

Fluorocarbon C3F8 Properties

(octafluoropropane R218)

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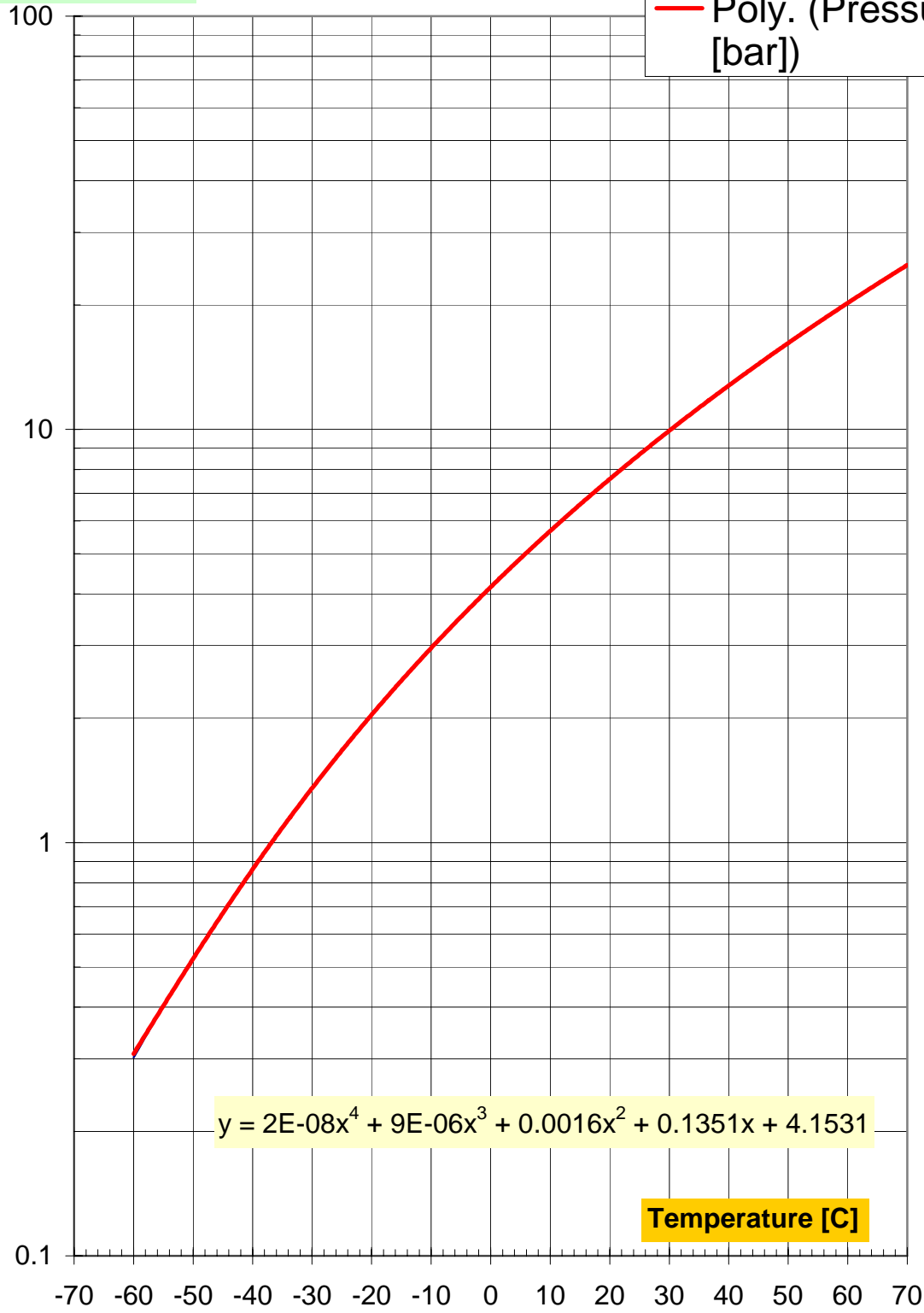
1. C3F8Some selected thermophysical properties of the C₃F₈

Fluorocarbon	PF5030
Chem.formula	C3F8
Mean Mol.Wt.	188
Boiling point @1 atm [°C]	-37
Dens.[g/cm ³]	1.35 @20°C
Liquid Dynamic Viscosity [10 ⁻³ Pa.s]	0.3 @0°C
Liquid Kinematic Viscosity [10 ⁻⁶ m ² /s]	0.2 @ 20°C
Surface Tens.[dy/cm]	4.3 @0°C
Vapor press. @ -10°C [Torr]	2200
[bara]	2.933
Latent Heat Vap. [J/mole]	15717
[kJ/kg]	84
Specific Heat [kJ/kg.K]	1.05
Thermal conductivity [W/m.K]	
Liquid Vol. Flow (90 W load) [cm ³ /s]	~0.8
Gas Vol. Flow (90 W load) [cm ³ /s]	~50
Liquid-Gas Expansion Fact @ -10°C	~60
DeltaP max for DeltaT=0.5°C [mbar]	~50

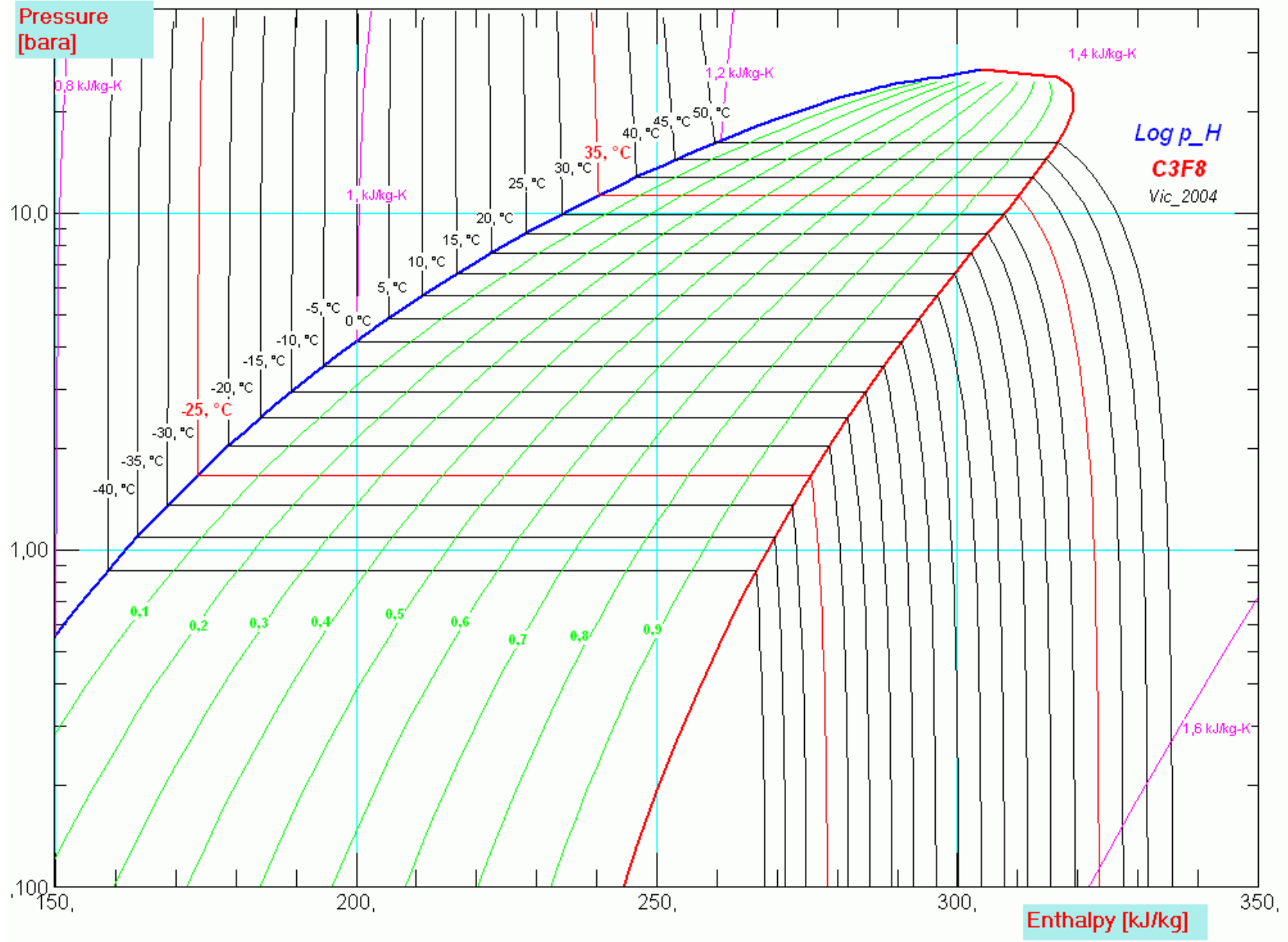
1.1 Saturation line curve for C₃F₈

P - T Diagram for C₃F₈

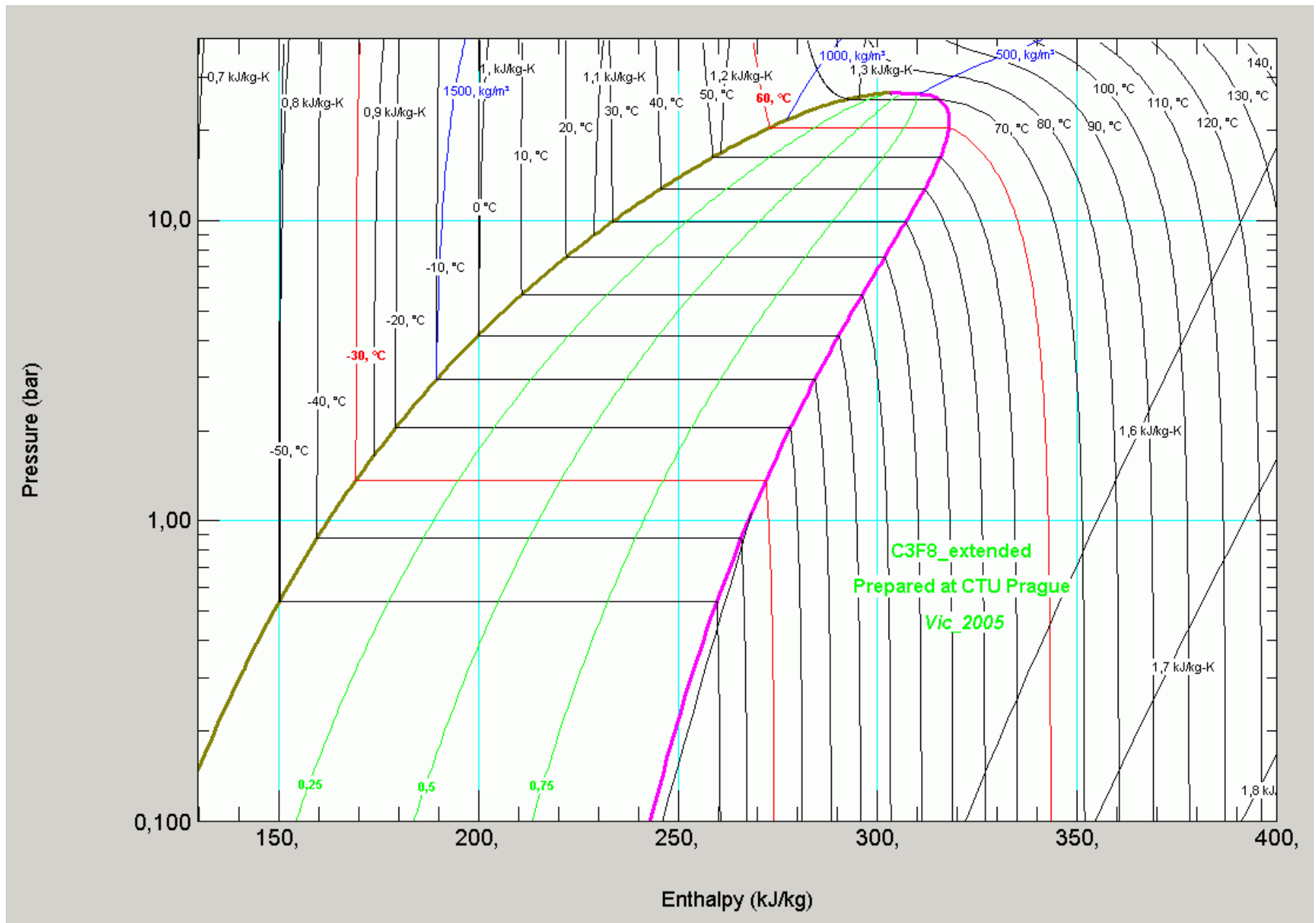
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1.2 logP-H diagram for C₃F₈



1.3 Extended logP-H diagram for C₃F₈



1.4 Table of Saturation properties for C3F8

C3F8 Saturation Properties between -40 and + 45 C

By Vic Vacek, March 1999

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Temp	Pres	Dens (L)	Dens (V)	Enth (L)	Enth (V)	Entr (L)	Entr (V)	Cp (L)	Cp (V)	SoS (L)	SoS (V)	Visc (L)	Visc (V)	Th C (L)	Th C (V)
[C]	[bar]	[kg/m ³]	[kg/m ³]	[kJ/kg]	[kJ/kg]	[kJ/K-kg]	[kJ/K-kg]	[kJ/K-kg]	[kJ/K-kg]	[m/s]	[m/s]	[μPa-s]	[μPa-s]	[W/m-K]	[W/m-K]
-40.0	0.865	1624.0	8.786	158.6	266.5	0.837	1.300	0.985	0.695	555.9	101.1	333.2	9.662	0.056	0.009
-38.0	0.950	1616.0	9.595	160.6	267.7	0.846	1.301	0.990	0.701	547.5	101.2	323.3	9.745	0.056	0.009
-36.0	1.041	1608.0	10.460	162.6	268.9	0.854	1.302	0.994	0.706	539.1	101.3	313.8	9.827	0.055	0.009
-36.0	1.041	1608.0	10.460	162.60	268.90	0.854	1.302	0.994	0.706	539.10	101.30	313.80	9.83	0.055	0.009
-34.0	1.139	1601.0	11.390	164.60	270.10	0.863	1.304	0.998	0.712	530.70	101.40	304.70	9.91	0.055	0.009
-32.0	1.244	1593.0	12.380	166.60	271.40	0.871	1.305	1.003	0.717	522.30	101.50	295.90	9.99	0.054	0.009
-30.0	1.356	1585.0	13.430	168.60	272.60	0.879	1.307	1.007	0.723	514.00	101.50	287.40	10.08	0.054	0.010
-28.0	1.475	1577.0	14.560	170.60	273.80	0.887	1.308	1.012	0.729	505.60	101.60	279.20	10.16	0.053	0.010
-26.0	1.603	1569.0	15.750	172.70	275.00	0.896	1.310	1.016	0.735	497.30	101.60	271.30	10.24	0.053	0.010
-24.0	1.739	1561.0	17.020	174.70	276.20	0.904	1.311	1.021	0.741	489.00	101.60	263.70	10.32	0.053	0.010
-22.0	1.884	1553.0	18.370	176.80	277.50	0.912	1.313	1.026	0.746	480.70	101.60	256.30	10.41	0.052	0.010
-20.0	2.037	1544.0	19.810	178.80	278.70	0.920	1.314	1.031	0.752	472.40	101.50	249.20	10.49	0.052	0.010
-18.0	2.200	1536.0	21.330	180.90	279.90	0.928	1.316	1.036	0.759	464.10	101.50	242.30	10.57	0.051	0.010
-16.0	2.373	1528.0	22.940	183.00	281.10	0.936	1.318	1.041	0.765	455.90	101.40	235.60	10.66	0.051	0.010
-14.0	2.556	1519.0	24.640	185.10	282.30	0.944	1.320	1.046	0.771	447.60	101.30	229.10	10.74	0.050	0.011
-12.0	2.749	1510.0	26.450	187.20	283.50	0.952	1.321	1.051	0.778	439.30	101.10	222.80	10.82	0.050	0.011
-10.0	2.953	1502.0	28.360	189.30	284.80	0.960	1.323	1.057	0.784	431.10	101.00	216.70	10.91	0.049	0.011
-8.0	3.169	1493.0	30.370	191.40	286.00	0.968	1.325	1.062	0.791	422.80	100.80	210.80	10.99	0.049	0.011
-6.0	3.396	1484.0	32.500	193.50	287.20	0.976	1.327	1.068	0.798	414.60	100.60	205.00	11.08	0.048	0.011
-4.0	3.635	1475.0	34.750	195.70	288.40	0.984	1.329	1.074	0.805	406.30	100.30	199.40	11.16	0.048	0.011
-2.0	3.886	1466.0	37.120	197.80	289.60	0.992	1.330	1.080	0.812	398.10	100.10	193.90	11.25	0.047	0.012
0.0	4.150	1456.0	39.630	200.00	290.80	1.000	1.332	1.087	0.819	389.90	99.79	188.60	11.34	0.047	0.012
2.0	4.428	1447.0	42.270	202.20	291.90	1.008	1.334	1.093	0.827	381.60	99.47	183.40	11.43	0.046	0.012
4.0	4.719	1437.0	45.050	204.40	293.10	1.016	1.336	1.100	0.834	373.40	99.11	178.30	11.52	0.046	0.012
6.0	5.024	1427.0	47.980	206.60	294.30	1.024	1.338	1.107	0.842	365.10	98.73	173.40	11.61	0.046	0.012
8.0	5.343	1417.0	51.070	208.80	295.50	1.031	1.340	1.114	0.850	356.90	98.32	168.60	11.70	0.045	0.012
10.0	5.677	1407.0	54.330	211.00	296.60	1.039	1.342	1.121	0.859	348.70	97.87	163.80	11.79	0.045	0.012
12.0	6.026	1397.0	57.760	213.30	297.80	1.047	1.343	1.129	0.868	340.40	97.40	159.20	11.88	0.044	0.013

Table of Saturation properties for C3F8 [continues]

C3F8 Saturation Properties between -40 and + 45 C

By Vic Vacek, March 1999

Temp	Pres	Dens (L)	Dens (V)	Enth (L)	Enth (V)	Entr (L)	Entr (V)	Cp (L)	Cp (V)	SoS (L)	SoS (V)	Visc (L)	Visc (V)	Th C (L)
[C]	[bar]	[kg/m ³]	[kg/m ³]	[kJ/kg]	[kJ/kg]	[kJ/K-kg]	[kJ/K-kg]	[kJ/K-kg]	[kJ/K-kg]	[m/s]	[m/s]	[μPa-s]	[μPa-s]	[W/m-K]
14.0	6.391	1386.0	61.380	215.50	298.90	1.055	1.345	1.137	0.877	332.10	96.88	154.70	11.98	0.044
16.0	6.772	1376.0	65.190	217.80	300.10	1.063	1.347	1.145	0.886	323.90	96.33	150.30	12.08	0.043
18.0	7.170	1365.0	69.210	220.10	301.20	1.071	1.349	1.154	0.896	315.60	95.74	145.90	12.18	0.043
20.0	7.585	1354.0	73.440	222.40	302.30	1.078	1.351	1.163	0.907	307.30	95.12	141.70	12.28	0.042
24.0	8.467	1331.0	82.630	227.10	304.50	1.094	1.354	1.183	0.930	290.70	93.74	133.40	12.49	0.042
26.0	8.935	1319.0	87.610	229.50	305.60	1.102	1.356	1.194	0.942	282.40	92.99	129.40	12.60	0.041
28.0	9.422	1307.0	92.870	231.80	306.60	1.110	1.358	1.206	0.955	274.00	92.19	125.40	12.72	0.041
30.0	9.928	1294.0	98.430	234.20	307.70	1.117	1.360	1.218	0.969	265.60	91.35	121.50	12.84	0.040
32.0	10.450	1281.0	104.300	236.70	308.70	1.125	1.361	1.231	0.984	257.20	90.45	117.60	12.96	0.040
34.0	11.000	1268.0	110.600	239.10	309.70	1.133	1.363	1.245	1.001	248.70	89.51	113.80	13.09	0.039
36.0	11.570	1254.0	117.200	241.60	310.70	1.141	1.364	1.260	1.019	240.20	88.51	110.10	13.23	0.039
38.0	12.160	1240.0	124.200	244.10	311.60	1.149	1.366	1.277	1.038	231.60	87.46	106.40	13.37	0.038
40.0	12.770	1226.0	131.700	246.60	312.60	1.157	1.367	1.295	1.060	222.90	86.35	102.70	13.52	0.038
42.0	13.400	1211.0	139.600	249.10	313.50	1.165	1.369	1.316	1.084	214.20	85.18	99.05	13.68	0.038
44.0	14.060	1195.0	148.200	251.70	314.30	1.173	1.370	1.339	1.111	205.40	83.94	95.42	13.85	0.037
46.0	14.740	1179.0	157.300	254.30	315.20	1.181	1.371	1.365	1.141	196.40	82.64	91.81	14.03	0.037

Reference state values according IIR

1.5 Saturation properties by 3M Company

TABLE - Saturated Properties of PF-5030 - C3F8

3M Data, digitalized by Vic Vacek; February 1999 at CERN

T	Tr	Pvp	Pr	ρ (L)	ρ (V)	Vmol (L)	Vmol (V)	U (L)	U (V)	H (L)	Δ Hvap	H (V)	S (L)	Δ Svap	S (V)
[K]	[-]	[bar]	[-]	[kg/m ³]	[kg/m ³]	[L/mol]	[L/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[J/mol K]	[J/mol K]	[J/mol K]
180.0	0.522	0.029	0.001	1800.9	0.36	0.104	518.38	0.00	20.89	0.00	22.38	22.38	0.00	126.52	126.52
182.0	0.527	0.034	0.001	1791.9	0.43	0.105	441.41	0.32	21.08	0.32	22.27	22.59	1.79	124.46	126.25
184.0	0.533	0.040	0.002	1784.3	0.50	0.105	377.45	0.65	21.28	0.65	22.15	22.80	3.56	122.45	126.01
186.0	0.539	0.048	0.002	1776.2	0.58	0.106	324.05	0.97	21.47	0.97	22.04	23.01	5.31	120.50	125.81
188.0	0.545	0.056	0.002	1767.7	0.67	0.106	279.28	1.30	21.67	1.30	21.92	23.22	7.08	118.56	125.63
190.0	0.551	0.065	0.002	1760.0	0.78	0.107	241.61	1.63	21.87	1.63	21.81	23.44	8.81	116.68	125.49
192.0	0.556	0.076	0.003	1752.0	0.90	0.107	209.76	1.96	22.07	1.96	21.69	23.65	10.54	114.83	125.37
194.0	0.562	0.088	0.003	1744.1	1.03	0.108	182.75	2.29	22.27	2.29	21.58	23.87	12.25	113.02	125.27
196.0	0.568	0.101	0.004	1735.9	1.18	0.108	159.76	2.63	22.47	2.63	21.46	24.09	13.97	111.23	125.20
198.0	0.574	0.116	0.004	1727.6	1.34	0.109	140.11	2.96	22.67	2.96	21.34	24.31	15.68	109.47	125.15
200.0	0.580	0.134	0.005	1719.8	1.53	0.109	123.26	3.30	22.88	3.30	21.23	24.52	17.37	107.76	125.13
202.0	0.585	0.153	0.006	1711.5	1.73	0.110	108.76	3.64	23.08	3.64	21.11	24.75	19.06	106.07	125.13
204.0	0.591	0.174	0.006	1703.8	1.95	0.110	96.25	3.98	23.29	3.98	20.99	24.97	20.72	104.42	125.15
206.0	0.597	0.198	0.007	1695.8	2.20	0.111	85.42	4.32	23.50	4.32	20.87	25.19	22.38	102.80	125.18
208.0	0.603	0.224	0.008	1687.8	2.47	0.111	76.02	4.66	23.71	4.66	20.75	25.41	24.04	101.20	125.24
210.0	0.609	0.253	0.009	1679.8	2.77	0.112	67.82	5.00	23.92	5.01	20.63	25.64	25.68	99.63	125.32
212.0	0.614	0.285	0.011	1671.8	3.10	0.112	60.67	5.35	24.13	5.35	20.51	25.86	27.32	98.09	125.41
214.0	0.620	0.321	0.012	1663.7	3.46	0.113	54.40	5.70	24.34	5.70	20.39	26.09	28.95	96.57	125.52
216.0	0.626	0.359	0.013	1655.7	3.85	0.114	48.89	6.04	24.56	6.05	20.27	26.31	30.57	95.08	125.64
218.0	0.632	0.402	0.015	1647.6	4.27	0.114	44.04	6.39	24.77	6.40	20.14	26.54	32.18	93.61	125.78
220.0	0.638	0.448	0.017	1639.6	4.73	0.115	39.76	6.74	24.99	6.75	20.02	26.77	33.78	92.16	125.94
222.0	0.643	0.499	0.019	1631.7	5.23	0.115	35.98	7.09	25.20	7.10	19.90	27.00	35.37	90.74	126.11
224.0	0.649	0.554	0.021	1623.6	5.76	0.116	32.62	7.45	25.42	7.45	19.77	27.22	36.95	89.34	126.29
226.0	0.655	0.614	0.023	1615.5	6.35	0.116	29.63	7.80	25.64	7.81	19.64	27.45	38.53	87.96	126.49
228.0	0.661	0.678	0.025	1607.6	6.97	0.117	26.97	8.16	25.85	8.16	19.52	27.68	40.09	86.60	126.69
230.0	0.667	0.748	0.028	1599.5	7.65	0.118	24.59	8.51	26.07	8.52	19.39	27.91	41.65	85.26	126.91
232.0	0.672	0.824	0.031	1591.3	8.37	0.118	22.46	8.87	26.29	8.88	19.26	28.14	43.21	83.93	127.14
234.0	0.678	0.906	0.034	1583.3	9.15	0.119	20.55	9.23	26.51	9.24	19.13	28.37	44.75	82.63	127.38
236.0	0.684	0.993	0.037	1575.0	9.98	0.119	18.84	9.59	26.73	9.60	19.00	28.60	46.29	81.34	127.63

T	Tr	Pvp	Pr	ρ (L)	ρ (V)	Vmol (L)	Vmol (V)	U (L)	U (V)	H (L)	Δ Hvap	H (V)	S (L)	Δ Svap	S (V)
[K]	[-]	[bar]	[-]	[kg/m ³]	[kg/m ³]	[L/mol]	[L/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[J/mol K]	[J/mol K]	[J/mol K]
242.0	0.701	1.297	0.048	1550.5	12.84	0.121	14.64	10.68	27.39	10.70	18.59	29.29	50.85	77.58	128.43
244.0	0.707	1.413	0.053	1542.3	13.92	0.122	13.50	11.05	27.62	11.07	18.46	29.52	52.36	76.35	128.71
246.0	0.713	1.536	0.057	1533.9	15.08	0.123	12.47	11.42	27.84	11.44	18.32	29.75	53.86	75.14	129.00
248.0	0.719	1.668	0.062	1525.6	16.31	0.123	11.53	11.79	28.06	11.81	18.18	29.98	55.35	73.94	129.30
250.0	0.725	1.808	0.067	1517.3	17.61	0.124	10.68	12.16	28.28	12.18	18.04	30.21	56.84	72.76	129.60
252.0	0.730	1.957	0.073	1508.8	19.00	0.125	9.90	12.53	28.51	12.55	17.89	30.44	58.32	71.59	129.91
254.0	0.736	2.115	0.079	1500.4	20.47	0.125	9.19	12.90	28.73	12.93	17.75	30.67	59.79	70.43	130.22
256.0	0.742	2.283	0.085	1491.9	22.03	0.126	8.54	13.28	28.95	13.30	17.60	30.90	61.26	69.28	130.54
258.0	0.748	2.461	0.092	1483.4	23.68	0.127	7.94	13.65	29.18	13.68	17.45	31.13	62.73	68.14	130.86
260.0	0.754	2.649	0.099	1474.7	25.43	0.127	7.39	14.03	29.40	14.06	17.30	31.36	64.18	67.01	131.19
262.0	0.759	2.848	0.106	1466.0	27.28	0.128	6.89	14.41	29.62	14.44	17.14	31.59	65.64	65.89	131.52
264.0	0.765	3.058	0.114	1457.3	29.23	0.129	6.43	14.79	29.85	14.83	16.99	31.81	67.08	64.78	131.86
266.0	0.771	3.279	0.122	1448.5	31.30	0.130	6.01	15.17	30.07	15.21	16.83	32.04	68.52	63.67	132.20
268.0	0.777	3.512	0.131	1439.6	33.48	0.131	5.62	15.55	30.29	15.60	16.67	32.26	69.96	62.58	132.54
270.0	0.782	3.758	0.140	1430.7	35.78	0.131	5.25	15.94	30.51	15.99	16.50	32.49	71.39	61.49	132.88
272.0	0.788	4.016	0.150	1421.6	38.22	0.132	4.92	16.32	30.74	16.38	16.34	32.71	72.82	60.41	133.23
274.0	0.794	4.288	0.160	1412.4	40.78	0.133	4.61	16.71	30.96	16.77	16.17	32.93	74.24	59.33	133.57
276.0	0.800	4.572	0.171	1403.2	43.49	0.134	4.32	17.10	31.18	17.16	15.99	33.16	75.66	58.26	133.92
278.0	0.806	4.871	0.182	1393.9	46.34	0.135	4.06	17.49	31.40	17.56	15.82	33.38	77.08	57.19	134.27
280.0	0.811	5.184	0.193	1384.5	49.35	0.136	3.81	17.88	31.62	17.95	15.64	33.59	78.49	56.13	134.61
282.0	0.817	5.512	0.206	1374.9	52.52	0.137	3.58	18.28	31.84	18.35	15.46	33.81	79.89	55.07	134.96
284.0	0.823	5.856	0.218	1365.2	55.86	0.138	3.37	18.68	32.06	18.76	15.27	34.03	81.30	54.01	135.31
286.0	0.829	6.215	0.232	1355.4	59.39	0.139	3.17	19.07	32.27	19.16	15.08	34.24	82.70	52.95	135.65
288.0	0.835	6.590	0.246	1345.5	63.11	0.140	2.98	19.47	32.49	19.57	14.89	34.45	84.10	51.90	135.99
290.0	0.840	6.982	0.261	1335.4	67.03	0.141	2.81	19.88	32.70	19.97	14.69	34.66	85.49	50.84	136.33
292.0	0.846	7.391	0.276	1325.1	71.16	0.142	2.64	20.28	32.92	20.39	14.48	34.87	86.89	49.78	136.67
294.0	0.852	7.818	0.292	1314.7	75.52	0.143	2.49	20.69	33.13	20.80	14.28	35.08	88.28	48.72	137.00
296.0	0.858	8.263	0.308	1304.0	80.13	0.144	2.35	21.10	33.34	21.22	14.06	35.28	89.67	47.66	137.33
298.0	0.864	8.727	0.326	1293.2	85.00	0.145	2.21	21.51	33.55	21.64	13.84	35.48	91.06	46.59	137.66
300.0	0.869	9.210	0.344	1282.1	90.14	0.147	2.09	21.92	33.76	22.06	13.62	35.68	92.45	45.52	137.98

TABLE - Saturated Properties of PF-5030 - C3F8

3M Data, digitalized by Vic Vacek; February 1999 at CERN

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T	Tr	Pvp	Pr	ρ (L)	ρ (V)	Vmol (L)	Vmol (V)	U (L)	U (V)	H (L)	Δ H _{vap}	H (V)	S (L)	Δ S _{vap}	S (V)
[K]	[-]	[bar]	[-]	[kg/m ³]	[kg/m ³]	[L/mol]	[L/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[kJ/mol]	[J/mol K]	[J/mol K]	[J/mol K]
302.0	0.875	9.713	0.362	1270.8	95.58	0.148	1.97	22.34	33.96	22.48	13.39	35.87	93.84	44.44	138.29
304.0	0.881	10.236	0.382	1259.3	101.34	0.149	1.86	22.76	34.16	22.91	13.15	36.06	95.23	43.36	138.59
306.0	0.887	10.781	0.402	1247.4	107.46	0.151	1.75	23.18	34.36	23.34	12.90	36.25	96.63	42.26	138.89
308.0	0.893	11.347	0.423	1235.2	113.94	0.152	1.65	23.61	34.56	23.78	12.65	36.43	98.02	41.15	139.18
310.0	0.898	11.935	0.445	1222.7	120.84	0.154	1.56	24.04	34.75	24.22	12.39	36.61	99.42	40.03	139.45
312.0	0.904	12.546	0.468	1209.8	128.18	0.155	1.47	24.47	34.94	24.66	12.11	36.78	100.82	38.90	139.71
314.0	0.910	13.181	0.492	1196.5	136.02	0.157	1.38	24.91	35.12	25.11	11.83	36.95	102.22	37.70	139.96
316.0	0.916	13.841	0.516	1182.6	144.41	0.159	1.30	25.35	35.30	25.57	11.54	37.11	103.63	36.56	140.20
318.0	0.922	14.525	0.542	1168.3	153.41	0.161	1.23	25.79	35.48	26.03	11.23	37.26	105.05	35.36	140.41
320.0	0.927	15.236	0.568	1153.3	163.09	0.163	1.15	26.25	35.65	26.49	10.91	37.40	106.48	34.12	140.60
322.0	0.933	15.973	0.596	1137.6	173.56	0.165	1.08	26.70	35.81	26.97	10.57	37.54	107.92	32.85	140.77
324.0	0.939	16.739	0.625	1121.0	184.92	0.168	1.02	27.17	35.96	27.45	10.21	37.66	109.37	31.54	140.92
326.0	0.945	17.533	0.654	1103.5	197.34	0.170	0.95	27.64	36.10	27.94	9.83	37.77	110.84	30.18	141.02
328.0	0.951	18.357	0.685	1084.8	210.99	0.173	0.89	28.12	36.23	28.44	9.43	37.87	112.34	28.76	141.09
330.0	0.956	19.211	0.717	1064.7	226.14	0.177	0.83	28.62	36.35	28.96	8.99	37.95	113.86	27.26	141.11
332.0	0.962	20.098	0.750	1042.8	243.14	0.180	0.77	29.12	36.45	29.49	8.52	38.00	115.41	25.66	141.07
334.0	0.968	21.019	0.784	1018.6	262.53	0.185	0.72	29.65	36.52	30.03	7.99	38.03	117.01	23.94	140.95
336.0	0.974	21.974	0.820	991.3	285.10	0.190	0.66	30.19	36.57	30.61	7.41	38.02	118.68	22.05	140.73
338.0	0.980	22.967	0.857	959.5	312.23	0.196	0.60	30.77	36.57	31.22	6.73	37.95	120.45	19.91	140.36
340.0	0.985	23.998	0.895	920.7	346.54	0.204	0.54	31.40	36.51	31.89	5.91	37.81	122.37	17.39	139.76
342.0	0.991	25.071	0.935	868.8	394.26	0.216	0.48	32.13	36.31	32.67	4.84	37.51	124.58	14.15	138.73
344.0	0.997	26.191	0.977	780.7	481.76	0.241	0.39	33.11	35.76	33.74	3.05	36.78	127.62	8.85	136.48
345.1	1.000	26.801	1.000	627.3	627.26	0.300	0.30	34.69	34.69	35.49	0.00	35.49	132.66	0.00	132.66

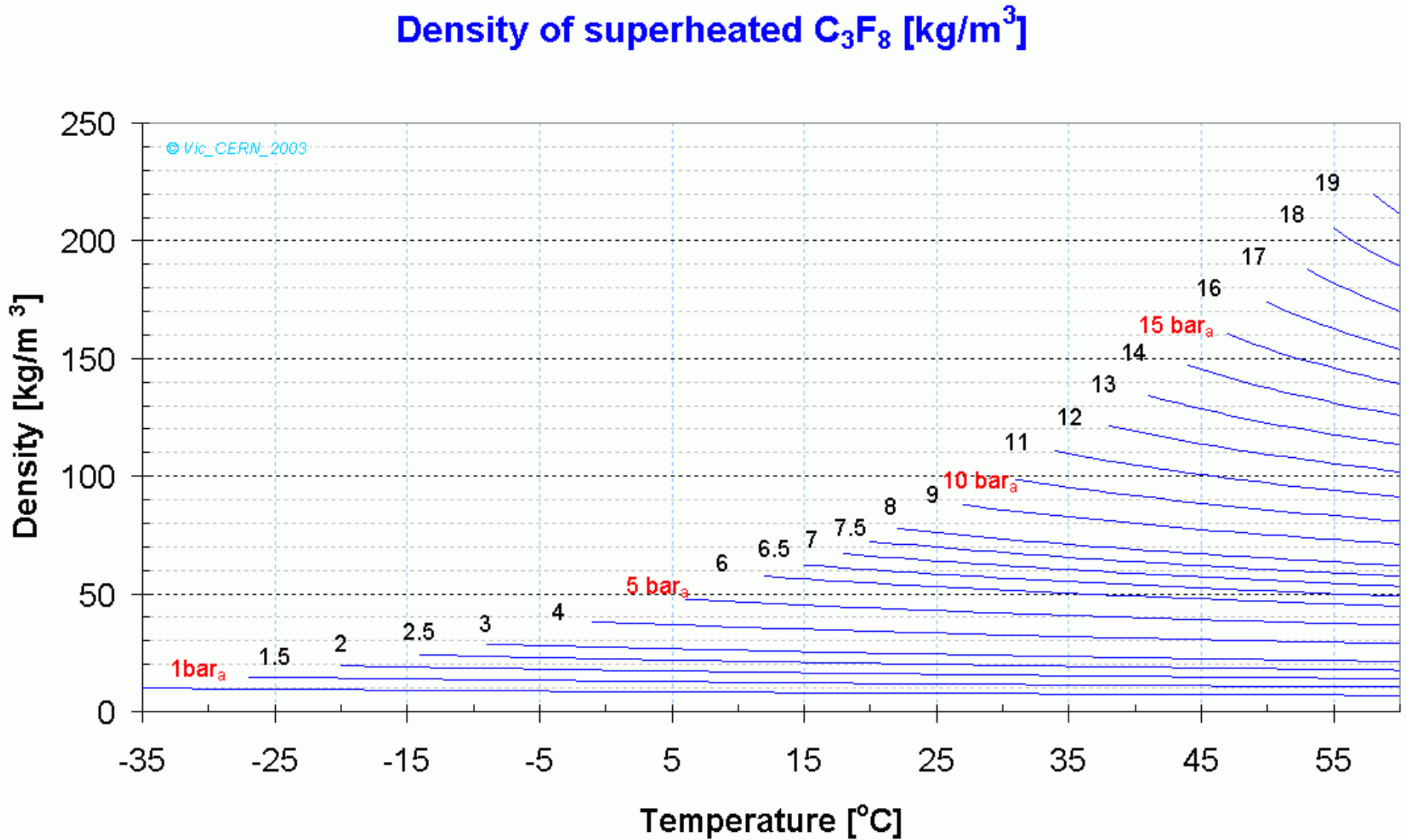
REFERENCE: Pure liquid at 180 K

SYMBOLS AND UNITS: Pvp = v.p. [bar]; ρ = density [kg/m³]; V = molar volume [L/mol]; U = int. energy [kJ/mol]; H = enthalpy [kJ/mol]; S = entropy [J/mol .K]; Δ = latent quantity (difference between sat. L and sat. V)

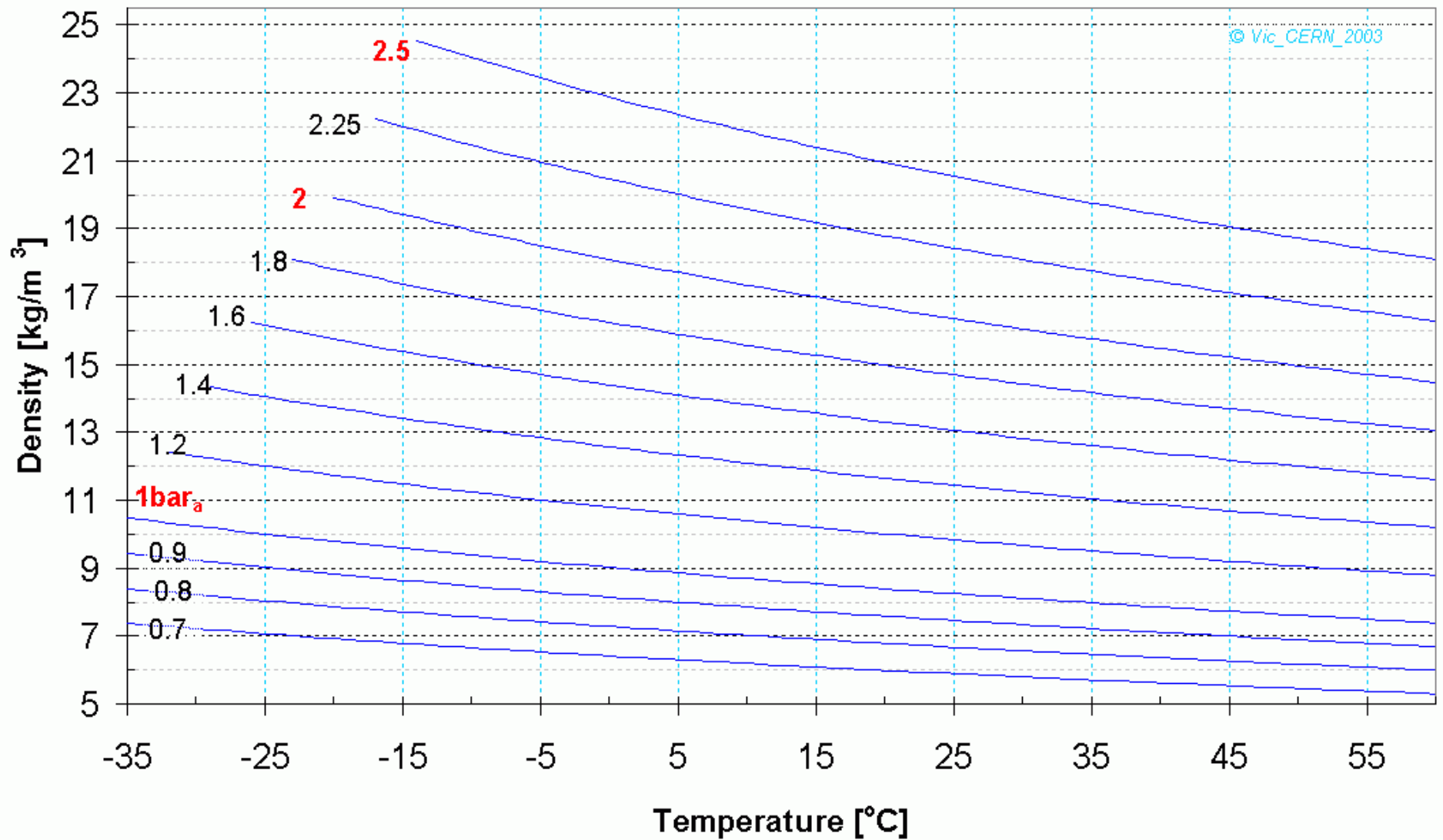
1.6 Properties of the superheated vapor of the C_3F_8

in the pressure range between 1 and 20 bar_a and temperature range between -35 °C and 60 °C.

1.6.1 Densities [with extended pressure range down to 0.7 bar_a]

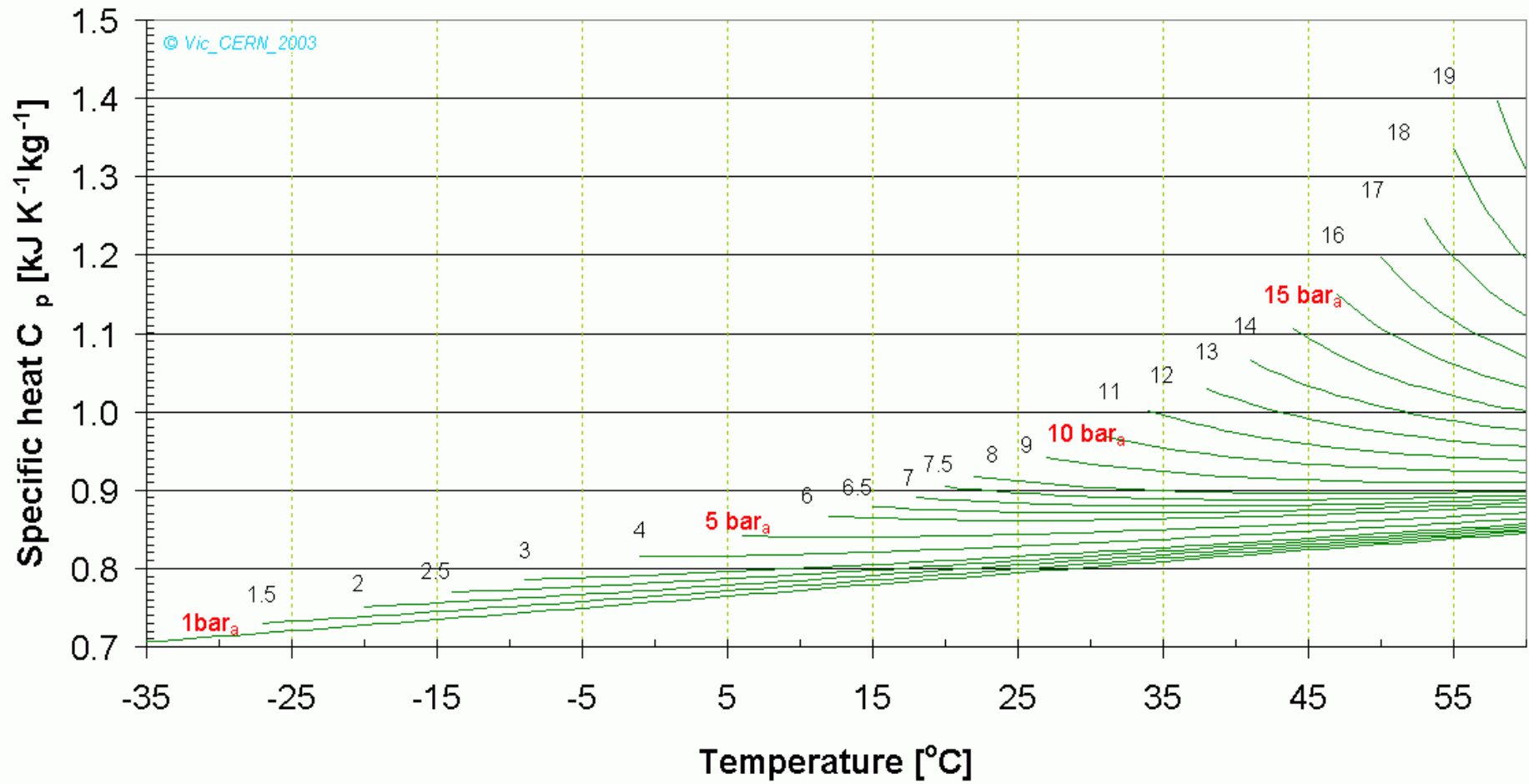


Density of superheated C_3F_8 at Low pressures

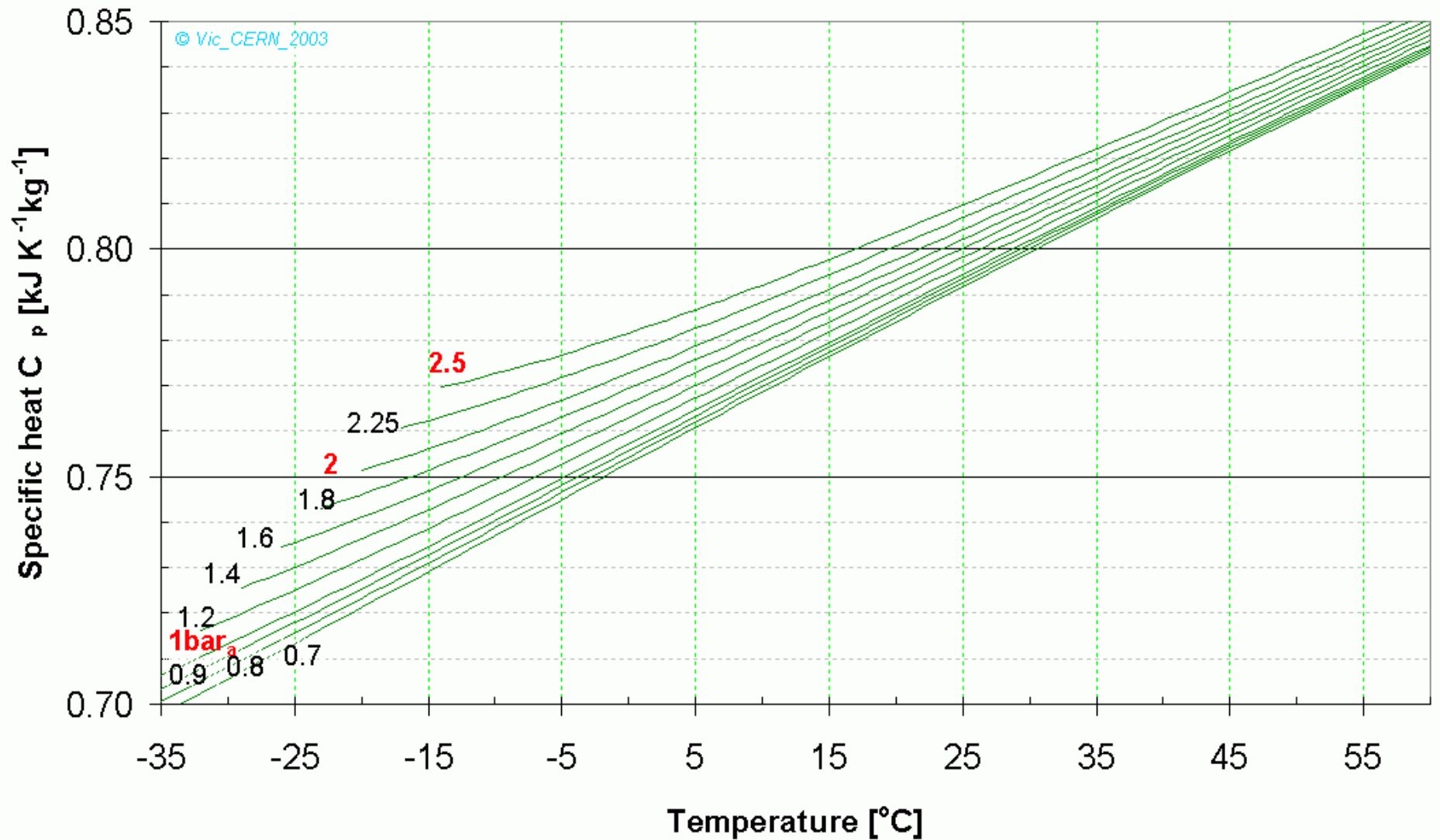


1.6.2 Specific heat [with extended pressure range down to 0.7 bar_a]

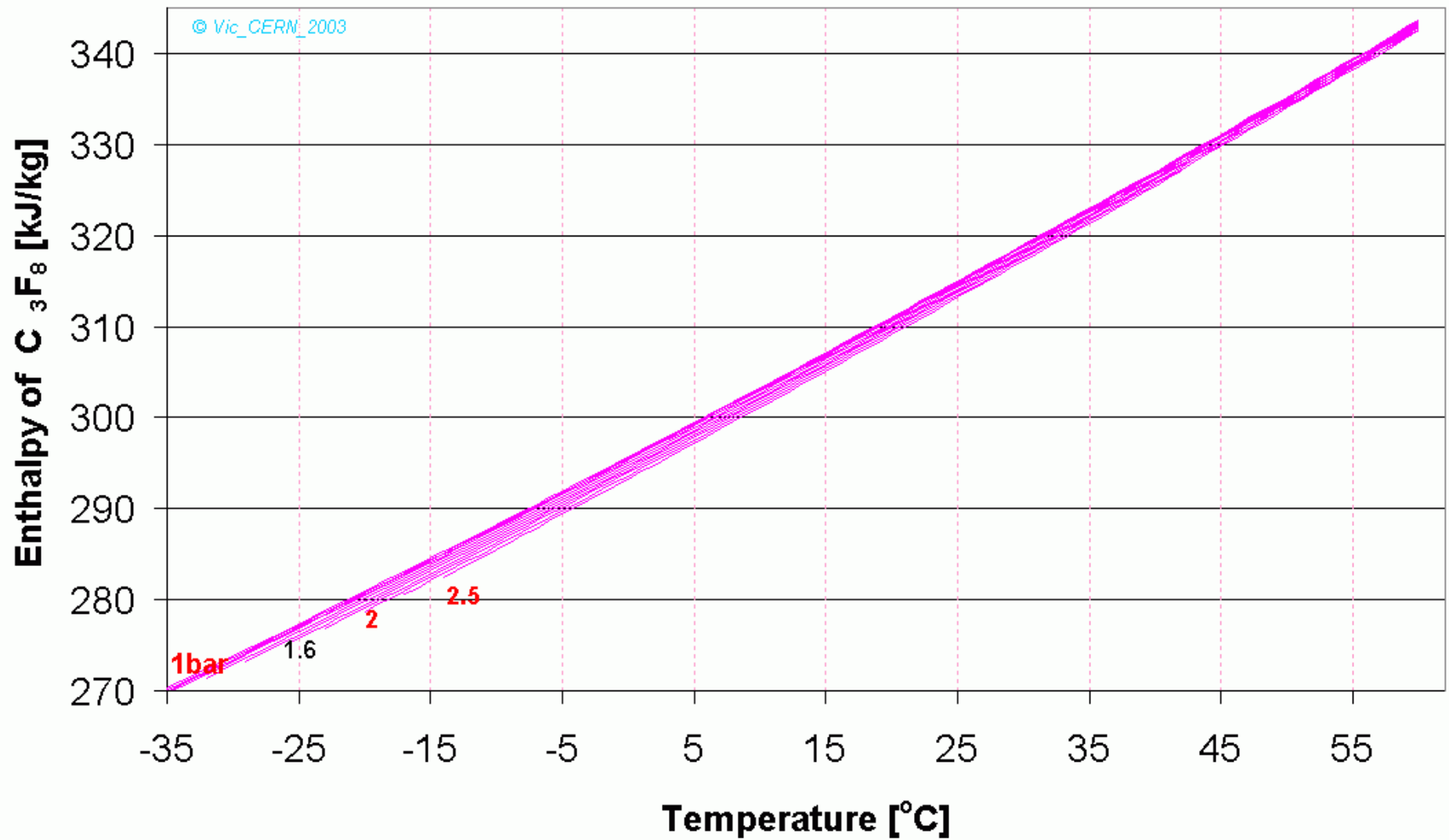
Specific heat of the superheated C₃F₈



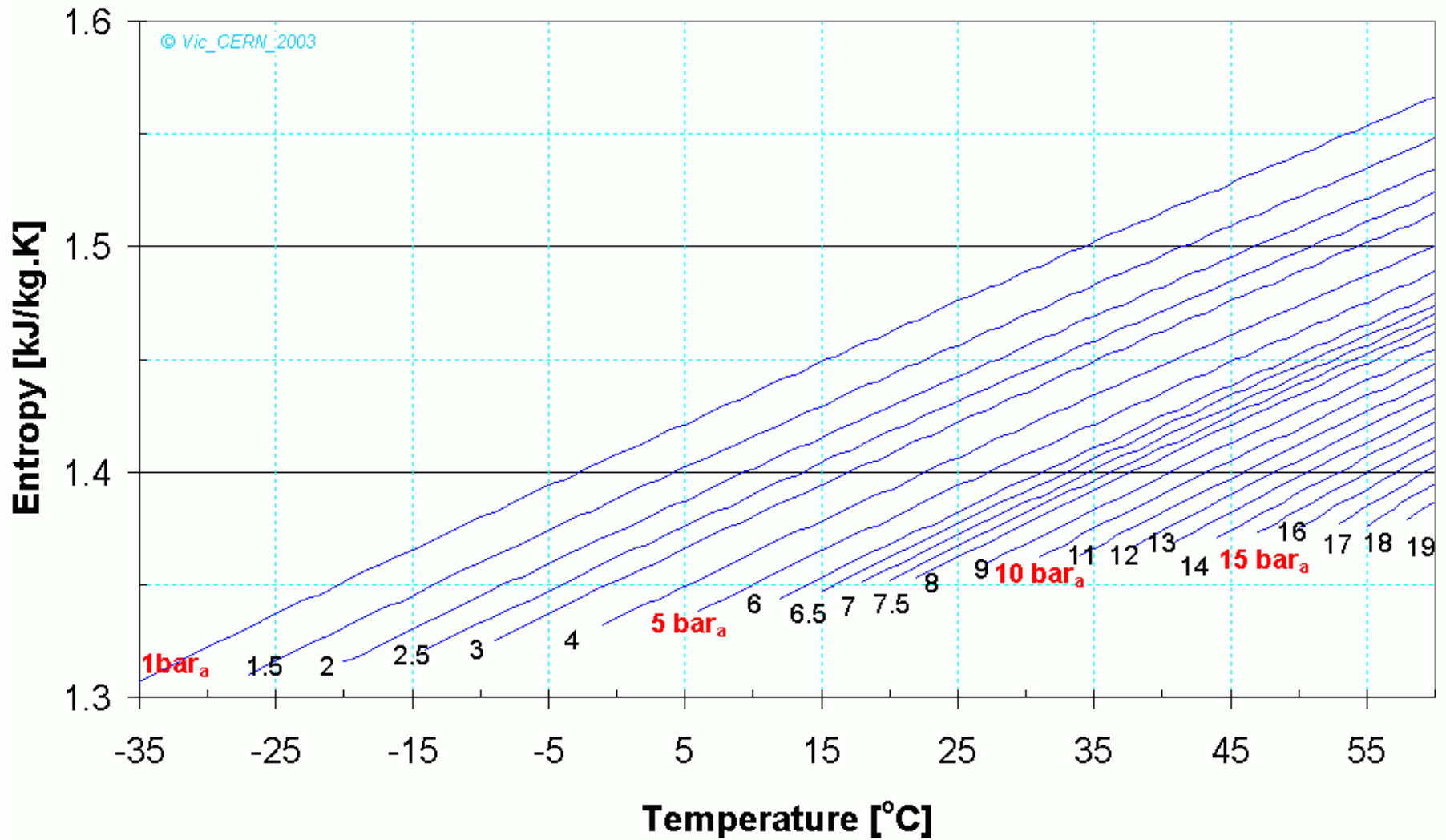
Specific heat of the superheated C_3F_8 at Low pressures



Enthalpy of the superheated C_3F_8 at Low pressures

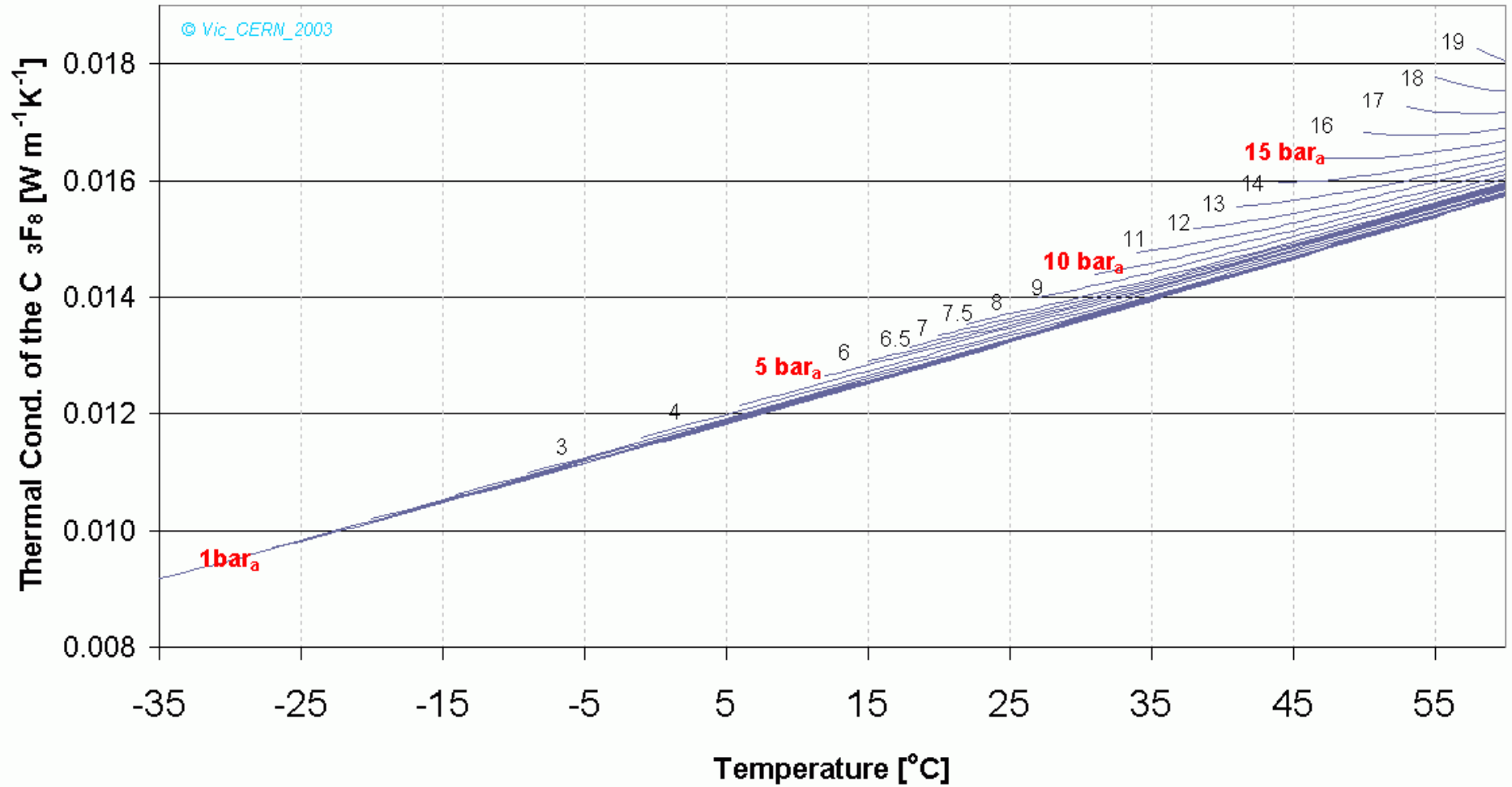


Entropy of superheated C₃F₈ [kJ/kg.K]

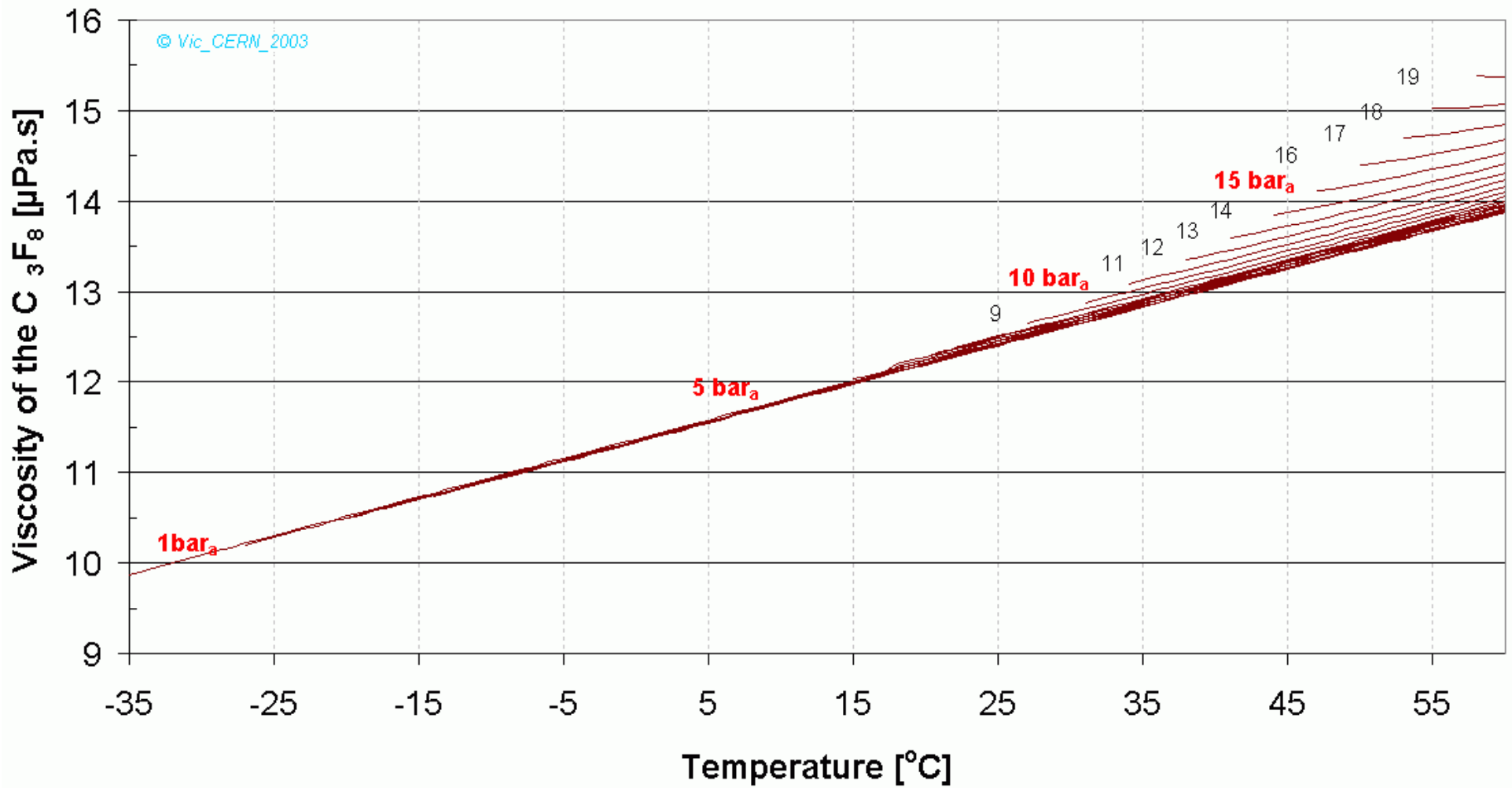


1.6.5 Thermal conductivity

Thermal Conductivity of the superheated C_3F_8 [$W m^{-1}K^{-1}$]



Viscosity of the superheated C₃F₈ [μ Pa.s]

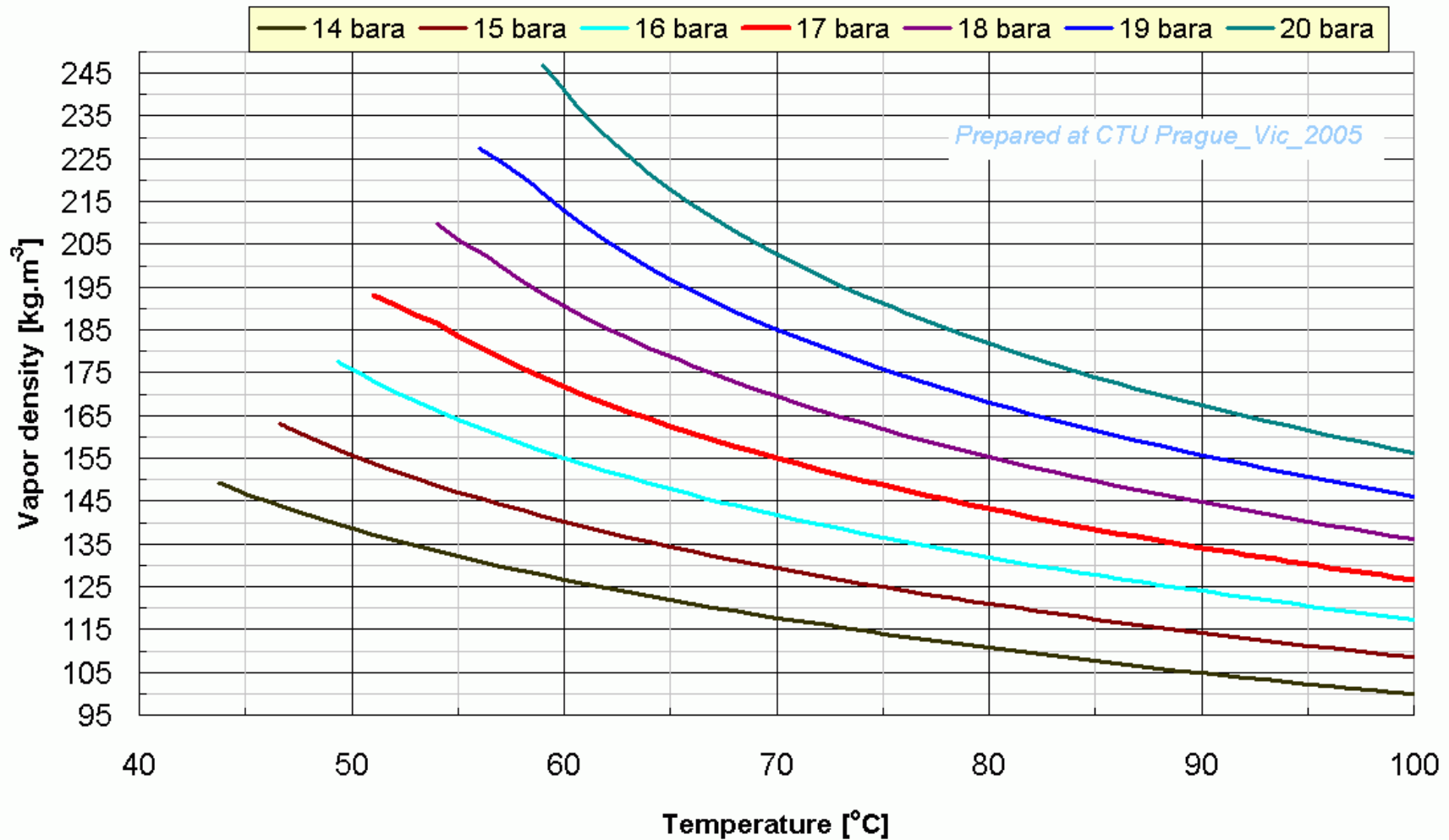


1.7 Extended Properties of the superheated vapor of the C₃F₈

in the extended pressure range between 15 and 20 bar_a and extended temperature range between 40 °C and 100 °C.

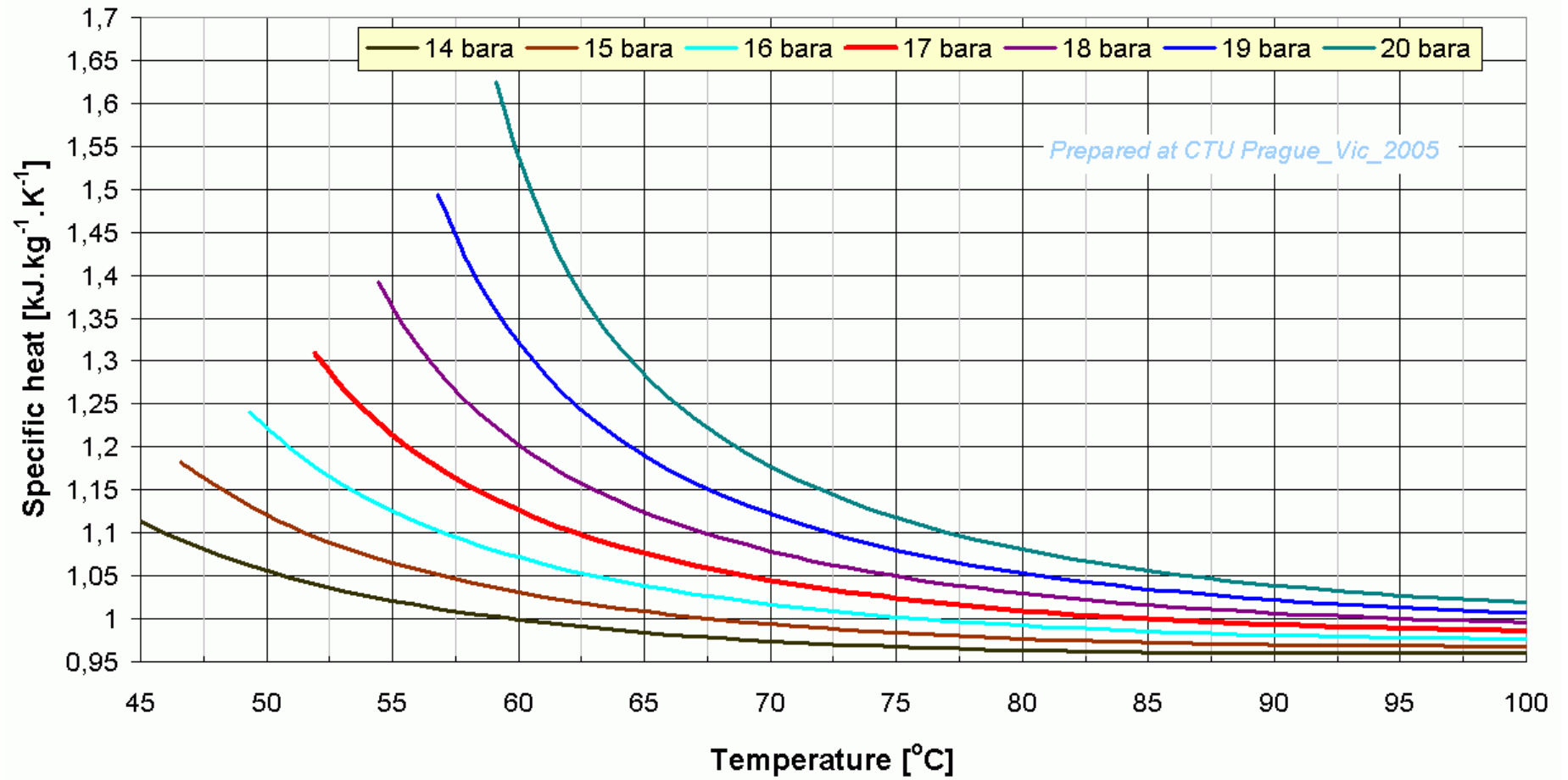
1.7.1 Density

Density_C3F8_superheated vapor

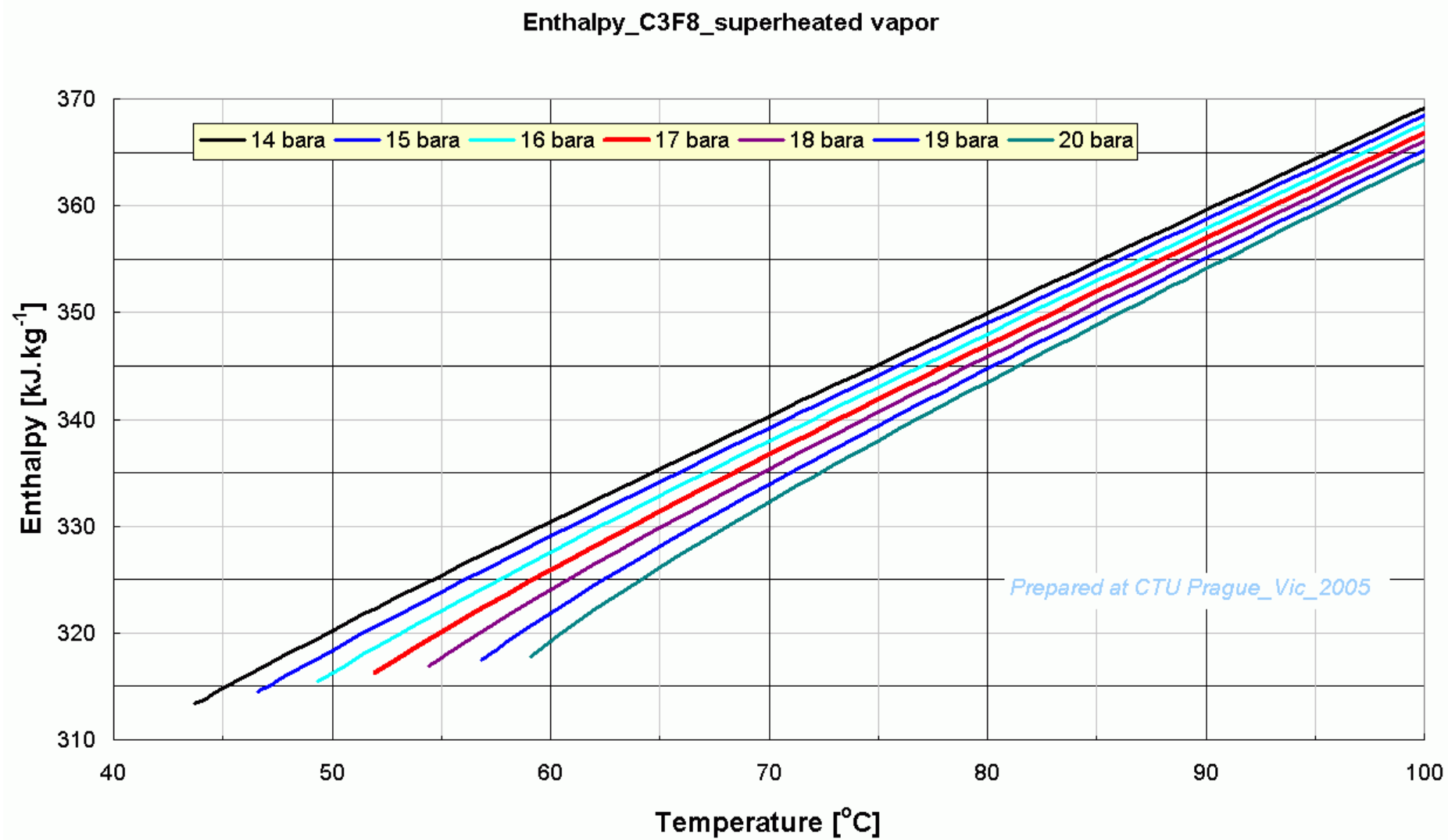


1.7.2 Specific heat

Specific heat_C3F8_superheated

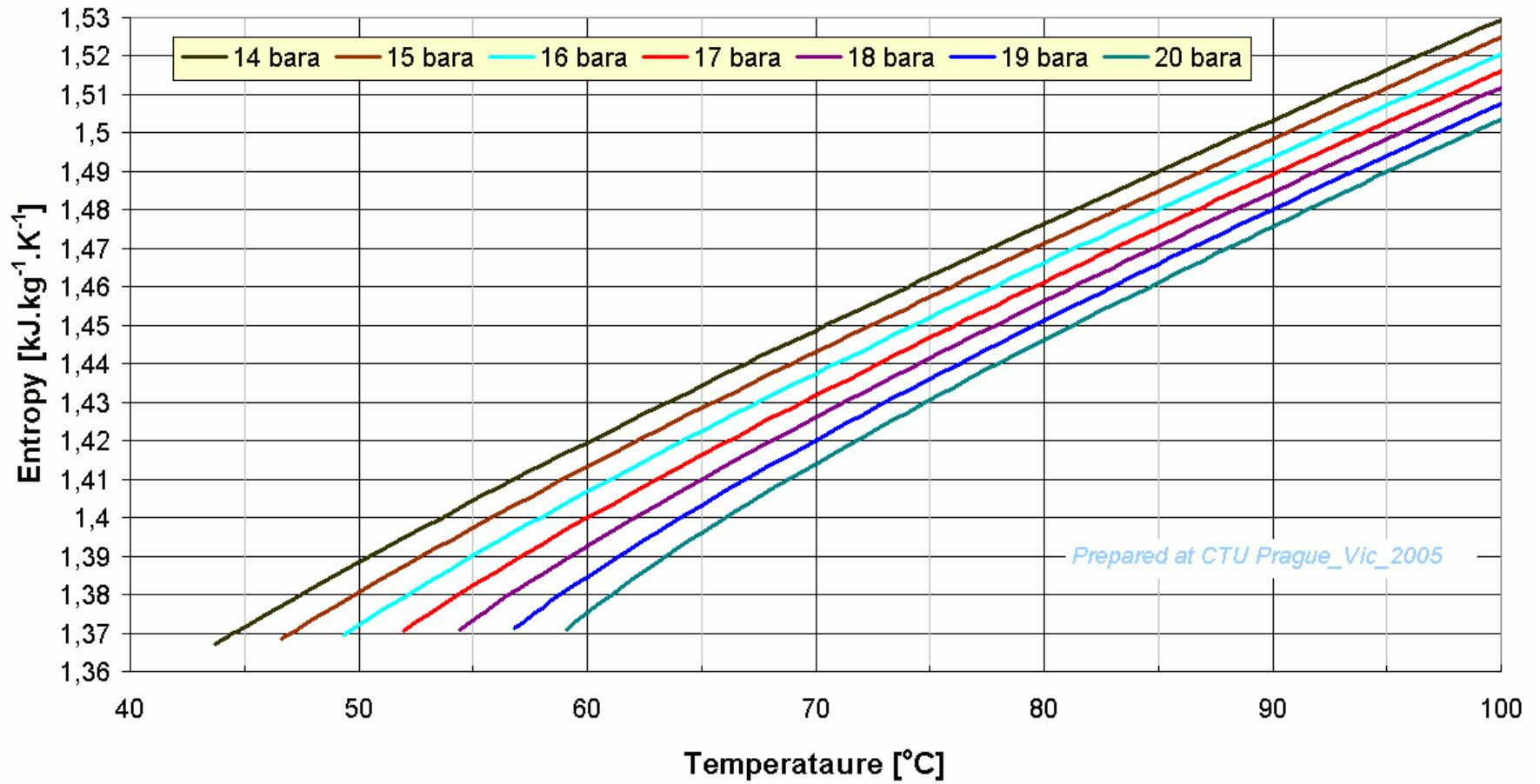


1.7.3 Enthalpy



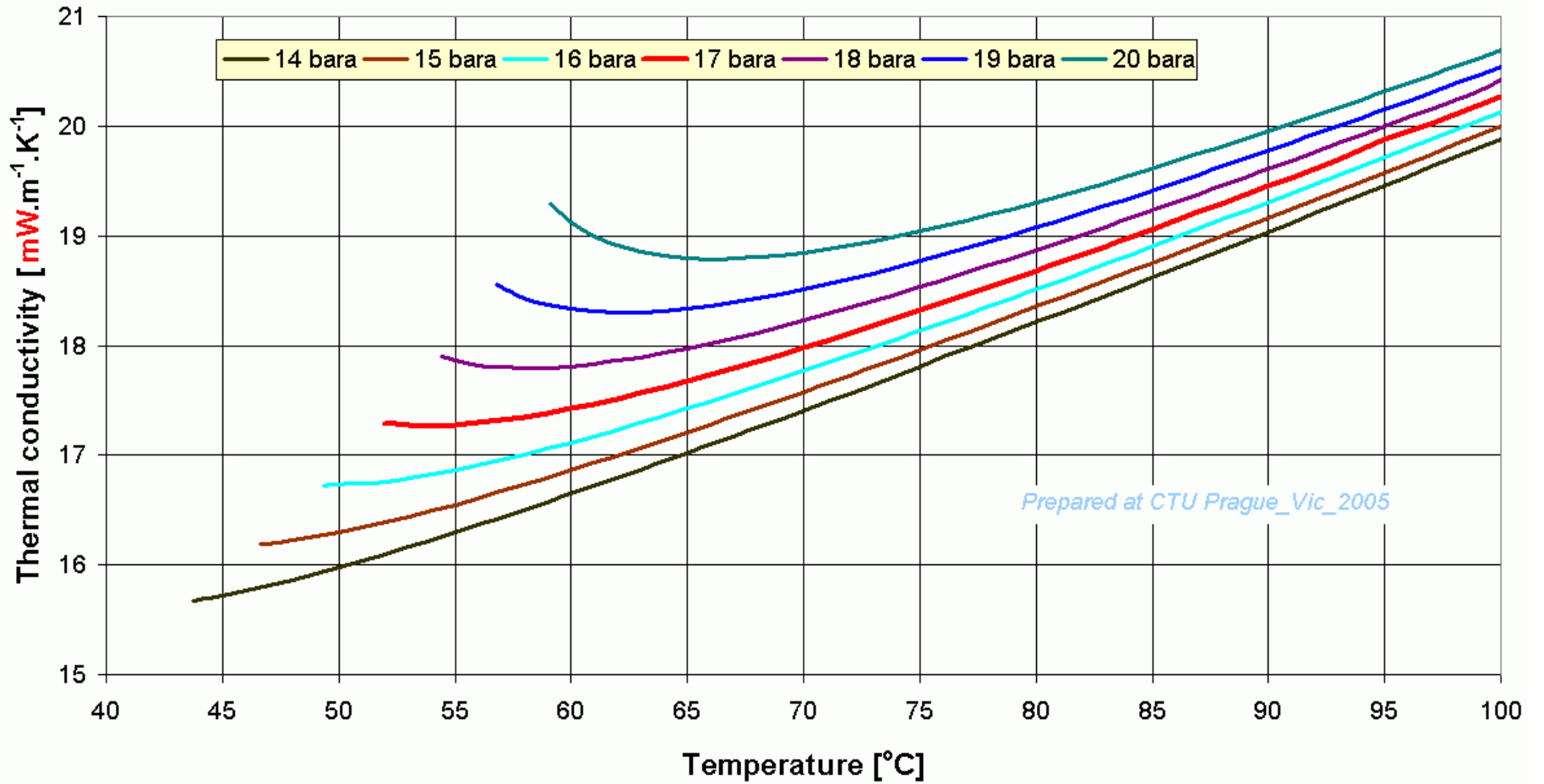
1.7.4 Entropy

Entropy_C3F8_superheated

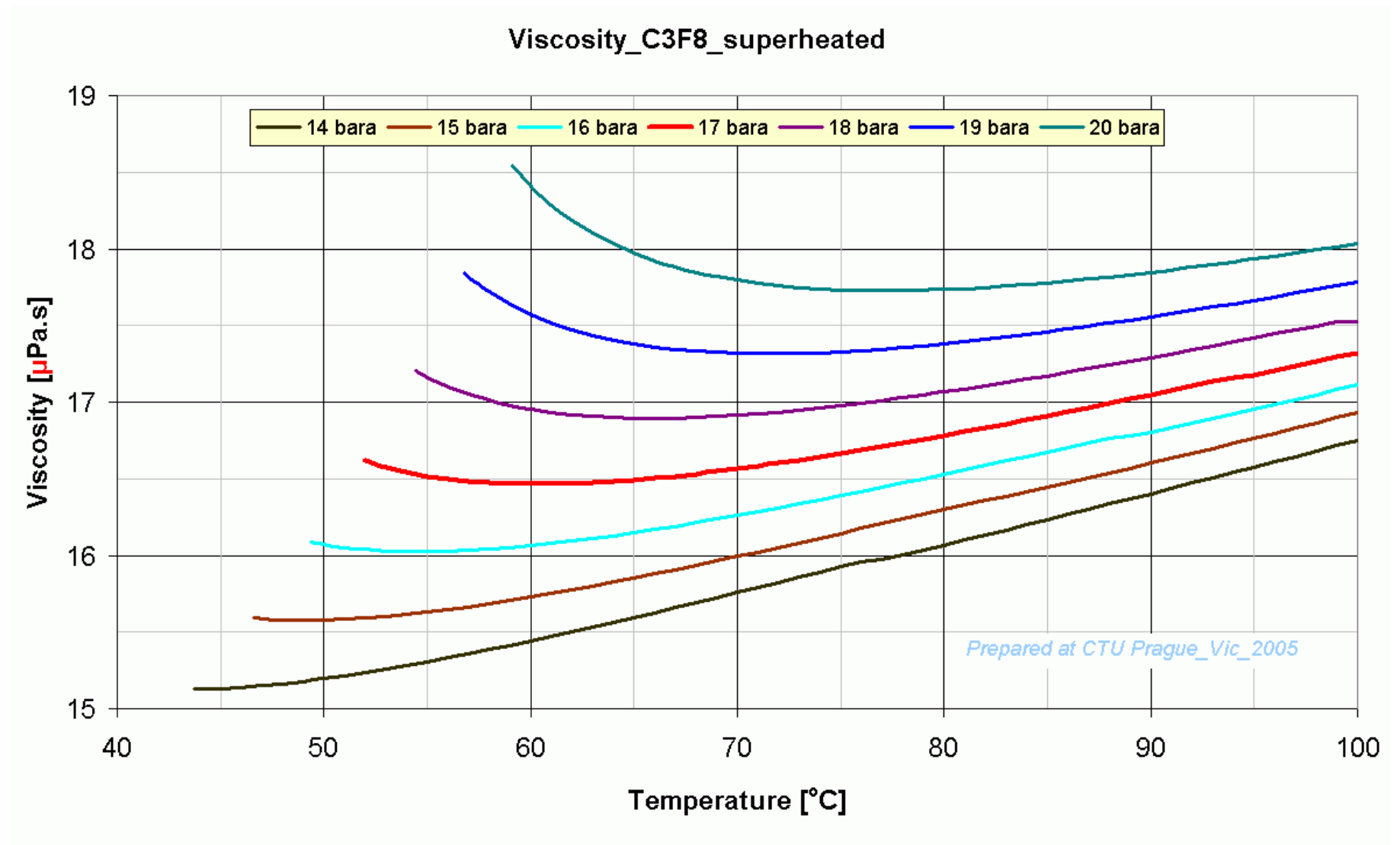


1.7.5 Thermal conductivity

Thermal conductivity_C3F8_superheated



1.7.6 Viscosity

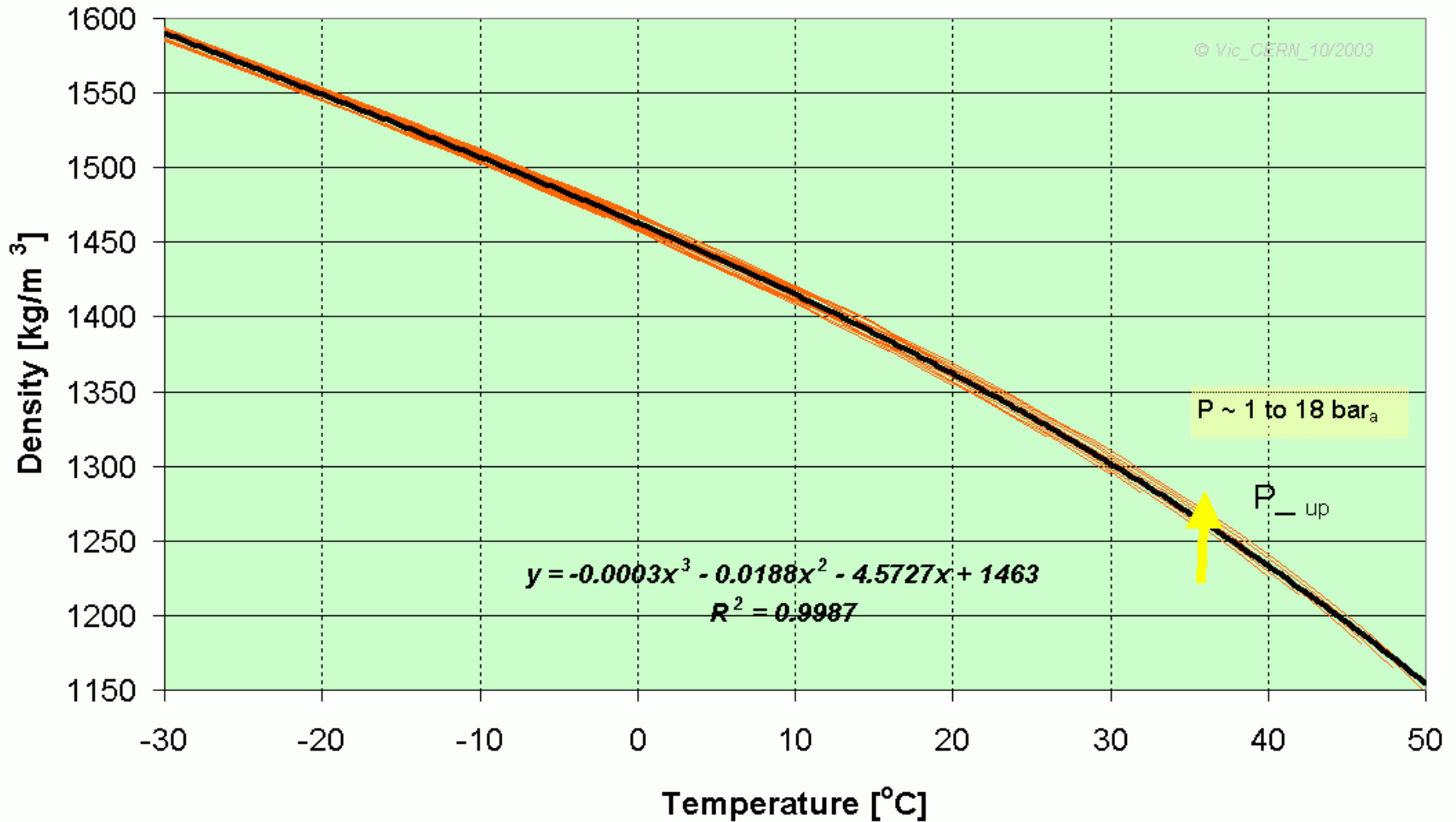


1.8 Properties of the sub-cooled liquid of the C₃F₈

in the pressure range between 1 and 18 bar_a and temperature range between -30 °C and 50 °C.

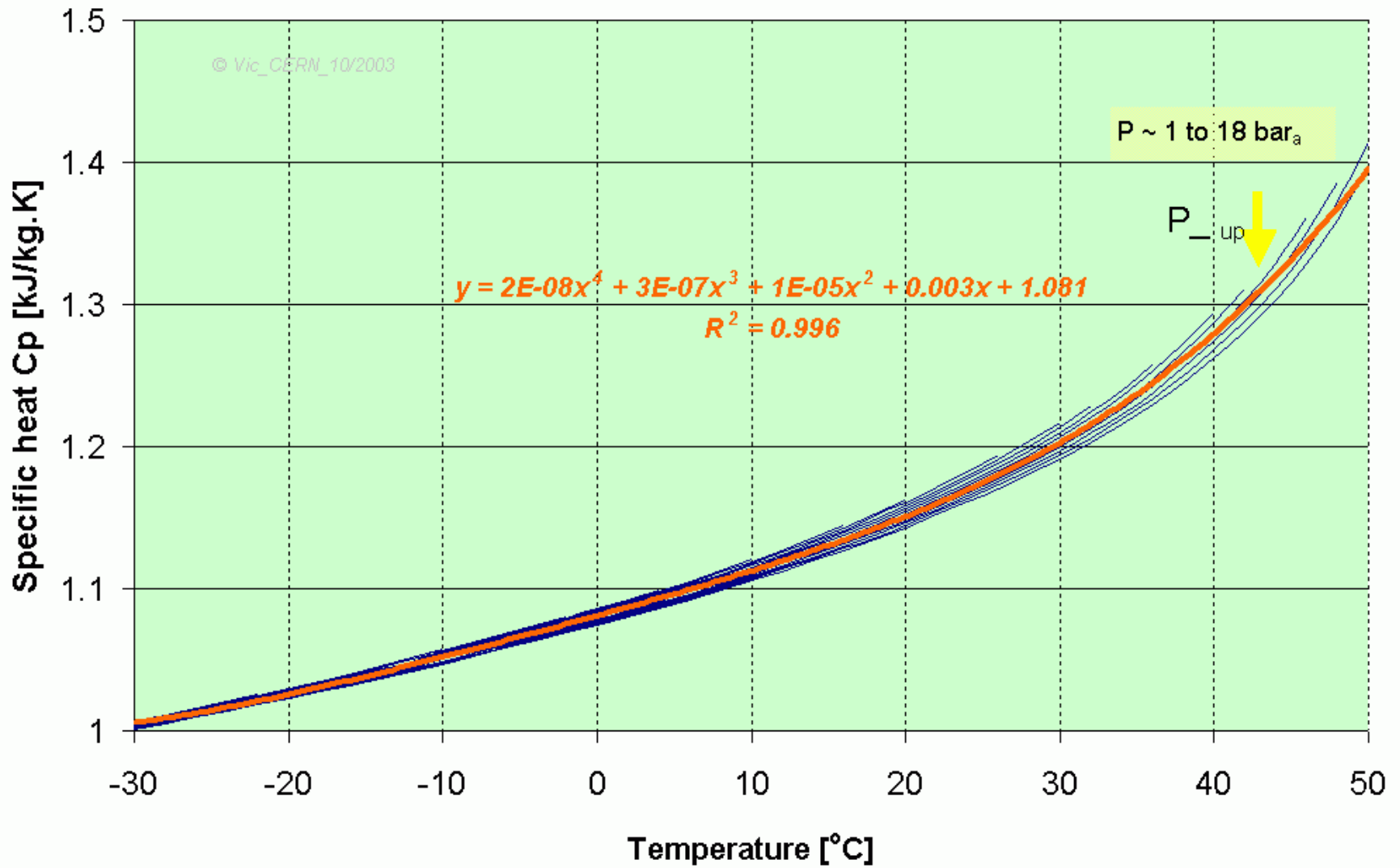
1.8.1 Density

Density of the Sub_Cooled Liquid C₃F₈



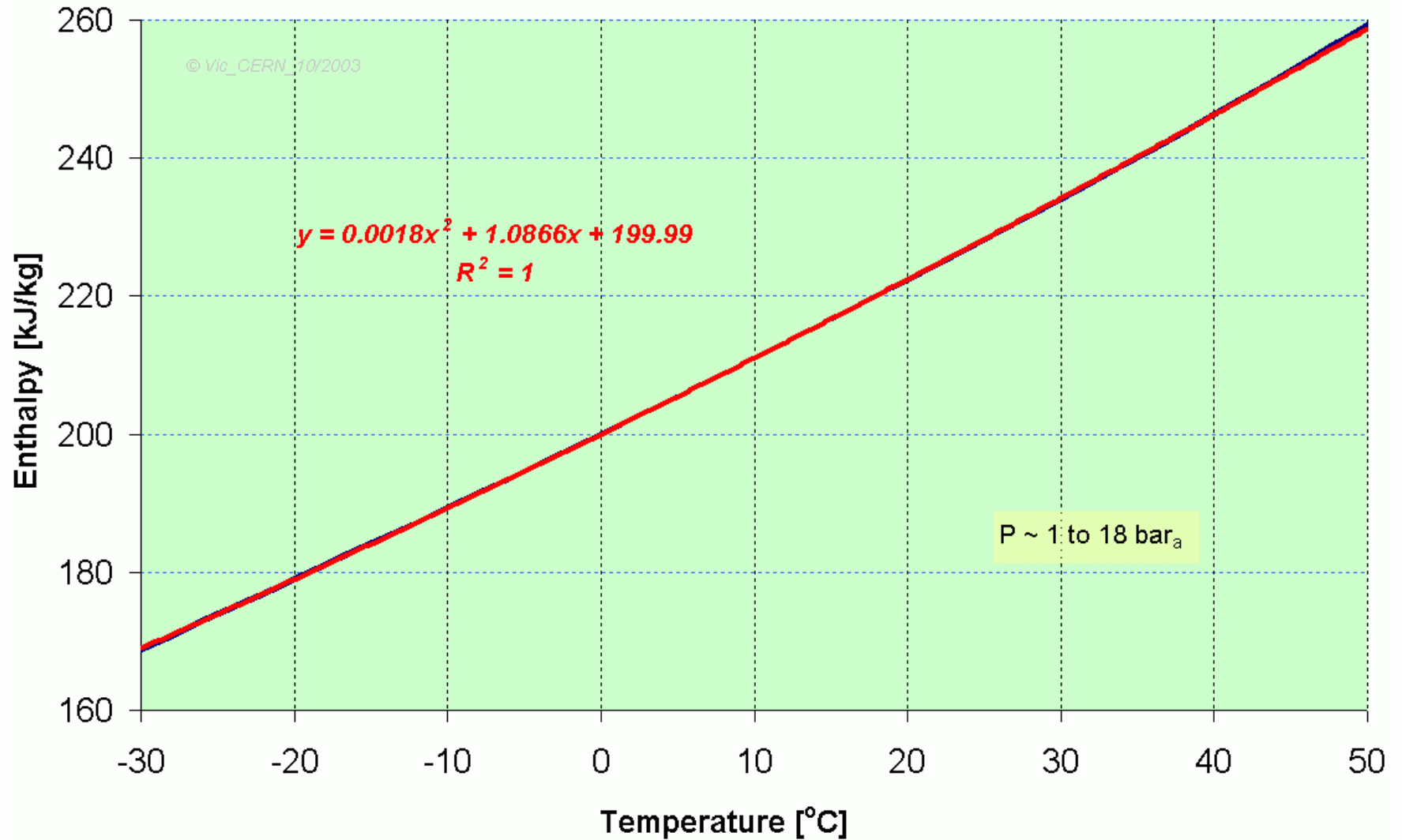
1.8.2 Specific heat

Specific heat of the Sub_Cooled Liquid C₃F₈

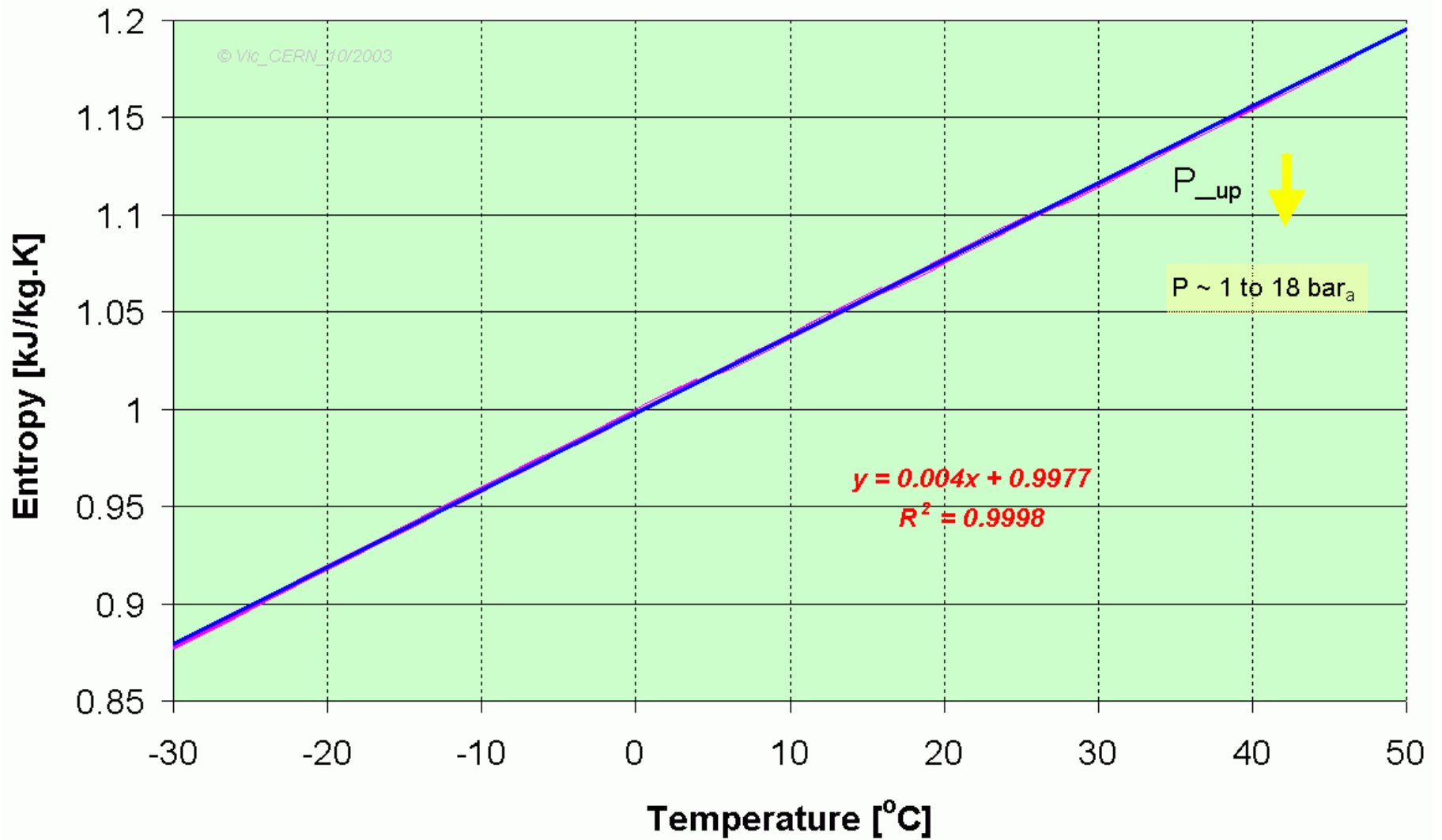


1.8.3 Enthalpy

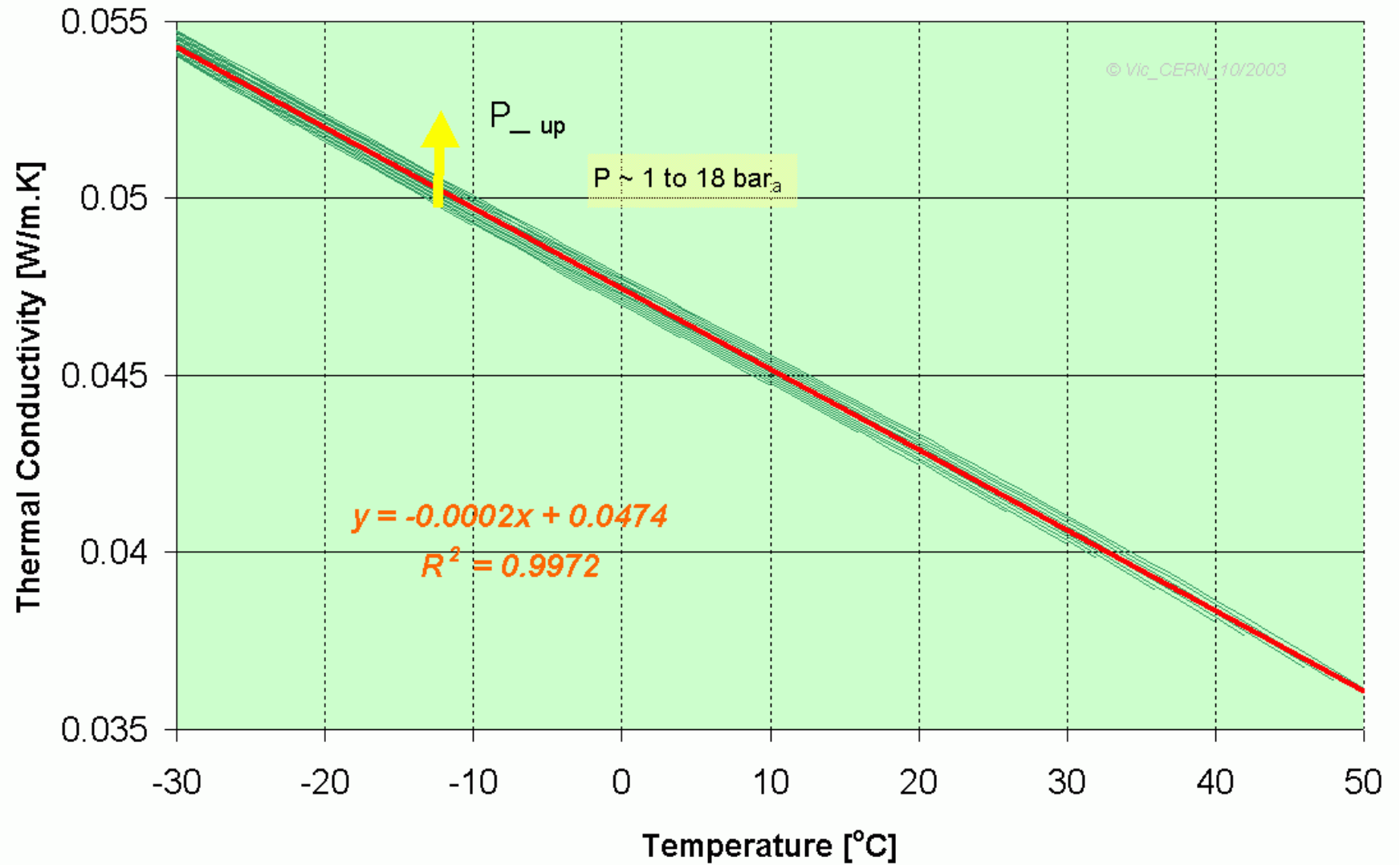
Enthalpy of the Sub_Cooled Liquid C₃F₈



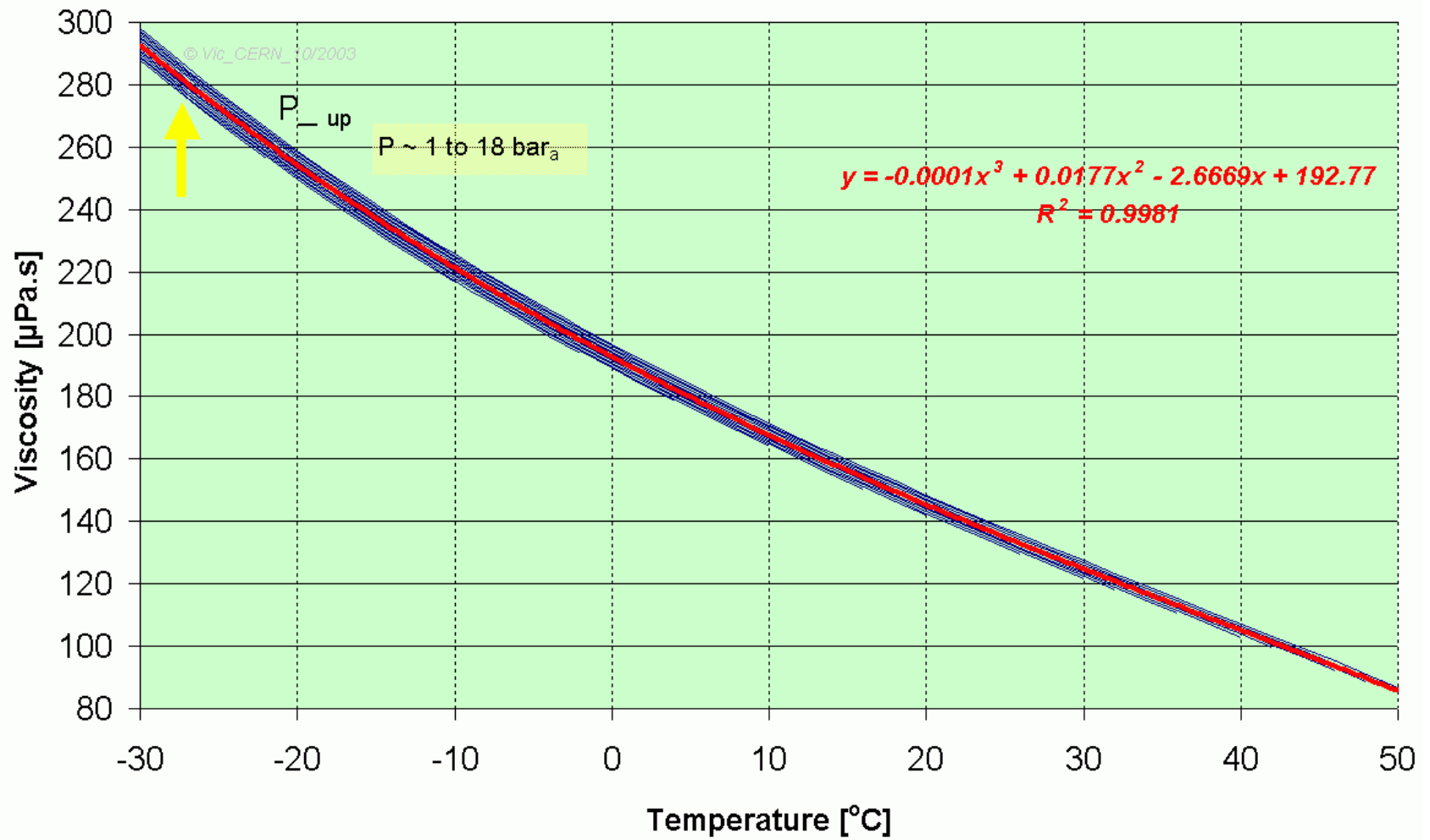
Entropy of the Sub_Cooled Liquid C₃F₈



Thermal Conductivity of the Sub_Cooled Liquid C₃F₈



Viscosity of the Sub_Cooled Liquid C₃F₈



1.9 Compatibility of fluorocarbons with materials

Communicated by Lionel Breuille - 3M FRANCE

3M and various materials manufacturers have been contacted regarding their compatibility with Fluorinert:

GOOD

- Acrylic (Acrylite / Acrysteel / Aristech / Cyrolite / Diakon / Kamax) ***possible**
- Buna-N - Nitrile rubber (NBR=Acrylonitrile butadiene rubber - Perbunan-NT / Hycar / Butacril / Chemigum / Isr-N / Stansolv / Sol-Vex) ***good**
- Nalgene - Polyurethane (PU/PUR=Polyurethane rubber - Vulkollan / Adiprene) ***possible**
- Neoprene W (CR=Polychloroprene rubber - Baypren / Neox / Stanzoil) ***prohibited**
- Silicone (SIR=Silicone rubber - Silastic) ***possible**

BAD

- Nylon (PA=Polyamid - Stanyl / Capron / Ultramid / Maranyl / Zytel / Orgamid / Grilon / Rilsan / Reny / Vestamid) ***possible**
- Polypropylene (PP=Polypropylene - Celmar / Coprax / Giacogreen / Hostelen PP / Novolen / Appryl / Lacqtene / Propathene / Ektar FB / Fortilene / Marlex / Polyfine / Pro-Fax / Tenite) ***possible**
- PVC (PVC=Polyvinyl chloride - Betaglas / Darvic / Fiberlok / Trovidur / Hostalit / Vestolit / Tygon) ***prohibited**
- Teflon (PTFE=Polytetrafluoroethylene - Flubriflon / Fluon / Teflon TFE / Valflon F / Hostaflon TF / Furon / Gortex / Tfm / Rulon) ***prohibited**
- Tygon (PVC) ***prohibited**
- Viton (FKM=Fluoroelastomer - Fluorel) ***prohibited**
- (from our test) EPDM (Ethylene propylene rubber - Keltan / Nordel / Vistalon / Buna-AP / Pyrofil) ***possible**

***CERN IS 41 classification regarding fire**

C₆F₁₄ - PIPING

	Rad Hard ¹	Compatibility ²	Gas Permeability Px10 ¹⁰ (cm ³ mm/cm ² s cm Hg) (DATA: Angst+Pfister)	GLOBAL RESULT
SS	1.10 OK	1.11 OK	0	OK
Aluminum	1.12 OK	OK (if fluid is pure) Not well know if fluid is contaminated with H ₂ O, O ₂ , C-H due to F-production	0	OK?
PEEK	1.13 10⁸ rad (Data: TIS-CFM/MTR/96-17)	1.14 OK (Data: 3M)		OK
PUR	10⁷ rad (Data: Angst+Pfister)	1.15 OK (Data: 3M)	5 N ₂ 15-50 O ₂ 140-400 CO ₂	OK
Polypropylene PP	10⁷ rad (Data: Angst+Pfister)		3-5 N ₂ ~10 O ₂ ~ 35 CO ₂	?
Polyethylene PE	10⁸ rad (Data: CERN 82-10)	1.16 OK (Data: DELPHI 95-21 RICH 66)	0.1 N ₂ ~ 1 O ₂ 1-6 CO ₂ 8 H ₂	OK
Nylon (Polyamide 6)	10⁷ rad (Data: CERN 82-10)	1.17 OK (Data: 3M)	~ 2 N ₂ ~ 1 O ₂ 1-6 CO ₂ 8 H ₂	OK
Rilsan (polyamide 11)		OK (Data: 3M) Discoloration, Weight loss, but mechanical prop. OK (Data: DELPHI 95-21 RICH 66)		BAD
Teflon (PTFE)	1.18 BAD	1.19 BAD		BAD
PVC	10⁸ rad (Data: Angst+Pfister)	1.20 Some effect (Data: 3M)	0.3 N ₂ ~ 1 O ₂ 1-10 CO ₂ 33 H ₂	BAD

See
Note

Note: one should avoid plastics with the fluorocarbons as they take out the plastiziser and the product becomes brittle.

Source: G. Lenzem, DELPHI RICH and 3M.

¹ BAD means that material does not show any damage up to the indicated dose. BAD means that it is affected well below 10⁵ rad.

² Effect means change of weight and/or volume after > 72h immersion in C₆F₁₄. Some effect means > 1%. BAD means >4%.

C6F14 - O-rings

How much weight/volume loss/increase is acceptable?
SOME EFFECT means > 1%.
BAD means > 4%.

Suggested by 3M as best choices

	Rad Hard	Compatibility	GLOBAL RESULT
EPDM	< 10⁸ rad (Data: CERN 82-10)	<i>1.20.1</i> OK (Data: 3M)	OK
Perbunan (NBR) or caoutchouc or nitrile rubber	10⁸ rad (Data: CERN 82-10)	OK (but some effect) (Data: 3M)	OK
Neoprene	10⁷ rad (Data: CERN 82-10)	OK (Data: 3M)	OK
Butyl rubber	< 10⁵ rad (Data: CERN 82-10)	OK (Data: 3M)	BAD
2. PVDF	10⁸ rad (Data: Angst+Pfister)	OK (but some effect) (Data: 3M)	OK
Kalrez	10⁶ rad (Data: CERN 82-10)		
Viton	< 10⁷ rad (Data: CERN 82-10)	<i>2.1.1</i> BAD (Data: 3M)	BAD *
Teflon (PTFE & PCTFE)	BAD	BAD	BAD

* Viton O-rings were used in DELPHI with no leak problems. Source: G. Lenzem, DELPHI RICH