Pressure-Volume-Temperature Properties of Propyne

S. P. VOHRA, T. L. KANG[1], K. A. KOBE[2], and J. J. McKETTA
Department of Chemical Engineering, University of Texas, Austin, Tex.

EXPERIMENTAL pressure-volume-temperature data for propyne in the temperature range of 50° to 200° C. and pressure range of 6 to 315 atm. were measured using a Beattie-type apparatus. Critical constants were also determined. Vapor pressures and orthobaric densities from 50° C. to the critical temperature were measured, smoothed, and correlated. Because of the polymerization of propyne at higher temperatures, P-V-T properties could not be measured for temperatures higher than 200° C.

EXPERIMENTAL

Purity. The propyne was supplied by the Air Reduction Chemical Co., with the specification of 98.65% purity. The initial purification by superfractionation yielded a product of 99.9+ mole % purity. Further purification was made as suggested by Vohra and Kobe (*9*). From the results of mass-spectrograph and freezing point analysis, propyne so obtained was almost 100% pure (at least greater than 99.99+%).

Method and Apparatus. The apparatus used for the measurements of P-V-T properties is similar to the one designed and used by Beattie (*1*). A detailed description of the design, construction, and calibration of the apparatus, as well as the experimental procedures and the data treatment have been given (*8*).

Reproducibility of Data. In selecting the sample sizes, care was taken to allow enough overlap in the volume ranges covered by different samples. The compressibility data in these regions were internally consistent and reproducible with 0.2% of uncertainty. However, at 200° C., evidence of slight polymerization was observed. Data at this temperature were estimated to have an uncertainty of 0.5%. The evidences and the estimation of this uncertainty are discussed elsewhere (*8*).

The maximum variation of 0.008 atm. was observed in vapor pressures obtained from the different samples at 50° C. Because of the difficulty in obtaining thermal equilibrium in the apparatus at low temperatures and the insensitivity of the dead-weight gage at low pressures, this figure was a little higher than the actual reproducibility of vapor pressure measurement, which was ±0.003 atm.

Experimental Data. P-V-T measurements were made from 6 atm. to either the vapor pressure at the prevailing temperature or the maximum pressure of 315 atm. at 50°, 75°, 100°, 125°, 129.25°, 150°, 175°, and 200° C. Additional data included several gas-phase isotherms at 135°, 140°, and 145° C., as well as a few points near the saturation curve at 90°, 95°, 105°, 110°, and 120° C. The experimental compressibility factor data for gaseous propyne are presented in Table I and shown in Figure 1. Isotherms investigated

[1] Present address, Research Center, The B.F. Goodrich Co., Brecksville, Ohio.
[2] Deceased.

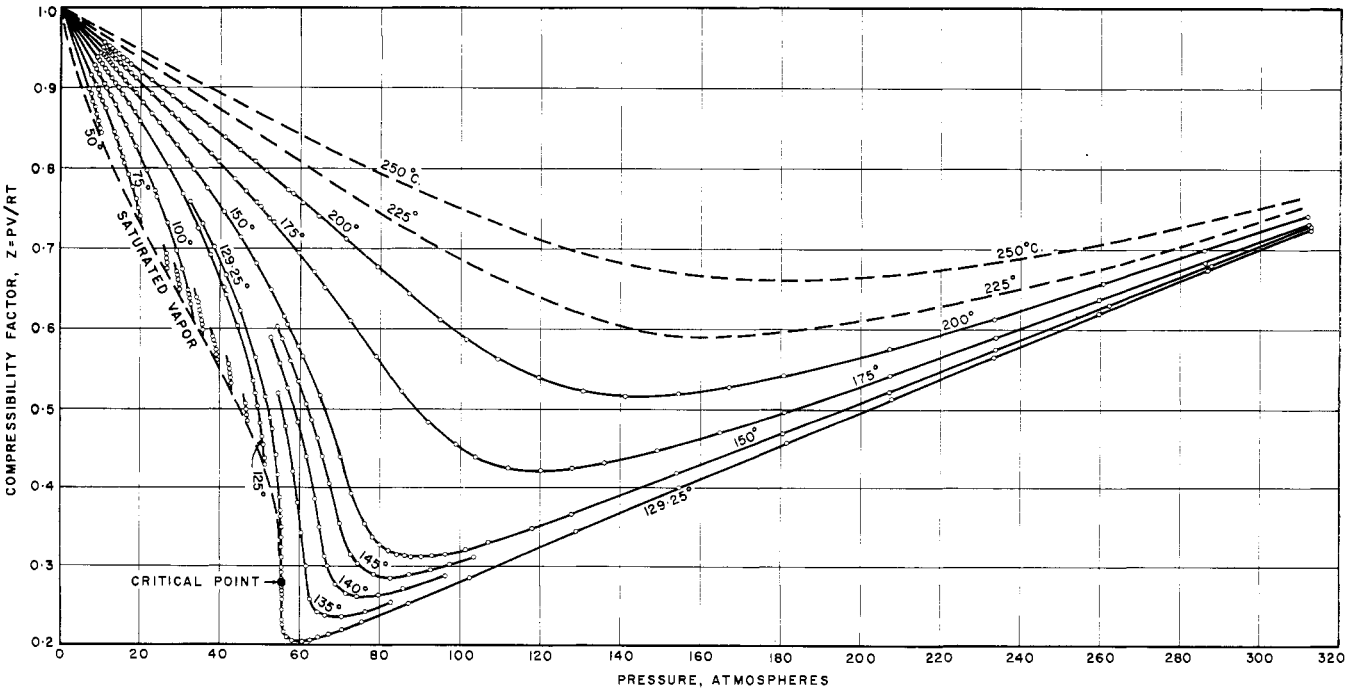

Figure 1. Compressibility factors of propyne

Table I. Experimental Compressibility Data for Gaseous Propyne

t	V	p	Z
	Mass of Sample = 0.4994 G.		
50	84.373	7.052	0.8990
	79.007	7.478	0.9826
	73.444	7.978	0.8852
	68.764	8.441	0.8770
	64.038	8.969	0.8677
	59.938	9.482	0.8586
	56.195	10.000	0.8490
	50.505	10.843	0.8274
75	84.341	7.745	0.9161
	74.033	8.714	0.9047
	69.385	9.232	0.8983
	65.145	9.763	0.8919
	61.477	10.274	0.8857
	56.184	11.103	0.8748
	42.871	13.933	0.8376
	39.826	14.787	0.8258
	37.444	15.523	0.8151
	35.882	16.045	0.8074
	33.384	16.939	0.7930
	30.833	17.969	0.7770
	28.664	18.928	0.7608
	27.545	19.454	0.7515
	26.923	19.740	0.7453
100	84.424	8.413	0.9293
	79.542	8.890	0.9252
	73.151	9.599	0.9187
	63.161	10.965	0.9061
	60.010	11.481	0.9015
	54.573	12.490	0.8918
	49.094	13.705	0.8803
	44.764	14.831	0.8686
	40.504	16.140	0.8553
	36.884	17.442	0.8417
	33.664	18.794	0.8278
	28.512	21.391	0.7980
	24.374	24.024	0.7661
100	20.973	26.662	0.7316
	18.337	29.040	0.6967
	16.873	30.551	0.6745
	15.543	31.894	0.6486
	15.301	32.160	0.6438
	15.022	32.451	0.6378
	14.744	32.667	0.6302
	24.621	24.013	0.7736[a]
	49.094	13.696	0.8798[a]
	84.424	8.418	0.9298[a]
125	84.417	9.076	0.9395
	79.476	9.606	0.9361
	75.060	10.128	0.9322
	71.126	10.647	0.9286
	67.484	11.176	0.9248
	64.276	11.687	0.9212
	58.486	12.740	0.9137
	54.517	13.572	0.9073
	51.298	14.333	0.9016
	46.527	15.632	0.8918
	42.494	16.921	0.8817
	38.869	18.284	0.8715
	35.585	19.687	0.8590
	24.946	26.251	0.8030
	20.539	30.480	0.7676
	17.199	34.427	0.7260
	15.036	37.550	0.6923
	12.613	41.538	0.6424
	11.164	44.177	0.6047
	9.0206	48.369	0.5350
	8.7267	48.616	0.5202
	8.3418	49.302	0.5043
	7.8554	50.043	0.4820
	7.0821	51.059	0.4434
	84.420	9.078	0.9397[a]
150	84.411	9.727	0.9474
	80.845	10.127	0.9446
	76.582	10.663	0.9422
	72.802	11.178	0.9389
	69.376	11.694	0.9360
	66.147	12.229	0.9333
	63.251	12.749	0.9304
	59.246	13.537	0.9253
	53.565	14.850	0.9177
150	48.798	16.157	0.9097
	44.675	17.498	0.9020
	41.616	18.649	0.8954
	37.114	20.628	0.8833
	33.214	22.716	0.8705
	30.120	24.683	0.8578
	27.241	26.859	0.8442
	24.635	29.174	0.8292
	22.138	31.746	0.8109
	20.594	33.624	0.7990
	18.276	36.782	0.7756
	15.724	41.070	0.7451
	13.751	45.006	0.7141
	12.048	48.976	0.6808
	10.663	52.679	0.6481
	9.2106	56.923	0.6049
	8.1019	60.578	0.5663
	84.413	9.725	0.9471[a]
175	84.390	10.356	0.9521
	80.339	10.854	0.9500
	76.024	11.440	0.9475
	72.547	11.965	0.9456
	67.558	12.790	0.9413
	63.623	13.528	0.9376
	58.736	14.578	0.9328
	52.586	16.163	0.9259
	48.362	17.449	0.9193
	44.663	18.787	0.9141
	36.094	22.723	0.8935
	31.994	25.313	0.8823
	28.680	27.821	0.8692
	26.993	29.314	0.8620
	24.071	32.306	0.8472
	21.887	34.943	0.8332
	19.869	37.877	0.8199
	18.719	39.690	0.8092
	16.540	43.701	0.7874
	15.204	46.584	0.7716
	13.793	50.065	0.7523
	14.131	49.246	0.7581
	12.667	53.105	0.7328
	11.237	57.211	0.7003
	9.7377	63.292	0.6714
200	84.364	11.009	0.9583
	75.703	12.222	0.9536
	71.945	12.794	0.9498
	69.277	13.251	0.9472
	63.942	14.293	0.9430
	58.246	15.606	0.9379
	56.145	16.161	0.9363
	51.722	17.439	0.9307
	44.470	20.069	0.9209
	38.875	22.705	0.9108
	34.614	25.249	0.9018
	31.024	27.827	0.8908
	27.952	30.452	0.8783
	25.496	33.100	0.8708
	22.321	37.095	0.8544
	19.857	40.989	0.8398
	17.751	44.941	0.8231
	16.028	48.930	0.8092
	14.491	52.602	0.7865
	13.207	56.721	0.7730
	12.113	60.583	0.7572
	Mass of Sample = 1.9760 G.		
90	18.429	27.063	0.6705
	18.241	27.125	0.6652
95	16.465	29.772	0.6501
	16.281	29.882	0.6452
	16.096	29.928	0.6388
100	23.609	24.469	0.7558
	18.496	29.274	0.6913
	15.013	32.270	0.6339
	14.828	32.471	0.6300
	14.643	32.665	0.6258
	14.458	32.822	0.6209
	14.273	32.911	0.6146
105	13.226	35.473	0.6057
	12.675	36.080	0.5904
110	11.335	39.218	0.5664
	11.161	39.416	0.5606
	11.053	39.554	0.5571
	10.942	39.609	0.5523
115	9.8208	42.927	0.5297
	9.6725	43.107	0.5239
120	8.395	46.886	0.4888
	Mass of Sample = 2.3655 G.		
90	19.156	26.600	0.6850
	19.002	26.696	0.6820
	19.466	26.399	0.6909
	19.311	26.514	0.6883
	18.847	26.798	0.6790
	18.692	26.863	0.6751
	18.538	26.915	0.6708
	18.383	26.956	0.6662
95	17.457	29.003	0.6714
	17.302	29.140	0.6686
	17.147	29.271	0.6652
	16.993	29.391	0.6623
	16.838	29.498	0.6587
	16.683	29.579	0.6544
	16.528	29.644	0.6498
105	14.514	34.089	0.6388
	14.283	34.363	0.6337
	14.049	34.643	0.6284
	13.927	34.782	0.6254
	13.818	34.908	0.6229
	13.725	35.021	0.6205
	13.601	35.162	0.6174
	13.477	35.311	0.6144
	13.322	35.475	0.6102
	13.167	35.598	0.6052
	13.059	35.719	0.6022
	12.942	35.813	0.5984
110	12.032	38.442	0.5894
	11.876	38.642	0.5848
	11.722	38.833	0.5800
	11.505	39.074	0.5728
	11.353	39.206	0.5672
	11.201	39.301	0.5609
115	10.488	42.132	0.5552
	10.331	42.349	0.5497
	10.176	42.557	0.5440
	10.021	42.748	0.5382
	9.8659	42.907	0.5318
120	8.774	46.437	0.5060
	8.619	46.642	0.4992
	8.464	46.828	0.4922
	8.309	46.968	0.4846
129.25	19.169	32.649	0.7593
	16.992	35.486	0.7316
	15.125	38.273	0.7023
	13.255	41.432	0.6663
	11.395	44.956	0.6215
	9.5321	48.741	0.5637
	8.2898	51.244	0.5154
	7.6690	52.414	0.4877
	7.3583	52.957	0.4728
	6.7367	53.925	0.4407
	6.2711	54.257	0.4149
	5.8055	54.985	0.3873
	5.4949	55.230	0.3682
	3.1657	56.073	0.2154
	3.0419	56.669	0.2091
	2.9009	58.073	0.2044
	2.7913	60.062	0.2035
	2.7029	62.566	0.2052
	2.6525	64.575	0.2078
	2.5999	67.192	0.2119
	2.5477	70.555	0.2181
	2.4879	75.548	0.2280
	2.3868	87.143	0.2523
	2.3000	102.19	0.2852
	2.2007	128.87	0.3441
	2.1331	154.58	0.4000
	2.0804	181.27	0.4575

(Continued)

Table I. (Continued)

t	V	p	Z	t	V	p	Z	t	V	p	Z
129.25	2.0362	207.59	0.5128	145	9.0581	55.529	0.5873	175	3.2257	119.99	0.4216
	1.9954	233.15	0.5644		8.3123	57.711	0.5601		3.0482	127.87	0.4246
	1.9701	259.35	0.6199		7.6673	59.652	0.5340		2.9166	135.65	0.4310
	1.9393	286.56	0.6742		7.0528	61.534	0.5067		2.7549	148.88	0.4468
	1.9122	312.33	0.7247		6.6324	62.828	0.4865		2.6202	164.76	0.4703
	9.5321	48.736	0.5636[a]		6.1672	64.240	0.4626		2.5210	180.76	0.4964
					5.7191	65.595	0.4380		2.4014	207.22	0.5421
135	7.9687	54.374	0.5183						2.3179	233.74	0.5902
	7.0879	56.346	0.4777	150	9.5346	56.003	0.6161		2.2506	259.60	0.6365
	6.0082	58.464	0.4202		8.4230	59.425	0.5775		2.1915	285.91	0.6826
	4.7265	60.317	0.3410		6.9041	64.942	0.5173		2.1486	311.87	0.7300
	3.4440	62.364	0.2569		5.4314	69.964	0.4384		12.968	52.167	0.7370[a]
	3.1154	64.313	0.2397		4.6549	72.996	0.3920		14.955	47.127	0.7678[a]
	2.9719	66.365	0.2359		4.0167	76.219	0.3532	200	14.962	51.649	0.7974
	2.7918	70.279	0.2347		3.7315	78.172	0.3366		12.797	58.243	0.7691
	2.6502	76.260	0.2417		3.5158	80.301	0.3257		11.090	64.739	0.7408
	2.5530	82.841	0.2530		3.3775	82.142	0.3201		9.6779	71.293	0.7119
	4.0842	61.075	0.2984		3.2313	84.290	0.3142		8.2865	79.179	0.6770
	5.3274	59.543	0.3794		3.1368	86.268	0.3122		7.1527	87.108	0.6429
140	9.4596	52.644	0.5885		3.0704	87.856	0.3112		6.2354	94.928	0.6108
	8.5883	54.922	0.5574		2.9915	90.183	0.3113		5.5938	101.51	0.5859
	7.8105	56.994	0.5261		2.9104	93.057	0.3125		4.9786	109.25	0.5612
	6.8681	59.464	0.4826		2.8394	96.236	0.3153		4.3508	119.83	0.5380
	6.0438	61.518	0.4394		2.7477	101.32	0.3212		3.8802	130.35	0.5219
	5.0248	63.825	0.3790		2.6700	106.91	0.3293		3.5511	140.95	0.5165
	3.9765	66.267	0.3114		2.5589	117.94	0.3482		3.2780	154.32	0.5220
	3.3831	68.880	0.2754		2.4844	127.76	0.3662		3.0583	167.27	0.5278
	3.1176	71.560	0.2636		2.3482	154.06	0.4174		2.9046	180.71	0.5416
	2.9646	74.279	0.2602		2.2573	180.38	0.4698		2.6961	207.07	0.5761
	2.7851	79.795	0.2626		2.1884	206.96	0.5234		2.5537	233.34	0.6125
	2.6650	85.810	0.2702		2.1336	233.56	0.5750		2.4468	260.32	0.6572
	2.5236	96.234	0.2870		2.0833	261.98	0.6297		2.3681	285.73	0.6982
	4.5450	64.876	0.3484		2.0525	286.57	0.6786		2.3037	311.77	0.7411
	3.7822	66.886	0.2989		2.0202	312.35	0.7280		14.961	51.521	0.7954
145	5.1352	67.360	0.4039		9.5346	55.993	0.6160[a]		Mass of Sample = 2.3922 G.		
	4.3157	70.005	0.3527	175	12.968	52.180	0.7372				
	3.7024	72.819	0.3148		10.718	59.480	0.6945	125	7.9006	49.911	0.4835
	3.4779	74.480	0.3024		9.0405	66.074	0.6508		7.5026	50.509	0.4647
	3.1370	78.662	0.2881		7.7249	72.485	0.6100		7.3023	50.781	0.4547
	2.9218	82.728	0.2822		6.5689	79.046	0.5657		7.0029	51.150	0.4392
	2.8249	87.270	0.2878		5.5958	85.628	0.5220		6.8031	51.367	0.4258
	2.7205	92.590	0.2941		4.8137	92.150	0.4833		6.6079	51.537	0.4176
	2.6471	97.503	0.3012		4.2120	98.835	0.4535		7.0033	51.147	0.4392[a]
	2.5758	103.38	0.3109		3.8753	103.79	0.4382		Mass of Sample = 3.0284 G.		
	9.5151	54.230	0.6025		3.4808	111.99	0.4247				
								125	12.997	40.809	0.6504
									6.9411	51.270	0.4364

[a]Check points.

in the critical region were 127.00°, 128.50°, 128.80°, 129.00°, 129.10°, 129.20°, 129.22°, 129.25°, and 129.30° C. The P-V-T data in the critical region are presented in Table II and shown in Figure 2.

Vapor pressures and specific volumes of both the saturated liquid and the saturated vapor were measured from 50° C., at 5° intervals, to the critical temperature, which was 129.23 ±0.02° C. In the liquid phase, P-V-T data were measured from the vapor pressure to about 315 atm. for four isotherms; 50°, 75°, 100°, and 125° C. The pressure-volume isotherms in the high-pressure region are presented in Table III and shown in Figure 3.

DERIVED QUANTITIES

Smoothed Vapor Pressures. For the experimental vapor pressure data, the constants of the Antoine equation were derived using the method of least squares. A simplified procedure of correlating, as recommended by Rossini (*6*), was used. In its final form, the Antoine equation for vapor pressure of propyne in the range from 50° C. to the critical temperature is as follows:

$$\log p = 4.81207 - \frac{1321.342}{t + 301.143} \quad (1)$$

Vapor pressures calculated from Equation 1 do not deviate from the experimental results by more than 0.055 atm. (0.167%) in the range 50° to 120° C. However, at 125° C. the deviation is 0.152 atm. (0.295%), which increases to 0.347 atm. (0.625%) at the critical temperature.

Smoothed vapor pressures were obtained by adding to the experimental vapor pressures the graphically smoothed residuals, which were the differences between experimental vapor pressures and the vapor pressures calculated from Equation 1. Both the experimental and smoothed vapor pressures are presented in Table IV.

Orthobaric Densities. The following equations were fitted by the method of least squares to the orthobaric densities, which were obtained by extrapolating the pressure-volume isotherms of Table I and Table III to the corresponding observed vapor pressures:

$$d = (d_L + d_g)/2 = 0.323918 - 0.000585672\,t \quad (2)$$

$$\Delta = (d_L + d_g)/2 = 0.067073\,(t_c - t)^{1/3} - 0.0116512 \quad (3)$$

These observed orthobaric densities were smoothed by using the same graphical residual method as employed in

Table II. Experimental Pressure-Volume Isotherms for Liquid Propyne

V	p	V	p	V	p
t, 50° C.		t, 90° C.		t, 115° C.	
1.7573	13.600	2.0570	27.888	2.4374	44.025
1.7551	18.337	2.0522	29.817	2.4243	44.890
1.7502	22.589	2.0478	31.271	2.4088	46.138
1.7418	33.540	2.0413	33.446	2.3915	47.384
1.7343	43.991			2.3670	50.046
1.7268	54.726	t, 95° C.			
1.7153	73.614	2.0986	30.886	t, 120° C.	
1.6995	101.47	2.0946	31.929		
1.6853	128.89	2.0905	33.305	2.6103	48.091
1.6722	157.26	2.0875	34.362	2.5911	48.825
1.6611	181.07			2.5634	50.025
1.6504	207.83	t, 100° C.		2.5329	51.679
1.6398	235.67				
1.6299	260.52	2.1433	35.558		
1.6209	286.36	2.1318	38.208	t, 125° C.	
1.6118	312.42	2.1110	43.505		
t, 75° C.		2.0894	50.047	2.8329	51.604
		2.0597	60.878	2.7957	52.211
2.0590	19.934	2.0248	75.758	2.7715	52.560
1.9241	20.383	1.9768	101.49	2.7151	53.615
1.9225	22.042	1.9375	125.77	2.6211	56.360
1.9182	23.701	1.9050	154.05	2.5331	60.519
1.9094	29.041	1.8759	180.39	2.3674	75.280
1.8928	39.045	1.8518	206.71	2.1845	101.64
1.8654	60.191	1.8309	233.02	2.1394	129.08
1.8536	75.476	1.8115	259.36	2.0814	154.65
1.8226	102.49			2.0344	180.62
1.8040	129.24	t, 105° C.		1.9970	206.85
1.7849	154.37			1.9609	234.86
1.7669	180.88	2.2397	36.726	1.9310	260.72
1.7491	207.67	2.2328	37.378	1.9035	286.43
1.7329	235.88	2.2092	41.220	1.8796	311.80
1.7172	261.36	2.1969	43.941		
1.7030	287.80			t, 127° C.	
1.6907	313.80	t, 110° C.			
t, 85° C.				3.0180	53.472
		2.3325	40.597	2.9234	54.016
1.9982	25.411	2.3223	42.117	2.8799	54.376
1.9901	28.824	2.3114	43.409	2.8332	54.909
1.9800	33.228	2.3000	44.871	2.7801	55.743

Sample Mass = 2.3922 G. at 125° and 127° C.
Sample Mass = 2.3655 G. at other temperatures.

Table III. Experimental Pressure-Volume Isotherms in the Critical Region of Propyne

(Sample Mass = 2.3922 G.)

V	p	V	p	V	p
t, 128.5° C.		t, 129.1° C.			
5.4024	54.692	5.4002	55.138	4.3124	55.517
5.3102	54.738	5.3014	55.193	4.2072	55.522
5.2122	54.778	5.1989	55.242	4.1526	55.524
5.1045	54.811	5.1110	55.278	4.0974	55.527
5.0019	54.829	5.0035	55.317	4.0513	55.527
4.8945	54.836	4.9021	55.345	3.9895	55.529
4.7754	54.838	4.8010	55.365	3.8977	55.531
4.5717	54.838	4.6964	55.384	3.8026	55.535
4.2630	54.839	4.5950	55.395	3.6060	55.547
3.8955	54.839	4.5026	55.401	3.4079	55.612
3.6802	54.838	4.4064	55.403	3.3096	55.693
3.4958	54.837	4.3124	55.405		
3.3885	54.839	4.2072	55.407		
3.2811	54.878	4.0974	55.408	t, 129.25° C.	
3.1748	55.027	3.9895	55.407		
3.0685	55.346	3.7073	55.409	5.4028	55.242
5.4012	54.696[a]	3.6060	55.419	5.1989	55.348
t, 128.8° C.		3.5078	55.431	4.8010	55.481
		3.4079	55.468	4.5950	55.515
5.4036	54.913	3.3096	55.544	4.4064	55.532
5.2039	55.010	3.2084	55.696	4.3124	55.537
5.0043	55.063			4.2072	55.542
4.7972	55.107			4.1526	55.544
4.6973	55.111			4.0974	55.546
4.5959	55.113	t, 129.2° C.		4.0513	55.549
4.5035	55.113			3.9895	55.551
4.0984	55.116	5.4028	55.217	3.8977	55.553
3.7086	55.116	5.3015	55.274	3.8026	55.557
3.6072	55.115	5.1989	55.323	3.6060	55.574
3.5114	55.117	5.1110	55.362	3.4079	55.634
3.4074	55.130	5.0035	55.398	3.3096	55.713
3.3091	55.195	4.9021	55.427	5.0030	55.425[a]
3.2097	55.321	4.8010	55.453		
t, 129° C.		4.6964	55.468		
		4.5950	55.480		
5.5864	54.962	4.5026	55.491	t, 129.30° C.	
5.4789	55.035	4.4064	55.498		
5.3714	55.094	4.3124	55.503	5.4016	55.286
5.2640	55.146	4.2072	55.508	5.3003	55.349
5.2025	55.175	4.0974	55.507	5.1978	55.398
5.1082	55.211	3.9895	55.509	5.1098	55.442
5.0154	55.239	3.8977	55.511	5.0023	55.480
4.9202	55.267	3.8026	55.513	4.9009	55.512
4.8036	55.287	3.7073	55.515	4.7998	55.540
4.6856	55.302	3.6060	55.528	4.6952	55.560
4.5846	55.312	3.5078	55.543	4.5939	55.573
4.4798	55.316	3.4079	55.590	4.5014	55.585
4.3880	55.322	3.3096	55.671	4.4095	55.592
4.2896	55.321	3.2084	55.836	4.3113	55.597
4.1884	55.321			4.2037	55.602
4.0844	55.322			4.0962	55.607
3.9822	55.321			3.9884	55.614
3.8808	55.321			3.8966	55.616
3.7736	55.322	t, 129.22° C.		3.8014	55.621
3.6659	55.322	5.4028	55.223	3.7062	55.626
3.5584	55.326	5.1989	55.335	3.6048	55.635
3.4509	55.349	5.0035	55.413	3.5066	55.661
3.3436	55.407	4.8010	55.467	3.4067	55.708
3.2367	55.536	4.5950	55.497	3.3084	55.797
3.1286	55.785	4.4064	55.512	3.2072	55.970

[a] Check point.

the smoothing of vapor pressures. Table IV also presents the orthobaric densities of propyne, both observed and smoothed.

Critical Constants. Critical constants of propyne were obtained from a large-scale, pressure-volume plot (Figure 2) of isotherms in the critical region. These isotherms were spaced very closely (0.02° C. apart near the critical temperature) so that the horizontal point of inflection could be determined. The critical temperature, 129.23 ± 0.02° C., was selected with the corresponding critical pressure of 55.54 ± 0.02 atm. The critical density was determined to be 0.2449 gram per c.c. from the rectilinear diameter, Equation 2, in conjunction with the smoothed residual. The critical compressibility factor, thus, is 0.27518.

DISCUSSION

A literature survey shows that practically no P-V-T measurements have been made on propyne at temperatures above the normal boiling point. Even at lower temperatures, the data are fragmentary. Thus, no comparison is made of the experimental data obtained in this work, such as compressibility factors, vapor pressures or orthobaric densities, with the data reported in literature.

No experimental values for the critical pressure or the critical volume are available. The critical pressure of propyne reported by Stull (7) represents an extrapolation of the vapor pressure curve (Cox chart) to the critical temperature. Table V compares the critical constants obtained in this investigation with those of other investigations.

Smoothed compressibility factors from this work are compared, in Table VI, with the values obtained from the generalized charts of Nelson and Obert (5). Reduced temperatures from 0.803 to 1.176 and reduced pressures from 0.10 to 5.5 are covered in the range of this comparison. Per cent deviations observed here are no larger than those encountered by Nelson and Obert, except in the critical region, where the deviations are as high as 4 to 5%.

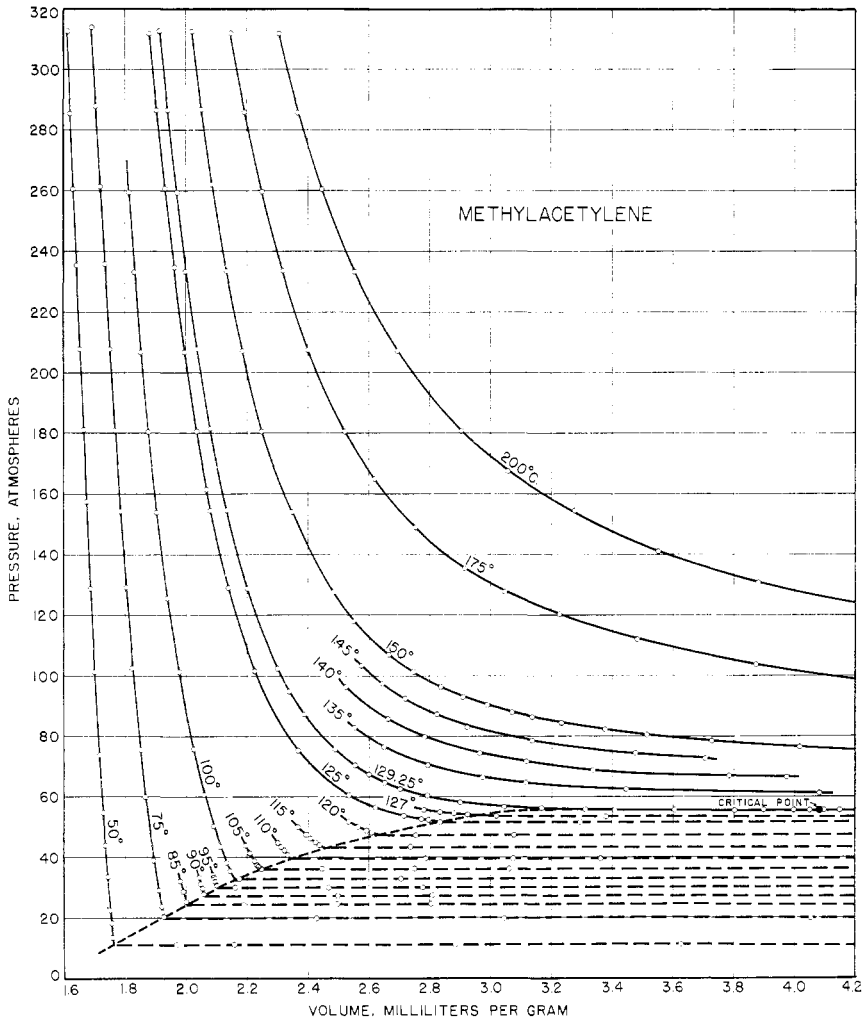

Figure 2. Pressure-volume isotherms in the critical region of propyne

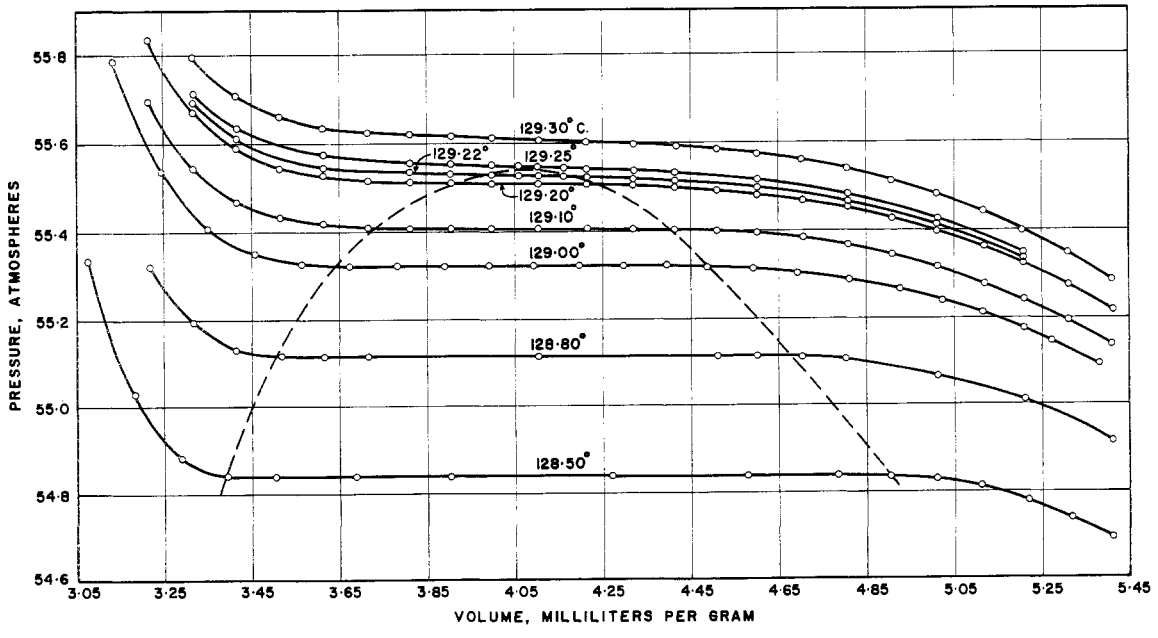

Figure 3. Pressure-volume isotherms for propyne in the high-pressure region

Table IV. Vapor Pressure and Orthobaric Density Data for Propyne

Temp., ° C.	Vapor Pressure, Atm.		Density for Satd. Vapor		Density of Satd. Liq.	
	Observed	Smoothed	Observed	Smoothed	Observed	Smoothed
50	11.184	11.184	0.02067	0.02070	0.5784	0.5703
55	12.646	12.645	0.02300	0.02300	0.5602	0.5602
60	14.236	14.236	...	0.02589	...	0.5501
65	15.982	15.972	...	0.02788	...	0.5413
70	17.887	17.864	...	0.03331	...	0.5279
75	19.928	19.920	0.03768	0.03780	0.5192	0.5192
80	22.149	22.149	...	0.04240	...	0.5088
85	24.554	24.556	...	0.04822	...	0.4974
90	27.144	27.145	0.05487	0.05470	0.4859	0.4861
95	29.928	29.940	0.06155	0.06214	0.4757	0.4741
100	32.916	32.947	0.06979	0.07050	0.4649	0.4603
105	36.169	36.171	0.07958	0.08018	0.4452	0.4448
110	39.624	39.623	0.09156	0.09148	0.4272	0.4275
115	43.310	43.310	0.1053	0.1058	0.4077	0.4070
120	47.275	47.255	0.1254	0.1252	0.3758	0.3812
125	51.600	51.597	0.1487	0.1560	0.3530	0.3440
127	53.405	53.410	0.1666	0.1760	0.3286	0.3204
128.5	54.838	54.843	0.2041	0.1927	0.2954	0.3011
128.8	55.115	55.127	0.2141	0.2020	0.2859	0.2912
129.0	55.322	55.352	0.2232	0.2221	0.2755	0.2709
129.1	55.407	55.426	0.2273	0.2291	0.2681	0.2637
129.2	55.508	55.528	0.2361	0.2423	0.2556	0.2503
129.23	...	55.540	...	0.2449	...	0.2449

Table V. Critical Constants for Propyne

t_c, ° C.	P_c, atm.	d_c, g./c.c.	Reference
129.5	...	...	(2)
127.9	...	...	(3)
121.6	...	...	(4)
128	52.8	...	(7)
129.23±0.02	55.54±0.02	0.2449±0.002	This work

Table VI. Comparison of Compressibility Factors for Propyne with Generalized Charts

Temp., ° C.,	Reduced Pressure	$Z = PV/RT$, (5)	This Work	Deviation, %
50	0.10	0.922	0.923	−0.11
	0.18	0.845[a]	0.850	−0.59
75	0.15	0.907	0.908	−0.11
	0.25	0.842	0.838	0.48
100	0.20	0.904	0.905	−0.11
	0.40	0.797	0.790	0.89
125	0.20	0.923	0.925	−0.22
	0.50	0.793[a]	0.796	−0.38
	0.80	0.607	0.603	0.66
150	0.20	0.935	0.939	−0.42
	2.00	0.340	0.335	1.49
	5.50	0.725	0.715	1.40
175	0.20	0.947	0.949	−0.21
	2.00	0.425	0.426	−0.23
	5.50	0.730	0.720	1.39
200	0.20	0.955	0.957	−0.21
	2.00	0.540	0.557	−3.05
	5.50	0.750	0.731	−2.59

[a] Obtained by extrapolation.

NOMENCLATURE

- d_c = critical density, g./c.c.
- d_g = density of saturated vapor, g./c.c.
- d_L = density of saturated liquid, g./c.c.
- p = pressure, atm.
- P = absolute pressure
- P_c = critical pressure, atm.
- R = gas constant
- T = absolute temperature
- t = temperature, ° C.
- t_c = critical temperature, ° C.
- V = volume, ml./g.
- Z = compressibility factor, PV/RT

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