COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

The vapor pressure of mercury has been measured by many workers. The experimental data have been evaluated a number of times. We present here data from three evaluations. Two of the evaluations were done in the early 1970's and one was done in 1951.

Douglas, Ball, and Ginnings compared values from 14 laboratories with the vapor pressure equation they developed from thermodynamic data in 1951. Their equation for the vapor pressure of mercury was obtained by equating the Gibbs energies of saturated liquid and vapor using the best available thermodynamic data at that time. They took into account the effect of gas imperfections and temperature scale. The equation, which contains over 20 constants is difficult to use. Vapor pressure values from the equation are tabulated at 20 degree intervals from near the triple point to 500°C in their paper. These values are given on the next page.

Douglas, Ball, and Ginnings give a simpler equation for practical use that reproduces the vapor pressure of the full equation between 100 and 500°C to within 0.01 percent. The equation is

$$\log\,(p/\mathrm{mmHg}) = 11.257555 - 3339.202/(\theta/\mathrm{K}) - 1.153092\,\log(\theta/\mathrm{K}) + 2.95697 \times 10^{-4}(\theta/\mathrm{K}) - 7.4588 \times 10^{-8}(\theta/\mathrm{K})^2 - 1.5605 \times 10^{-11}(\theta/\mathrm{K})^3 + 3.600\,\exp(-5360/(\theta/\mathrm{K})),$$

where θ is the temperature on the 1948 International Practical Temperature Scale, related at the thermodynamic scale by

$$(T/\mathrm{K}) - (\theta/\mathrm{K}) = 0.6381 - 4.809 \times 10^{-3}(\theta/\mathrm{K}) + 1.1096 \times 10^{-5}(\theta/\mathrm{K})^2 - 7.481 \times 10^{-8}(\theta/\mathrm{K})^3.$$

Unfortunately these equations are somewhat dated. However, they do represent a thorough careful evaluation, and they should not be ignored because they are related to the 1948 IPTS.

Ambrose and Sprake combined measurements of their own with earlier data and information from earlier evaluations to develop two equations for the vapor pressure of mercury. The first equation is a third order Chebyshev polynomial for the 400 to 686 K temperature interval. It is

$$(T/\mathrm{K})\,\log(p/\mathrm{kPa}) = 1313.8587/2 + 997.8311\,E_1(x) - 3.0387\,E_2(x) + 0.2965\,E_3(x)$$

where

$$x = \{2(T/\mathrm{K}) - (686 + 400)\}/(686 - 400)$$

and the Chebyshev polynomials are

$E_0(x) = 1$, $E_1(x) = x$, $E_2(x) = 2x^2 - 1$, $E_3(x) = 4x^3 - 3x$, and $E_4(x) = 8x^4 - 8x^2 + 1$.

They are related by the recurrence relation

$$E_{s+1}(x) = 2xE_s(x) - E_{s-1}(x).$$

Value from the equation are reproduced on the next page from 273.15 to 673.15 K. The second equation of Ambrose and Sprake is a fifth order Chebyshev polynomial for the 400 to 1765 K temperature interval. It was fitted to experimental data over the 400 to 772 K range and to the critical temperature and pressure. The equation is:

$$(T/\mathrm{K})\,\log(p/\mathrm{kPa}) = 8745.7706/2 + 4708.7980\,E_1(x) + 13.2829\,E_2(x) + 29.7025\,E_3(x) + 11.7077\,E_4(x) + 4.5180\,E_5(x)$$

(continued on page 243)

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Douglas, Ball, Ginnings	Vargaftik
t/°C	p/mmHg	p/mmHg	p/mmHg
-38.88		0.00219×10^{-3}	
-20		0.02336×10^{-3}	
0	0.197×10^{-3}	0.1996×10^{-3}	0.205×10^{-3}
10	0.515×10^{-3}		0.533×10^{-3}
20	1.258×10^{-3}	1.268×10^{-3}	1.30×10^{-3}
25	1.921×10^{-3}	1.935×10^{-3}	
30	2.893×10^{-3}		2.98×10^{-3}
40	6.304×10^{-3}	6.340×10^{-3}	6.47×10^{-3}
50	13.08×10^{-3}		13.4×10^{-3}
60	25.95×10^{-3}	26.048×10^{-3}	26.5×10^{-3}
70	49.44×10^{-3}		50.4×10^{-3}
80	90.75×10^{-3}	90.954×10^{-3}	92.4×10^{-3}
90	0.1610		0.164
100	0.2768	0.2771	0.281
110	0.4623		0.468
120	0.7517	0.75213	0.761
130	1.193		1.21
140	1.850	1.8499	1.87
150	2.808		2.83
160	4.180	4.1795	4.21
170	6.180		6.15
180	8.775	8.7734	8.83
190	12.40		12.48
200	17.27	17.27	17.37
210	23.72		23.83
220	32.14	32.15	32.28
230	43.02		43.19
240	56.90	56.93	57.11
250	74.45		74.70
260	96.41	96.70	96.70
270	123.6		124.0
280	157.4	157.23	157.5
290	197.8		198.3
300	247.1	247.41	247.6
310	306.2		306.9
320	376.7	377.27	377.4
330	460.2		461.0
340	558.4	559.22	559.3
350	673.2		674.3
360	806.8	808.00	807.9
370	961.3		962.7
380	1139.1	1140.65	1140.6
390	1342.8		1344.4
400	1575.0	1576.64	1576.9
420	2136.7	2137.76	
440	2848.2	2848.1	
460	3736.4	3733.8	
480	4829.8	4822.9	
500	6159.2	6145.4	

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Vargaftik
t/°C	p/bar	p/bar
0	0.2632×10^{-6}	0.2728×10^{-6}
10	0.6869×10^{-6}	0.7101×10^{-6}
20	1.677×10^{-6}	1.7929×10^{-6}
25	2.562×10^{-6}	
30	3.857×10^{-6}	3.68×10^{-6}
40	8.405×10^{-6}	8.626×10^{-6}
50	17.44×10^{-6}	17.86×10^{-6}
60	34.60×10^{-6}	35.36×10^{-6}
70	65.91×10^{-6}	67.24×10^{-6}
80	0.121×10^{-3}	0.1232×10^{-3}
90	0.2146×10^{-3}	0.2182×10^{-3}
100	0.3690×10^{-3}	0.3745×10^{-3}
110	0.6163×10^{-3}	0.6247×10^{-3}
120	1.002×10^{-3}	1.015×10^{-3}
130	1.590×10^{-3}	1.608×10^{-3}
140	2.466×10^{-3}	2.491×10^{-3}
150	3.744×10^{-3}	3.778×10^{-3}
160	5.573×10^{-3}	5.618×10^{-3}
170	8.144×10^{-3}	8.204×10^{-3}
180	11.70×10^{-3}	11.78×10^{-3}
190	16.53×10^{-3}	16.64×10^{-3}
200	23.03×10^{-3}	23.15×10^{-3}
210	31.62×10^{-3}	31.77×10^{-3}
220	42.85×10^{-3}	43.04×10^{-3}
230	57.35×10^{-3}	57.58×10^{-3}
240	75.86×10^{-3}	76.14×10^{-3}
250	99.26×10^{-3}	99.59×10^{-3}
260	0.1285	0.12892
270	0.1648	0.16527
280	0.2094	0.20993
290	0.2637	0.26435
300	0.3294	0.33015
310	0.4083	0.40910
320	0.5022	0.50320
330	0.6135	0.61460
340	0.7444	0.74567
350	0.8975	0.89896
360	1.0756	1.0772
370	1.2816	1.2834
380	1.5187	1.5207
390	1.7903	1.7925
400	2.0999	2.1024
420	2.8487	2.852
440	3.797	3.801
460	4.982	4.986
480	6.439	6.446
500	8.212	8.222
520	10.341	10.358
540	12.872	12.901
560	15.851	15.899
580	19.324	19.403
600	23.34	23.46
620	27.94	28.14

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

	Ambrose and Sprake	Vargaftik
t/°C	*p*/bar	*p*/bar
640	33.18	33.47
660	39.11	39.53
680	45.76	46.36
700	53.18	54.03
720	61.42	62.59
740	70.51	72.10
760	80.50	82.60
780	91.42	94.17
800	103.29	106.85
820	116.16	
840	130.06	
860	145.00	
880	161.03	
900	178.15	
950	225.9	
1000	281.2	
1050	344.2	
1100	415.8	
1150	496.7	
1200	588.3	
1250	692.4	
1300	812.0	
1350	950.8	
1400	1115	
1450	1312	
1490	1500	
1492 (ct)	1510	

COMPONENTS:	EVALUATOR:
Mercury; Hg; [7439-97-6]	Appendix IV Vapor Pressure of Liquid Mercury

CRITICAL EVALUATION:

with

$$x = \{2(T/K) - (400 + 1765)\}/(1765 - 400)$$

and the Chebyshev polynomials defined as stated previously. Values from the equation are given on the next two pages for temperatures from 683.15 to 1765 K.

The third set of values presented here are the vapor pressures from Vargaftik based on the evaluation of Vukalovich and Fokin. The table presents the vapor pressure in bars at 10 degree intervals from 0 to 800°C and in mmHg from 0 to 400°C.

Both Douglas, Ball and Ginnings and Ambrose and Sprake mention that the vapor pressures from the triple point to 400 K show poorer agreement than the values measured at higher temperatures. We make no recommendation that one data set is better than the other. The differences may reflect the overall uncertainty of the data on which they are based.

REFERENCES:

1. Douglas, T. B.; Ball, A. F.; Ginnings, D. C. *J. Res. National Bureau of Standards* 1951, *46*, 334 - 48.
2. Ambrose, D.; Sprake, C. H. S. *J. Chem. Thermodyn.* 1972, *4*, 603 - 20.
3. Vargaftik, N. B. *Tables on the thermophysical properties of liquids and gases*, Hemisphere Pub. Corp., Washington and London, 1975. (English translation of the 2nd Russian Edition, distributed by Halsted Press); *Chem. Abstr.* 1974, *80*, 137452v; 1976, *84*, 35655d.
4. Vukalovich, M. P.; Fokin, R. V. *Thermophysical properties of mercury*, Standards Press, 1971, 311 pp.; *Chem. Abstr.* 1973, *78*, 114619z.