	198.536	204.462	210.284	216.024	221.698	227.318	232.895	238.434	243.942	249.424	254.883	260.322	265.744	271.150	276.544	281.925	287.296	292.657	298.009	303.354
-75	1.495	148.751	153.470	158.072	162.583	167.022	171.403	175.738	180.033	184.295	188.530	192.741	196.932	201.104	205.261	209.405	213.536	217.655	221.767	225.869	229.962	234.049
-70	1.937	116.522	120.262	123.899	127.456	130.949	134.391	137.791	141.157	144.492	147.803	151.093	154.364	157.619	160.859	164.087	167.304	170.511	173.709	176.899	180.082	183.258
-65	2.474	92.390	95.404	98.326	101.177	103.970	106.718	109.428	112.107	114.759	117.388	119.998	122.591	125.169	127.734	130.288	132.832	135.366	137.892	140.410	142.922	145.427
-60	3.119	74.059	76.526	78.910	81.229	83.497	85.724	87.916	90.079	92.218	94.337	96.438	98.523	100.595	102.654	104.703	106.743	108.774	110.797	112.814	114.824	116.828
-55	3.886	59.946	61.996	63.969	65.883	67.751	69.580	71.378	73.150	74.899	76.629	78.343	80.042	81.729	83.405	85.071	86.728	88.377	90.019	91.654	93.284	94.908
-50	4.789	48.947	50.673	52.339	53.931	55.489	57.012	58.505	59.975	61.423	62.854	64.270	65.673	67.063	68.444	69.815	71.177	72.533	73.881	75.224	76.560	77.892
-45	5.844	40.275	41.749	43.157	44.514	45.831	47.114	48.370	49.603	50.817	52.015	53.198	54.369	55.529	56.679	57.820	58.954	60.080	61.201	62.315	63.424	64.528
-40	7.065	33.364	34.640	35.852	37.016	38.141	39.236	40.304	41.351	42.380	43.394	44.394	45.382	46.359	47.328	48.288	49.241	50.188	51.128	52.063	52.992	53.918
-35	8.470	27.802	28.920	29.977	30.986	31.959	32.903	33.822	34.720	35.601	36.468	37.322	38.164	38.997	39.821	40.637	41.446	42.249	43.046	43.838	44.625	45.407
-30	10.074	23.283	24.275	25.207	26.093	26.944	27.765	28.564	29.343	30.105	30.853	31.589	32.314	33.030	33.737	34.438	35.131	35.818	36.500	37.177	37.849	38.517
-25	11.896	19.578	20.470	21.301	22.088	22.839	23.562	24.262	24.944	25.610	26.262	26.902	27.532	28.153	28.765	29.371	29.971	30.564	31.152	31.736	32.315	32.890
-20	13.953	16.514	17.327	18.077	18.783	19.453	20.095	20.716	21.318	21.904	22.477	23.039	23.590	24.134	24.669	25.197	25.720	26.236	26.748	27.255	27.758	28.257
-15	16.265	13.959	14.710	15.396	16.035	16.639	17.215	17.770	18.306	18.826	19.334	19.831	20.318	20.797	21.268	21.733	22.191	22.644	23.093	23.536	23.976	24.412
-10	18.853	11.810	12.515	13.150	13.735	14.284	14.806	15.305	15.787	16.253	16.706	17.149	17.582	18.007	18.425	18.836	19.242	19.642	20.038	20.429	20.816	21.200
-5	21.739	9.988	10.660	11.255	11.797	12.301	12.777	13.231	13.666	14.087	14.495	14.892	15.280	15.660	16.033	16.399	16.760	17.116	17.467	17.814	18.157	18.497
0	24.947	8.427	9.082	9.646	10.153	10.621	11.059	11.474	11.871	12.253	12.622	12.981	13.331	13.672	14.007	14.336	14.659	14.977	15.291	15.600	15.906	16.208
5	28.503	7.075	7.729	8.272	8.752	9.189	9.595	9.978	10.342	10.691	11.027	11.353	11.670	11.979	12.282	12.578	12.869	13.155	13.436	13.714	13.988	14.259
10	32.438	5.887	6.560	7.092	7.551	7.963	8.342	8.697	9.030	9.342	9.622	9.959	10.248	10.524	10.804	11.072	11.335	11.593	11.847	12.098	12.344	12.588
15	36.791	4.817	5.544	6.073	6.516	6.907	7.263	7.594	7.906	8.202	8.486	8.759	9.023	9.280	9.530	9.774	10.013	10.247	10.477	10.704	10.927	11.147
20	41.610	3.805	4.652	5.188	5.619	5.993	6.329	6.639	6.930	7.204	7.466	7.717	7.960	8.195	8.424	8.647	8.865	9.078	9.287	9.493	9.695	9.895
25	46.986	2.632	3.862	4.412	4.835	5.193	5.512	5.803	6.074	6.329	6.572	6.804	7.027	7.243	7.453	7.657	7.856	8.051	8.244	8.429	8.613	8.794

Thermodynamic properties of R-23 - (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
-140	0.006	296.646	299.256	301.876	304.511	307.167	309.846	312.550	315.282	318.042	320.832	323.653	326.505	329.389	332.306	335.257	338.241	341.259	344.311	347.398	350.520	353.677
-135	0.011	299.106	301.761	304.421	307.095	309.788	312.502	315.241	318.008	320.803	323.627	326.482	329.369	332.289	335.241	338.226	341.245	344.299	347.387	350.510	353.668	356.861
-130	0.021	301.564	304.267	306.973	309.688	312.420	315.173	317.950	320.753	323.584	326.444	329.336	332.258	335.213	338.201	341.223	344.278	347.366	350.492	353.651	356.845	360.075
-125	0.036	304.014	306.771	309.525	312.286	315.061	317.855	320.671	323.513	326.382	329.281	332.209	335.169	338.161	341.186	344.244	347.336	350.463	353.624	356.820	360.052	363.318
-120	0.059	306.453	309.269	312.075	314.885	317.706	320.544	323.402	326.285	329.194	332.132	335.100	338.098	341.128	344.191	347.288	350.418	353.582	356.781	360.014	363.284	366.588
-115	0.094	308.875	311.754	314.618	317.480	320.350	323.235	326.138	329.064	332.016	334.995	338.003	341.042	344.112	347.214	350.349	353.518	356.721	359.959	363.231	366.539	369.881
-110	0.145	311.274	314.221	317.146	320.065	322.988	325.923	328.874	331.846	334.842	337.864	340.915	343.996	347.107	350.250	353.426	356.635	359.877	363.155	366.466	369.813	373.195
-105	0.217	313.645	316.664	319.655	322.635	325.614	328.602	331.604	334.624	337.667	340.735	343.831	346.955	350.109	353.294	356.512	359.762	363.046	366.364	369.716	373.103	376.525
-100	0.316	315.979	319.077	322.138	325.183	328.222	331.266	334.322	337.394	340.486	343.602	346.744	349.914	353.113	356.343	359.604	362.897	366.223	369.583	372.977	376.405	379.868
-95	0.449	318.271	321.451	324.588	327.701	330.805	333.909	337.022	340.148	343.293	346.459	349.651	352.868	356.114	359.389	362.695	366.033	369.403	372.806	376.243	379.714	383.219
-90	0.624	320.512	323.781	326.998	330.185	333.356	336.524	339.697	342.881	346.081	349.301	352.543	355.811	359.106	362.429	365.782	369.166	372.581	376.029	379.510	383.024	386.572
-85	0.850	322.693	326.057	329.360	332.625	335.869	339.104	342.341	345.586	348.844	352.120	355.416	358.736	362.082	365.455	368.857	372.289	375.752	379.246	382.773	386.332	389.925
-82.02	1.013	323.961	327.384	330.740	334.054	337.344	340.622	343.898	347.181	350.475	353.785	357.116	360.468	363.846	367.250	370.682	374.143	377.634	381.155	384.712	388.299	391.918
-80	1.137	324.807	328.272	331.666	335.014	338.335	341.643	344.947	348.256	351.576	354.910	358.264	361.639	365.038	368.463	371.916	375.398	378.910	382.452	386.026	389.632	393.270
-75	1.495	326.844	330.417	333.908	337.345	340.748	344.132	347.508	350.885	354.269	357.666	361.079	364.512	367.967	371.447	374.953	378.487	382.049	385.641	389.264	392.918	396.604
-70	1.937	328.794	332.484	336.079	339.610	343.100	346.565	350.017	353.465	356.918	360.386	363.856	367.349	370.863	374.400	377.962	381.549	385.165	388.809	392.482	396.186	399.921
-65	2.474	330.649	334.463	338.169	341.801	345.383	348.933	352.466	355.990	359.515	363.046	366.588	370.145	373.720	377.317	380.936	384.580	388.251	391.949	395.675	399.431	403.216
-60	3.119	332.396	336.344	340.169	343.908	347.589	351.230	354.848	358.453	362.054	365.657	369.269	372.893	376.532	380.191	383.871	387.574	391.302	395.056	398.837	402.646	406.484
-55	3.886	334.023	338.116	342.069	345.923	349.709	353.448	357.156	360.846	364.527	368.207	371.892	375.586	379.293	383.018	386.761	390.525	394.313	398.125	401.963	405.828	409.721
-50	4.789	335.527	339.768	343.859	347.837	351.736	355.578	359.382	363.162	366.928	370.689	374.451	378.219	381.997	385.790	389.600	393.428	397.278	401.151	405.048	408.971	412.920
-45	5.844	336.863	341.286	345.527	349.639	353.658	357.611	361.518	365.394	369.250	373.096	376.939	380.785	384.638	388.503	392.382	396.277	400.193	404.129	408.088	412.070	416.078
-40	7.065	338.043	342.656	347.062	351.318	355.467	359.539	363.555	367.533	371.485	375.422	379.351	383.278	387.210	391.150	395.101	399.068	403.051	407.051	411.076	415.121	419.189
-35	8.470	339.036	343.862	348.448	352.862	357.152	361.351	365.485	369.572	373.626	377.658	381.678	385.692	389.707	393.726	397.754	401.793	405.848	409.919	414.009	418.119	422.251
-30	10.074	339.817	344.882	349.669	354.257	358.701	363.038	367.298	371.502	375.664	379.799	383.915	388.020	392.122	396.225	400.333	404.449	408.578	412.721	416.881	421.059	425.257
-25	11.896	340.356	345.696	350.708	355.489	360.100	364.589	368.985	373.314	377.593	381.836	386.054	390.257	394.450	398.641	402.833	407.031	411.238	415.456	419.689	423.937	428.203
-20	13.953	340.616	346.276	351.545	356.540	361.337	365.990	370.535	374.998	379.420	383.761	388.089	392.394	396.685	400.968	405.249	409.532	413.821	418.118	422.427	426.749	431.087
-15	16.265	340.548	346.589	352.153	357.391	362.396	367.230	371.936	376.546	381.084	385.568	390.011	394.426	398.820	403.202	407.576	411.949	416.323	420.703	425.092	429.491	433.903
-10	18.853	340.092	346.596	352.502	358.022	363.259	368.293	373.176	377.946	382.629	387.247	391.815	396.346	400.850	405.335	409.808	414.275	418.740	423.206	427.672	432.158	436.648
-5	21.739	339.163	346.247	352.572	358.408	363.908	369.165	374.244	379.187	384.028	388.790	393.491	398.146	402.762	407.362	411.940	416.506	421.066	425.623	430.179	434.925	439.671
0	24.947	337.643	345.481	352.309	358.521	364.321	369.830	375.124	380.258	385.270	390.187	395.032	399.820	404.565	409.277	413.965	418.636	423.296	427.949	432.600	437.251	441.907
5	28.503	335.556	344.219	351.672	358.331	364.476	370.268	375.803	381.147	386.345	391.431	396.430	401.360	406.237	411.074	415.879	420.660	425.425	430.179	434.925	439.669	444.413
10	32.438	332.010	342.356	350.701	357.801	364.348	370.461	376.264	381.839	387.241	392.510	397.674	402.757	407.776	412.744	417.673	422.572	427.447	432.306	437.153	441.994	446.831
15	36.791	327.059	339.754	349.048	356.892	363.907	370.385	376.488	382.319	387.943	393.410	398.754	404.000	409.170	414.279	419.339	424.361	429.354	434.324	439.277	444.218	449.152
20	41.610	319.169	336.224	346.912	355.551	363.114	370.009	376.448	382.561	388.430	394.112	399.649	405.072	410.403	415.661	420.861	426.015	431.131	436.218	441.283	446.330	451.366
25	46.986	301.549	331.470	344.056	353.676	361.886	369.260	376.080	382.508	388.647	394.566	400.314	405.928	411.434	416.853	422.203	427.497	432.745	437.956	443.139	448.299	453.442

Thermodynamic properties of R-23 - (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
-140	0.006	2.193	2.213	2.231	2.249	2.267	2.284	2.301	2.318	2.334	2.350	2.365	2.381	2.396	2.411	2.425	2.440	2.454	2.468	2.482	2.496	2.510
-135	0.011	2.135	2.154	2.172	2.190	2.208	2.224	2.241	2.257	2.273	2.289	2.304	2.319	2.334	2.349	2.363	2.378	2.392	2.406	2.420	2.433	2.447
-130	0.021	2.083	2.101	2.119	2.137	2.154	2.170	2.187	2.203	2.219	2.234	2.249	2.264	2.279	2.293	2.307	2.322	2.336	2.349	2.363	2.377	2.390
-125	0.036	2.035	2.053	2.071	2.088	2.105	2.121	2.138	2.153	2.169	2.184	2.199	2.214	2.228	2.243	2.257	2.271	2.285	2.298	2.312	2.325	2.339
-120	0.059	1.992	2.010	2.027	2.044	2.061	2.077	2.093	2.108	2.124	2.139	2.154	2.168	2.183	2.197	2.211	2.225	2.238	2.252	2.265	2.279	2.292
-115	0.094	1.952	1.970	1.988	2.004	2.021	2.037	2.052	2.068	2.083	2.098	2.112	2.127	2.141	2.155	2.169	2.183	2.196	2.210	2.223	2.236	2.249
-110	0.145	1.917	1.934	1.951	1.968	1.984	2.000	2.016	2.031	2.046	2.060	2.075	2.089	2.103	2.117	2.131	2.145	2.158	2.171	2.185	2.198	2.211
-105	0.217	1.884	1.901	1.918	1.935	1.951	1.967	1.982	1.997	2.012	2.026	2.041	2.055	2.069	2.083	2.096	2.110	2.123	2.136	2.149	2.162	2.175
-100	0.316	1.853	1.871	1.888	1.904	1.920	1.936	1.951	1.966	1.981	1.995	2.009	2.023	2.037	2.051	2.065	2.078	2.091	2.104	2.117	2.130	2.143
-95	0.449	1.826	1.843	1.860	1.876	1.892	1.908	1.923	1.938	1.952	1.967	1.981	1.995	2.009	2.022	2.036	2.049	2.062	2.075	2.088	2.101	2.114
-90	0.624	1.800	1.818	1.834	1.851	1.867	1.882	1.897	1.912	1.926	1.941	1.955	1.969	1.982	1.996	2.009	2.022	2.035	2.048	2.061	2.074	2.087
-85	0.850	1.776	1.794	1.811	1.827	1.843	1.858	1.873	1.888	1.902	1.917	1.931	1.944	1.958	1.971	1.985	1.998	2.011	2.024	2.037	2.049	2.062
-82.02	1.013	1.763	1.781	1.798	1.814	1.830	1.845	1.860	1.875	1.889	1.903	1.917	1.931	1.945	1.958	1.971	1.984	1.997	2.010	2.023	2.036	2.048
-80	1.137	1.754	1.772	1.789	1.805	1.821	1.836	1.851	1.866	1.880	1.894	1.908	1.922	1.936	1.949	1.962	1.975	1.988	2.001	2.014	2.027	2.039
-75	1.495	1.734	1.752	1.769	1.785	1.801	1.816	1.831	1.846	1.860	1.874	1.888	1.902	1.915	1.929	1.942	1.955	1.968	1.981	1.993	2.006	2.018
-70	1.937	1.715	1.733	1.750	1.766	1.782	1.797	1.812	1.827	1.841	1.855	1.869	1.883	1.896	1.910	1.923	1.936	1.949	1.961	1.974	1.987	1.999
-65	2.474	1.697	1.715	1.732	1.748	1.764	1.780	1.795	1.809	1.824	1.838	1.852	1.865	1.879	1.892	1.905	1.918	1.931	1.944	1.956	1.969	1.981
-60	3.119	1.680	1.698	1.715	1.732	1.748	1.763	1.778	1.793	1.807	1.821	1.835	1.849	1.862	1.876	1.889	1.902	1.915	1.927	1.940	1.952	1.965
-55	3.886	1.664	1.682	1.700	1.716	1.732	1.748	1.763	1.778	1.792	1.806	1.820	1.834	1.847	1.860	1.874	1.887	1.899	1.912	1.925	1.937	1.949
-50	4.789	1.648	1.667	1.685	1.702	1.718	1.733	1.749	1.763	1.778	1.792	1.806	1.820	1.834	1.846	1.859	1.872	1.885	1.898	1.910	1.923	1.935
-45	5.844	1.633	1.653	1.671	1.688	1.704	1.720	1.735	1.750	1.764	1.779	1.793	1.806	1.820	1.833	1.846	1.859	1.872	1.885	1.897	1.910	1.922
-40	7.065	1.619	1.639	1.657	1.674	1.691	1.707	1.722	1.737	1.752	1.766	1.780	1.794	1.807	1.821	1.834	1.847	1.860	1.872	1.885	1.897	1.910
-35	8.470	1.605	1.625	1.644	1.662	1.678	1.694	1.710	1.725	1.740	1.754	1.768	1.782	1.796	1.809	1.822	1.835	1.848	1.861	1.873	1.886	1.898
-30	10.074	1.592	1.612	1.631	1.649	1.666	1.683	1.698	1.714	1.728	1.743	1.757	1.771	1.785	1.798	1.811	1.824	1.837	1.850	1.862	1.875	1.887
-25	11.896	1.578	1.598	1.619	1.637	1.655	1.671	1.687	1.702	1.717	1.732	1.746	1.760	1.774	1.787	1.801	1.814	1.827	1.840	1.852	1.865	1.877
-20	13.953	1.564	1.586	1.607	1.625	1.643	1.660	1.676	1.692	1.707	1.722	1.736	1.750	1.764	1.778	1.791	1.804	1.817	1.830	1.842	1.855	1.867
-15	16.265	1.550	1.573	1.594	1.614	1.632	1.649	1.666	1.681	1.697	1.712	1.726	1.740	1.754	1.768	1.781	1.795	1.808	1.821	1.833	1.846	1.858
-10	18.853	1.536	1.560	1.582	1.602	1.621	1.638	1.655	1.671	1.687	1.702	1.717	1.731	1.745	1.759	1.772	1.786	1.799	1.812	1.824	1.837	1.849
-5	21.739	1.520	1.547	1.570	1.590	1.610	1.628	1.645	1.661	1.677	1.692	1.707	1.722	1.736	1.750	1.764	1.777	1.790	1.803	1.816	1.829	1.841
0	24.947	1.504	1.532	1.557	1.578	1.598	1.617	1.635	1.651	1.668	1.683	1.698	1.713	1.727	1.741	1.755	1.769	1.782	1.795	1.808	1.821	1.833
5	28.503	1.486	1.517	1.543	1.566	1.587	1.606	1.624	1.642	1.658	1.674	1.689	1.704	1.719	1.733	1.747	1.760	1.774	1.787	1.800	1.813	1.825
10	32.438	1.465	1.501	1.529	1.554	1.575	1.595	1.614	1.632	1.649	1.665	1.680	1.696	1.710	1.725	1.739	1.753	1.767	1.779	1.792	1.805	1.818
15	36.791	1.439	1.483	1.514	1.540	1.563	1.584	1.604	1.622	1.639	1.656	1.672	1.687	1.702	1.716	1.731	1.745	1.758	1.772	1.785	1.798	1.811
20	41.610	1.405	1.463	1.498	1.527	1.551	1.573	1.593	1.612	1.629	1.646	1.663	1.678	1.693	1.708	1.723	1.737	1.751	1.764	1.777	1.790	1.803
25	46.986	1.340	1.439	1.481	1.511	1.538	1.561	1.581	1.601	1.619	1.637	1.653	1.669	1.685	1.700	1.714	1.729	1.743	1.756	1.770	1.783	1.796