

**SCHAUM'S
OUTLINE OF**

Mühendisler İçin Termodinamik

Thermodynamics
for Engineers

İkinci Basımdan Çeviri
Second Edition

Merle C. POTTER, Ph.D.
Craig W. SOMERTON, Ph.D.

Çeviri Editörü:
Prof. Dr. Hüsamettin BULUT

**Mc
Graw
Hill**

nobel

AKADEMİK YAYINCILIK

EK A

Birim Dönüşümleri

Uzunluk

1 cm = 0.3937 inç
1 m = 3.281 ft
1 km = 0.6214 mil
1 in = 2.54 cm
1 ft = 0.3048 m
1 mil = 1.609 km
1 mil = 5280 ft
1 = 1760 yd

İş ve Isı

1 J = 10 ⁷ ergs
1 ft-lbf = 1.356 J
1 Cal = 3.088 ft-lb
1 Cal = 0.003968 Btu
1 Btu = 1055 J
1 Btu = 0.2930 W·h
1 Btu = 778 ft-lb
1 kWh = 3412 Btu
1 therm = 10 ⁵ Btu
1 quad = 10 ¹⁵ Btu

Kuvvet

1 lbf = 0.4448 × 10 ⁶ dyne
1 dyne = 2.248 × 10 ⁻⁶ lbf
1 kip = 1000 lbf
1 N = 0.2248 lbf
1 N = 10 ⁵ dyne

Güç

1 ho = 550 ft-lb/s
1 BG = 2545 Btu/h
1 BG = 0.7455 kW
1 W = 1 J/s
1 W = 1.0 × 10 ⁷ dyne·cm/s
1 W = 3.412 Btu/h
1 kW = 1.341 BG
1 ton = 12,000 Btu/h
1 ton = 3.517 kW

Kütle

1 oz = 28.35 gr
1 lbm = 0.4536 kg
1 slug = 32.17 lbm
1 slug = 14.59 kg
1 kg = 2.205 lbm

Basınç

1 psi = 2.036 inç Hg
1 psi = 27.7 inç H ₂ O
1 atm = 29.92 inç Hg
1 atm = 33.93 ft H ₂ O
1 atm = 101.3 kPa
1 atm = 1.0133 bar
1 atm = 14.7 psi
1 inç Hg = 0.4912 psi
1 ft H ₂ O = 0.4331 psi
1 psi = 6.895 kPa
1 kPa = 0.145 psi

Hız

1 m/h = 1.467 ft/s
1 m/h = 0.8684 knot
1 ft/s = 0.3048 m/s
1 km/h = 0.2778 m/s
1 knot = 1.688 ft/s

Hacim

1 ft ³ = 7.481 gal (U.S.)
1 ft ³ = 0.02832 m ³
1 galon (ABD) = 231 inç ³
1 galon (İngiliz) = 1.2 galon (ABD)
1 litre = 10 ⁻³ m ³
1 litre = 0.03531 ft ³
1 litre = 0.2642 galon
1 m ³ = 264.2 galon
1 m ³ = 35.31 ft ³
1 ft ³ = 28.32 litre
1 inç ³ = 16.387 cm ³

EK B

Malzeme Özellikleri

Tablo B-1 Standart Atmosfer Özellikleri

$$P_0 = 101.3 \text{ kPa}, \quad \rho_0 = 1.225 \text{ kg/m}^3$$

Yükseklik m	Sıcaklık °C	Basınç P/P_0	Yoğunluk ρ/ρ_0
0	15.2	1.000	1.000
1,000	9.7	0.8870	0.9075
2,000	2.2	0.7846	0.8217
3,000	-4.3	0.6920	0.7423
4,000	-10.8	0.6085	0.6689
5,000	-17.3	0.5334	0.6012
6,000	-23.8	0.4660	0.5389
7,000	-30.3	0.4057	0.4817
8,000	-36.8	0.3519	0.4292
10,000	-49.7	0.2615	0.3376
12,000	-56.3	0.1915	0.2546
14,000	-56.3	0.1399	0.1860
16,000	-56.3	0.1022	0.1359
18,000	-56.3	0.07466	0.09930
20,000	-56.3	0.05457	0.07258
30,000	-46.5	0.01181	0.01503
40,000	-26.6	0.2834×10^{-2}	0.3262×10^{-2}
50,000	-2.3	0.7874×10^{-3}	0.8383×10^{-3}
60,000	-17.2	0.2217×10^{-3}	0.2497×10^{-3}
70,000	-53.3	0.5448×10^{-4}	0.7146×10^{-4}

Tablo B-1E Standart Atmosfer Özellikleri

$$P_0 = 14.7 \text{ psia}, \rho_0 = 0.0763 \text{ kg/ft}^3$$

Yükseklik ft	Sıcaklık °F	Basınç P/P_0	Yoğunluk ρ/ρ_0
0	59.0	1.00	1.00
1,000	55.4	0.965	0.975
2,000	51.9	0.930	0.945
5,000	41.2	0.832	0.865
10,000	23.4	0.688	0.743
15,000	5.54	0.564	0.633
20,000	-12.3	0.460	0.536
25,000	-30.1	0.371	0.451
30,000	-48.0	0.297	0.376
35,000	-65.8	0.235	0.311
36,000	-67.6	0.224	0.299
40,000	-67.6	0.185	0.247
50,000	-67.6	0.114	0.153
100,000	-67.6	0.0106	0.0140
110,000	-47.4	0.00657	0.00831
150,000	113.5	0.00142	0.00129
200,000	160.0	0.314×10^{-3}	0.262×10^{-3}
260,000	-28	0.351×10^{-4}	0.422×10^{-4}

Tablo B-2 Değişik İdeal Gazların Özellikleri

Gaz	Kimyasal Formül	Mol Kütlesi	R		C_p		C_v		k
			kJ/kg·K	ft-lbf/lbm-°R	kJ/kg·K	Btu/lbm-°R	kJ/kg·K	Btu/lbm-°R	
Hava	—	28.97	0.287 0	53.34	1.003	0.240	0.717	0.171	1.400
Argon	Ar	39.95	0.208 1	38.68	0.520	0.1253	0.312	0.0756	1.667
Bütan	C ₄ H ₁₀	58.12	0.143 0	26.58	1.716	0.415	1.573	0.381	1.091
Karbondioksit	CO ₂	44.01	0.188 9	35.10	0.842	0.203	0.653	0.158	1.289
Karbonmonoksit	CO	28.01	0.296 8	55.16	1.041	0.249	0.744	0.178	1.400
Etan	C ₂ H ₆	30.07	0.276 5	51.38	1.766	0.427	1.490	0.361	1.186
Etilen	C ₂ H ₄	28.05	0.296 4	55.07	1.548	0.411	1.252	0.340	1.237
Helyum	He	4.00	2.077 0	386.0	5.198	1.25	3.116	0.753	1.667
Hidrojen	H ₂	2.02	4.124 2	766.4	14.209	3.43	10.085	2.44	1.409
Metan	CH ₄	16.04	0.518 4	96.35	2.254	0.532	1.735	0.403	1.299
Neon	Ne	20.18	0.412 0	76.55	1.020	0.246	0.618	0.1477	1.667
Azot	N ₂	28.01	0.296 8	55.15	1.042	0.248	0.745	0.177	1.400
Oktan	C ₈ H ₁₈	114.23	0.072 8	13.53	1.711	0.409	1.638	0.392	1.044
Oksijen	O ₂	32.00	0.259 8	48.28	0.922	0.219	0.662	0.157	1.393
Propan	C ₃ H ₈	44.10	0.188 6	35.04	1.679	0.407	1.491	0.362	1.126
Buhar	H ₂ O	18.02	0.461 5	85.76	1.872	0.445	1.411	0.335	1.327

Not: C_p , C_v ve k 300 K'dedir. kJ/kg·K, kJ/kg·°C ile aynıdır.

KAYNAK: G. J. Van Wylen ve R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1976.

Tablo B-3 Kritik Nokta Sabitleri

Madde	Formül	Mol		Sıcaklık		Basınç		Hacim		Z_{cr}
		Kütlesi	K	°R	MPa	psia	ft ³ /lbmol	m ³ /kmol		
Hava		28.97	133	239	3.77	547	1.41	0.0883	0.30	
Amonyak	NH ₃	17.03	405.5	729.8	11.28	1636	1.16	0.0724	0.243	
Argon	Ar	39.94	151	272	4.86	705	1.20	0.0749	0.290	
Benzen	C ₆ H ₆	78.11	562	1012	4.92	714	4.17	0.2603	0.274	
Bütan	C ₄ H ₁₀	58.12	425.2	765.2	3.80	551	4.08	0.2547	0.274	
Karbondioksit	CO ₂	44.01	304.2	547.5	7.39	1070	1.51	0.0943	0.275	
Karbonmonoksit	CO	28.01	133	240	3.50	507	1.49	0.0930	0.294	
Karbon tetraklorid	CCl ₄	153.84	556.4	1001.5	4.56	661	4.42	0.2759	0.272	
Etan	C ₂ H ₆	30.07	305.5	549.8	4.88	708	2.37	0.148	0.284	
Etilen	C ₂ H ₄	28.05	282.4	508.3	5.12	742	1.99	0.1242	0.271	
Helyum	He	4.00	5.3	9.5	0.23	33.2	0.926	0.0578	0.302	
Hidrojen	H ₂	2.02	33.3	59.9	1.30	188	1.04	0.0649	0.304	
Metan	CH ₄	16.04	191.1	343.9	4.64	673	1.59	0.0993	0.290	
Neon	Ne	20.18	44.5	80.1	2.73	395	0.668	0.0417	0.308	
Azot	N ₂	28.02	126.2	227.1	3.39	492	1.44	0.0899	0.291	
Oksijen	O ₂	32.00	154.8	278.6	5.08	736	1.25	0.078	0.308	
Propan	C ₃ H ₈	44.09	370.0	665.9	4.26	617	3.20	0.1998	0.277	
Propilen	C ₃ H ₆	42.08	365.0	656.9	4.62	670	2.90	0.1810	0.276	
R134a	CF ₃ CH ₂ F	102.03	374.3	613.7	4.07	596	2.96	0.2478	0.324	
Sülfür dioksit	SO ₂	64.06	430.7	775.2	7.88	1143	1.95	0.1217	0.269	
Su	H ₂ O	18.02	647.4	1165.3	22.1	3204	0.90	0.0568	0.233	

KAYNAK: K. A. Kobe ve R. E. Lynn, Jr., Chem. Rev., 52: 117-236 (1953).

Tablo B-4 Sıvı ve Katıların Özgül Isıları

 C_p , kJ/kg·°C

Sıvılar					
Madde	Durum	C_p	Madde	Durum	C_p
Su	1 atm, 25 °C	4.177	Gliserin	1 atm, 10 °C	2.32
Amonyak	doymuş, -20 °C	4.52	Bizmut	1 atm, 425 °C	0.144
	doymuş, 50 °C	5.10	Cıva	1 atm, 10 °C	0.138
Freon 12	doymuş, -20 °C	0.908	Sodyum	1 atm, 95 °C	1.38
	doymuş, 50 °C	1.02	Propan	1 atm, 0 °C	2.41
Benzen	1 atm, 15 °C	1.80	Etil alkol	1 atm, 25 °C	2.43
Katılar					
Madde	T , °C	C_p	Madde	T , °C	C_p
Buz	-11	2.033	Kurşun	-100	0.118
	-2.2	2.10		0	0.124
Alüminyum	-100	0.699		100	0.134
	0	0.870	Bakır	-100	0.328
	100	0.941		0	0.381
Demir	20	0.448		100	0.393
Gümüş	20	0.233			

KAYNAK: Kenneth Wark, *Thermodynamics*, 3d ed., McGraw-Hill, New York, 1981.

Tablo B-4E Sıvı ve Katıların Özgül Isıları

C_p , Btu/lbm-°F

Sıvılar					
Madde	Durum	C_p	Madde	Durum	C_p
Su	1 atm, 77 °C	1.00	Gliserin	1 atm, 50 °C	0.555
Amonyak	doymuş, -4 °C	1.08	Bizmut	1 atm, 800 °C	0.0344
	doymuş, 120 °C	1.22	Cıva	1 atm, 50 °C	0.0330
Freon 12	doymuş, -4 °C	0.217	Sodyum	1 atm, 200 °C	0.330
	doymuş, 120 °C	0.244	Propan	1 atm, 32 °C	0.577
Benzen	1 atm, 60 °F	0.431	Etil alkol	1 atm, 77 °C	0.581
Katılar					
Madde	T , °F	C_p	Madde	T , °F	C_p
Buz	-76	0.392	Gümüş	-4	0.0557
	-12	0.486	Kurşun	-150	0.0282
Alüminyum	-28	0.402		30	0.0297
	-150	0.167		210	0.0321
	30	0.208	Bakır	-150	0.0785
	210	0.225		30	0.0911
Demir	-4	0.107		210	0.0940

KAYNAK: Kenneth Wark, *Thermodynamics*, 3d ed., McGraw-Hill, New York, 1981.

Tablo B-5 Değişik İdeal Gazların Sabit Basıncıta Özgül Isısı

$\theta \equiv T(\text{Kelvin})/100$

Gaz	C_p kJ/kmol·K	Aralık K	Maks. Hata %
N ₂	$39.060 - 512.79\theta^{-1.5} + 1072.78\theta^{-2} - 820.40\theta^{-3}$	300-3500	0.43
O ₂	$37.432 + 0.020102\theta^{1.5} - 178.57\theta^{-1.5} + 236.88\theta^{-2}$	300-3500	0.30
H ₂	$56.505 - 702.74\theta^{-0.75} + 1165.0\theta^{-1} - 560.70\theta^{-1.5}$	300-3500	0.60
CO	$69.145 - 0.70463\theta^{0.75} - 200.77\theta^{-0.5} + 176.76\theta^{-0.75}$	300-3500	0.42
OH	$81.546 - 59.350\theta^{0.25} + 17.329\theta^{0.75} - 4.2660\theta$	300-3500	0.43
NO	$59.283 - 1.7096\theta^{0.5} - 70.613\theta^{-0.5} + 74.889\theta^{-1.5}$	300-3500	0.34
H ₂ O	$143.05 - 183.54\theta^{0.25} + 82.751\theta^{0.5} - 3.6989\theta$	300-3500	0.43
CO ₂	$-3.7357 + 30.529\theta^{0.5} - 4.1034\theta + 0.024198\theta^2$	300-3500	0.19
NO ₂	$46.045 + 216.10\theta^{-0.5} - 363.66\theta^{-0.75} + 232.550\theta^{-2}$	300-3500	0.26
CH ₄	$-672.87 + 439.74\theta^{0.25} - 24.875\theta^{0.75} + 323.88\theta^{-0.5}$	300-2000	0.15
C ₂ H ₄	$-95.395 + 123.15\theta^{0.5} - 35.641\theta^{0.75} + 182.77\theta^{-3}$	300-2000	0.07

KAYNAK: G. J. Van Wylen ve R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley

Tablo B-5E Değişik İdeal Gazların Sabit Basıncıta Özgül Isısı

$$\theta \equiv T(\text{Rankine})/180$$

Gaz	C_p Btu/lbmol-°R	Aralık °R	Maks. Hata %
N ₂	$9.3355 - 122.56\theta^{-1.5} + 256.38\theta^{-2} - 196.08\theta^{-3}$	540-6300	0.43
O ₂	$8.9465 + 4.8044 \times 10^{-3}\theta^{1.5} - 42.679\theta^{-1.5} + 56.615\theta^{-2}$	540-6300	0.30
H ₂	$13.505 - 167.96\theta^{-0.75} + 278.44\theta^{-1} - 134.01\theta^{-1.5}$	540-6300	0.60
CO	$16.526 - 0.16841\theta^{0.75} - 47.985\theta^{-0.5} + 42.246\theta^{-0.75}$	540-6300	0.42
OH	$19.490 - 14.185\theta^{0.25} + 4.1418\theta^{0.75} - 1.0196\theta$	540-6300	0.43
NO	$14.169 - 0.40861\theta^{0.5} - 16.877\theta^{-0.5} + 17.899\theta^{-1.5}$	540-6300	0.34
H ₂ O	$34.190 - 43.868\theta^{0.25} + 19.778\theta^{0.5} - 0.88407\theta$	540-6300	0.43
CO ₂	$-0.89286 + 7.2967\theta^{0.5} - 0.98074\theta + 5.7835 \times 10^{-3}\theta^{-2}$	540-6300	0.19
NO ₂	$11.005 + 51.650\theta^{0.5} - 86.916\theta^{0.75} + 55.580\theta^{-2}$	540-6300	0.26
CH ₄	$-160.82 + 105.10\theta^{0.25} - 5.9452\theta^{0.75} + 77.408\theta^{-0.5}$	540-3600	0.15
C ₂ H ₄	$-22.800 + 29.433\theta^{0.5} - 8.5185\theta^{0.75} + 43.683\theta^{-3}$	540-3600	0.07

KAYNAK: G. J. Van Wylen ve R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1976

Tablo B-6 Oluşum Entalpisi ve Buharlaştırma Entalpisi

25 °C (77 °F), 1 atm

Madde	Formül	\bar{h}_f° , kJ/kmol	\bar{h}_{fg} , kJ/kmol	\bar{h}_f° , Btu/lbmol	\bar{h}_{fg} , Btu/lbmol
Karbon	C(s)	0		0	
Hidrojen	H ₂ (g)	0		0	
Azot	N ₂ (g)	0		0	
Oksijen	O ₂ (g)	0		0	
Karbonmonoksit	CO(g)	-110 530		-47,540	
Karbondioksit	CO ₂ (g)	-393 520		-169,300	
Su	H ₂ O(g)	-241 820		-104,040	
Su	H ₂ O(l)	-285 830	44 010	-122,970	
Hidrojen peroksit	H ₂ O ₂ (g)	-136 310	61 090	-58,640	26,260
Amonyak	NH ₃ (g)	-46 190		-19,750	
Oksijen	O(g)	249 170		+ 107,210	
Hidrojen	H(g)	218 000		+ 93,780	
Azot	N(g)	472 680		+203,340	
Hidroksil	OH(g)	39 040		+ 16,790	
Metan	CH ₄ (g)	-74 850		-32,210	
Asetilen (Etin)	C ₂ H ₂ (g)	226 730		+ 97,540	
Etilen (Etin)	C ₂ H ₄ (g)	52 280		+ 22,490	
Etan	C ₂ H ₆ (g)	-84 680		-36,420	
Propilen (Propen)	C ₃ H ₆ (g)	20 410		+ 8,790	
Propan	C ₃ H ₈ (g)	-103 850	15 060	-44,680	6,480
n-Bütan	C ₄ H ₁₀ (g)	-126 150	21 060	-54,270	9,060
n-Pentan	C ₅ H ₁₂ (g)	-146 440	31 410		
n-Oktan	C ₈ H ₁₈ (g)	-208 450	41 460	-89,680	17,835
Benzen	C ₆ H ₆ (g)	82 930	33 830	+ 35,680	14,550
Metil alkol	CH ₃ OH(g)	-200 890	37 900	-86,540	16,090
Etil alkol	C ₂ H ₅ OH(g)	-235 310	42 340	-101,230	18,220

KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971; *Selected Values of Chemical Thermodynamic Properties*, NBS Technical Note 270-3, 1968; and API Res. Project 44, Carnegie Press, Carnegie Institute of Technology, Pittsburgh, 1953.

Tablo B-7 Oluşum Entalpisi ve Buharlaştırma Entalpisi

25 °C (77 °F), 1 atm

Madde	Formül	-ÜİD, kJ/kmol	\bar{h}_{fg} , kJ/kmol	-ÜİD, Btu/lbmol	\bar{h}_{fg} , Btu/lbmol
Hidrojen	H ₂ (g)	-285 840		-122,970	
Karbon	C(s)	-393 520		-169,290	
Karbonmonoksit	CO(g)	-282 990		-121,750	
Metan	CH ₄ (g)	-890 360		-383,040	
Asetilen	C ₂ H ₂ (g)	-1 299 600		-559,120	
Etilen	C ₂ H ₄ (g)	-1 410 970		-607,010	
Etan	C ₂ H ₆ (g)	-1 559 900		-671,080	
Propilen	C ₃ H ₆ (g)	-2 058 500		-885,580	
Propan	C ₃ H ₈ (g)	-2 220 000	15 060	-955,070	6,480
n-Bütan	C ₄ H ₁₀ (g)	-2 877 100	21 060	-1,237,800	9,060
n-Pentan	C ₅ H ₁₂ (g)	-3 536 100	26 410	-1,521,300	11,360
n-Hekzan	C ₆ H ₁₄ (g)	-4 194 800	31 530	-1,804,600	13,560
n-Heptan	C ₇ H ₁₆ (g)	-4 853 500	36 520	-2,088,000	15,710
n-Oktan	C ₈ H ₁₈ (g)	-5 512 200	41 460	-2,371,400	17,835
Benzen	C ₆ H ₆ (g)	-3 301 500	33 830	-1,420,300	14,550
Tolüen	C ₇ H ₈ (g)	-3 947 900	39 920	-1,698,400	17,180
Metil alkol	CH ₃ OH(g)	-764 540	37 900	-328,700	16,090
Etil alkol	C ₂ H ₅ OH(g)	-1 409 300	42 340	-606,280	18,220

Not: Su, yanma ürünlerinde sıvı olarak görülür.

KAYNAK: Kenneth Wark, *Thermodynamics*, 3d ed., McGraw-Hill, New York, 1981, pp. 834-835, Table A-23M.

Tablo B-8 Van der Waals ve Redlich-Kwong Hâl Denklemi İçin Sabitler

Van der Waals Denklemi				
	a , kPa·m ⁶ /kg ²	b , m ³ /kg	a , lbf·ft ⁴ /lbm ²	b , ft ³ /lbm
Hava	0.1630	0.00127	870	0.0202
Amonyak	1.468	0.00220	7850	0.0351
Karbon dioksit	0.1883	0.000972	1010	0.0156
Karbonmonoksit	0.1880	0.00141	1010	0.0227
Freon 12	0.0718	0.000803	394	0.0132
Helyum	0.214	0.00587	1190	0.0959
Hidrojen	6.083	0.0132	32,800	0.212
Metan	0.888	0.00266	4780	0.0427
Azot	0.1747	0.00138	934	0.0221
Oksijen	0.1344	0.000993	720	0.0159
Propan	0.481	0.00204	2580	0.0328
Su	1.703	0.00169	9130	0.0271

Tablo B-8 (Devamı)

Redlich-Kwong Denklemi				
	a , kPa·m ⁶ ·K ^{1/2} /kg ²	b , m ³ /kg	a , lbf·ft ⁴ ·°R ^{1/2} /lbm ²	b , ft ³ /lbm
Hava	1.905	0.000878	13,600	0.014
Amonyak	30.0	0.00152	215,000	0.0243
Karbondioksit	3.33	0.000674	24,000	0.0108
Karbonmonoksit	2.20	0.000978	15,900	0.0157
Freon 12	1.43	0.000557	10,500	0.00916
Helyum	0.495	0.00407	3,710	0.0665
Hidrojen	35.5	0.00916	257,000	0.147
Metan	12.43	0.00184	89,700	0.0296
Azot	1.99	0.000957	14,300	0.0153
Oksijen	1.69	0.000689	12,200	0.0110
Propan	9.37	0.00141	67,600	0.0228
Su	43.9	0.00117	316,000	0.0188

Suyun Termodinamik Özellikleri (Buhar Tabloları)

Tablo C-1 Doymuş Suyun Özellikleri—Sıcaklık Tablosu

$T, ^\circ\text{C}$	P, MPa	Hacim, m^3/kg		Enerji, kJ/kg		Entalpi, kJ/kg			Entropi, $\text{kJ}/\text{kg}\cdot\text{K}$		
		v_f	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
0.010	0.0006113	0.001000	206.1	0.0	2375.3	0.0	2501.3	2501.3	0.0000	9.1571	9.1571
2	0.0007056	0.001000	179.9	8.4	2378.1	8.4	2496.6	2505.0	0.0305	9.0738	9.1043
5	0.0008721	0.001000	147.1	21.0	2382.2	21.0	2489.5	2510.5	0.0761	8.9505	9.0266
10	0.001228	0.001000	106.4	42.0	2389.2	42.0	2477.7	2519.7	0.1510	8.7506	8.9016
15	0.001705	0.001001	77.93	63.0	2396.0	63.0	2465.9	2528.9	0.2244	8.5578	8.7822
20	0.002338	0.001002	57.79	83.9	2402.9	83.9	2454.2	2538.1	0.2965	8.3715	8.6680
25	0.003169	0.001003	43.36	104.9	2409.8	104.9	2442.3	2547.2	0.3672	8.1916	8.5588
30	0.004246	0.001004	32.90	125.8	2416.6	125.8	2430.4	2556.2	0.4367	8.0174	8.4541
35	0.005628	0.001006	25.22	146.7	2423.4	146.7	2418.6	2565.3	0.5051	7.8488	8.3539
40	0.007383	0.001008	19.52	167.5	2430.1	167.5	2406.8	2574.3	0.5723	7.6855	8.2578
45	0.009593	0.001010	15.26	188.4	2436.8	188.4	2394.8	2583.2	0.6385	7.5271	8.1656
50	0.01235	0.001012	12.03	209.3	2443.5	209.3	2382.8	2592.1	0.7036	7.3735	8.0771
55	0.01576	0.001015	9.569	230.2	2450.1	230.2	2370.7	2600.9	0.7678	7.2243	7.9921
60	0.01994	0.001017	7.671	251.1	2456.6	251.1	2358.5	2609.6	0.8310	7.0794	7.9104
65	0.02503	0.001020	6.197	272.0	2463.1	272.0	2346.2	2618.2	0.8934	6.9384	7.8318
70	0.03119	0.001023	5.042	292.9	2469.5	293.0	2333.8	2626.8	0.9549	6.8012	7.7561
75	0.03858	0.001026	4.131	313.9	2475.9	313.9	2321.4	2635.3	1.0155	6.6678	7.6833
80	0.04739	0.001029	3.407	334.8	2482.2	334.9	2308.8	2643.7	1.0754	6.5376	7.6130
85	0.05783	0.001032	2.828	355.8	2488.4	355.9	2296.0	2651.9	1.1344	6.4109	7.5453
90	0.07013	0.001036	2.361	376.8	2494.5	376.9	2283.2	2660.1	1.1927	6.2872	7.4799
95	0.08455	0.001040	1.982	397.9	2500.6	397.9	2270.2	2668.1	1.2503	6.1664	7.4167

Tablo C-1 (Devamı)

T, °C	P, MPa	Hacim, m ³ /kg		Enerji, kJ/kg		Entalpi, kJ/kg			Entropi, kJ/kg·K		
		v_f	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
100	0.1013	0.001044	1.673	418.9	2506.5	419.0	2257.0	2676.0	1.3071	6.0486	7.3557
110	0.1433	0.001052	1.210	461.1	2518.1	461.3	2230.2	2691.5	1.4188	5.8207	7.2395
120	0.1985	0.001060	0.8919	503.5	2529.2	503.7	2202.6	2706.3	1.5280	5.6024	7.1304
130	0.2701	0.001070	0.6685	546.0	2539.9	546.3	2174.2	2720.5	1.6348	5.3929	7.0277
140	0.3613	0.001080	0.5089	588.7	2550.0	589.1	2144.8	2733.9	1.7395	5.1912	6.9307
150	0.4758	0.001090	0.3928	631.7	2559.5	632.2	2114.2	2746.4	1.8422	4.9965	6.8387
160	0.6178	0.001102	0.3071	674.9	2568.4	675.5	2082.6	2758.1	1.9431	4.8079	6.7510
170	0.7916	0.001114	0.2428	718.3	2576.5	719.2	2049.5	2768.7	2.0423	4.6249	6.6672
180	1.002	0.001127	0.1941	762.1	2583.7	763.2	2015.0	2778.2	2.1400	4.4466	6.5866
190	1.254	0.001141	0.1565	806.2	2590.0	807.5	1978.8	2786.4	2.2363	4.2724	6.5087
200	1.554	0.001156	0.1274	850.6	2595.3	852.4	1940.8	2793.2	2.3313	4.1018	6.4331
210	1.906	0.001173	0.1044	895.5	2599.4	897.7	1900.8	2798.5	2.4253	3.9340	6.3593
220	2.318	0.001190	0.08620	940.9	2602.4	943.6	1858.5	2802.1	2.5183	3.7686	6.2869
230	2.795	0.001209	0.07159	986.7	2603.9	990.1	1813.9	2804.0	2.6105	3.6050	6.2155
240	3.344	0.001229	0.05977	1033.2	2604.0	1037.3	1766.5	2803.8	2.7021	3.4425	6.1446
250	3.973	0.001251	0.05013	1080.4	2602.4	1085.3	1716.2	2801.5	2.7933	3.2805	6.0738
260	4.688	0.001276	0.04221	1128.4	2599.0	1134.4	1662.5	2796.9	2.8844	3.1184	6.0028
270	5.498	0.001302	0.03565	1177.3	2593.7	1184.5	1605.2	2789.7	2.9757	2.9553	5.9310
280	6.411	0.001332	0.03017	1227.4	2586.1	1236.0	1543.6	2779.6	3.0674	2.7905	5.8579
290	7.436	0.001366	0.02557	1278.9	2576.0	1289.0	1477.2	2766.2	3.1600	2.6230	5.7830
300	8.580	0.001404	0.02168	1332.0	2563.0	1344.0	1405.0	2749.0	3.2540	2.4513	5.7053
310	9.856	0.001447	0.01835	1387.0	2546.4	1401.3	1326.0	2727.3	3.3500	2.2739	5.6239
320	11.27	0.001499	0.01549	1444.6	2525.5	1461.4	1238.7	2700.1	3.4487	2.0883	5.5370
330	12.84	0.001561	0.01300	1505.2	2499.0	1525.3	1140.6	2665.9	3.5514	1.8911	5.4425
340	14.59	0.001638	0.01080	1570.3	2464.6	1594.2	1027.9	2622.1	3.6601	1.6765	5.3366
350	16.51	0.001740	0.008815	1641.8	2418.5	1670.6	893.4	2564.0	3.7784	1.4338	5.2122
360	18.65	0.001892	0.006947	1725.2	2351.6	1760.5	720.7	2481.2	3.9154	1.1382	5.0536
370	21.03	0.002213	0.004931	1844.0	2229.0	1890.5	442.2	2332.7	4.1114	0.6876	4.7990
374.136	22.088	0.003155	0.003155	2029.6	2029.6	2099.3	0.0	2099.3	4.4305	0.0000	4.4305

KAYNAK: Keenan, Keyes, Hill, and Moore, *Steam Tables*, Wiley, New York, 1969; G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1973.

Tablo C-2 Doymuş Suyun Özellikleri—Basınç Tablosu

P, MPa	T, °C	Hacim, m ³ /kg		Enerji, kJ/kg		Entalpi, kJ/kg			Entropi, kJ/kg·K		
		v_f	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
0.000611	0.01	0.001000	206.1	0.0	2375.3	0.0	2501.3	2501.3	0.0000	9.1571	9.1571
0.0008	3.8	0.001000	159.7	15.8	2380.5	15.8	2492.5	2508.3	0.0575	9.0007	9.0582
0.001	7.0	0.001000	129.2	29.3	2385.0	29.3	2484.9	2514.2	0.1059	8.8706	8.9765
0.0012	9.7	0.001000	108.7	40.6	2388.7	40.6	2478.5	2519.1	0.1460	8.7639	8.9099
0.0014	12.0	0.001001	93.92	50.3	2391.9	50.3	2473.1	2523.4	0.1802	8.6736	8.8538
0.0016	14.0	0.001001	82.76	58.9	2394.7	58.9	2468.2	2527.1	0.2101	8.5952	8.8053
0.0018	15.8	0.001001	74.03	66.5	2397.2	66.5	2464.0	2530.5	0.2367	8.5259	8.7626
0.002	17.5	0.001001	67.00	73.5	2399.5	73.5	2460.0	2533.5	0.2606	8.4639	8.7245
0.003	24.1	0.001003	45.67	101.0	2408.5	101.0	2444.5	2545.5	0.3544	8.2240	8.5784
0.004	29.0	0.001004	34.80	121.4	2415.2	121.4	2433.0	2554.4	0.4225	8.0529	8.4754
0.006	36.2	0.001006	23.74	151.5	2424.9	151.5	2415.9	2567.4	0.5208	7.8104	8.3312
0.008	41.5	0.001008	18.10	173.9	2432.1	173.9	2403.1	2577.0	0.5924	7.6371	8.2295
0.01	45.8	0.001010	14.67	191.8	2437.9	191.8	2392.8	2584.6	0.6491	7.5019	8.1510
0.012	49.4	0.001012	12.36	206.9	2442.7	206.9	2384.1	2591.0	0.6961	7.3910	8.0871
0.014	52.6	0.001013	10.69	220.0	2446.9	220.0	2376.6	2596.6	0.7365	7.2968	8.0333
0.016	55.3	0.001015	9.433	231.5	2450.5	231.5	2369.9	2601.4	0.7719	7.2149	7.9868
0.018	57.8	0.001016	8.445	241.9	2453.8	241.9	2363.9	2605.8	0.8034	7.1425	7.9459
0.02	60.1	0.001017	7.649	251.4	2456.7	251.4	2358.3	2609.7	0.8319	7.0774	7.9093
0.03	69.1	0.001022	5.229	289.2	2468.4	289.2	2336.1	2625.3	0.9439	6.8256	7.7695
0.04	75.9	0.001026	3.993	317.5	2477.0	317.6	2319.1	2636.7	1.0260	6.6449	7.6709
0.06	85.9	0.001033	2.732	359.8	2489.6	359.8	2293.7	2653.5	1.1455	6.3873	7.5328
0.08	93.5	0.001039	2.087	391.6	2498.8	391.6	2274.1	2665.7	1.2331	6.2023	7.4354
0.1	99.6	0.001043	1.694	417.3	2506.1	417.4	2258.1	2675.5	1.3029	6.0573	7.3602
0.12	104.8	0.001047	1.428	439.2	2512.1	439.3	2244.2	2683.5	1.3611	5.9378	7.2980
0.14	109.3	0.001051	1.237	458.2	2517.3	458.4	2232.0	2690.4	1.4112	5.8360	7.2472
0.16	113.3	0.001054	1.091	475.2	2521.8	475.3	2221.2	2696.5	1.4553	5.7472	7.2025
0.18	116.9	0.001058	0.9775	490.5	2525.9	490.7	2211.1	2701.8	1.4948	5.6683	7.1631
0.2	120.2	0.001061	0.8857	504.5	2529.5	504.7	2201.9	2706.6	1.5305	5.5975	7.1280
0.3	133.5	0.001073	0.6058	561.1	2543.6	561.5	2163.8	2725.3	1.6722	5.3205	6.9927
0.4	143.6	0.001084	0.4625	604.3	2553.6	604.7	2133.8	2738.5	1.7770	5.1197	6.8967
0.6	158.9	0.001101	0.3157	669.9	2567.4	670.6	2086.2	2756.8	1.9316	4.8293	6.7609
0.8	170.4	0.001115	0.2404	720.2	2576.8	721.1	2048.0	2769.1	2.0466	4.6170	6.6636
1	179.9	0.001127	0.1944	761.7	2583.6	762.8	2015.3	2778.1	2.1391	4.4482	6.5873
1.2	188.0	0.001139	0.1633	797.3	2588.8	798.6	1986.2	2784.8	2.2170	4.3072	6.5242
1.4	195.1	0.001149	0.1408	828.7	2592.8	830.3	1959.7	2790.0	2.2847	4.1854	6.4701
1.6	201.4	0.001159	0.1238	856.9	2596.0	858.8	1935.2	2794.0	2.3446	4.0780	6.4226
1.8	207.2	0.001168	0.1104	882.7	2598.4	884.8	1912.3	2797.1	2.3986	3.9816	6.3802
2	212.4	0.001177	0.09963	906.4	2600.3	908.8	1890.7	2799.5	2.4478	3.8939	6.3417
3	233.9	0.001216	0.06668	1004.8	2604.1	1008.4	1795.7	2804.1	2.6462	3.5416	6.1878
4	250.4	0.001252	0.04978	1082.3	2602.3	1087.3	1714.1	2801.4	2.7970	3.2739	6.0709
6	275.6	0.001319	0.03244	1205.4	2589.7	1213.3	1571.0	2784.3	3.0273	2.8627	5.8900
8	295.1	0.001384	0.02352	1305.6	2569.8	1316.6	1441.4	2758.0	3.2075	2.5365	5.7440
10	311.1	0.001452	0.01803	1393.0	2544.4	1407.6	1317.1	2724.7	3.3603	2.2546	5.6149
12	324.8	0.001527	0.01426	1472.9	2513.7	1491.3	1193.6	2684.9	3.4970	1.9963	5.4933
14	336.8	0.001611	0.01149	1548.6	2476.8	1571.1	1066.5	2637.6	3.6240	1.7486	5.3726
16	347.4	0.001711	0.009307	1622.7	2431.8	1650.0	930.7	2580.7	3.7468	1.4996	5.2464
18	357.1	0.001840	0.007491	1698.9	2374.4	1732.0	777.2	2509.2	3.8722	1.2332	5.1054
20	365.8	0.002036	0.005836	1785.6	2293.2	1826.3	583.7	2410.0	4.0146	0.9135	4.9281
22.088	374.136	0.003155	0.003155	2029.6	2029.6	2099.3	0.0	2099.3	4.4305	0.0000	4.4305

KAYNAK: Keenan, Keyes, Hill, and Moore, *Steam Tables*, Wiley, New York, 1969; G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1973.

Tablo C-3 Kızgın Buhar [T (°C), v (m³/kg), u ve h (kJ/kg), s (kJ/kg·K) olarak verilmiştir.]

T	v	u	h	s	v	u	h	s	v	u	h	s
	$P = 0.010$ MPa (45.81 °C)				$P = 0.050$ MPa (81.33 °C)				$P = 0.10$ MPa (99.63 °C)			
Doy.	14.674	2437.9	2584.7	8.1502	3.240	2483.9	2645.9	7.5939	1.6940	2506.1	2675.5	7.3594
50	14.869	2443.9	2592.6	8.1749								
100	17.196	2515.5	2687.5	8.4479	3.418	2511.6	2682.5	7.6947	1.6958	2506.7	2676.2	7.3614
150	19.512	2587.9	2783.0	8.6882	3.889	2585.6	2780.1	7.9401	1.9364	2582.8	2776.4	7.6134
200	21.825	2661.3	2879.5	8.9038	4.356	2659.9	2877.7	8.1580	2.172	2658.1	2875.3	7.8343
250	24.136	2736.0	2977.3	9.1002	4.820	2735.0	2976.0	8.3556	2.406	2733.7	2974.3	8.0333
300	26.445	2812.1	3076.5	9.2813	5.284	2811.3	3075.5	8.5373	2.639	2810.4	3074.3	8.2158
400	31.063	2968.9	3279.6	9.6077	6.209	2968.5	3278.9	8.8642	3.103	2967.9	3278.2	8.5435
500	35.679	3132.3	3489.1	9.8978	7.134	3132.0	3488.7	9.1546	3.565	3131.6	3488.1	8.8342
600	40.295	3302.5	3705.4	10.1608	8.057	3302.2	3705.1	9.4178	4.028	3301.9	3704.7	9.0976
700	44.911	3479.6	3928.7	10.4028	8.981	3479.4	3928.5	9.6599	4.490	3479.2	3928.2	9.3398
800	49.526	3663.8	4159.0	10.6281	9.904	3663.6	4158.9	9.8852	4.952	3663.5	4158.6	9.5652
900	54.141	3855.0	4396.4	10.8396	10.828	3854.9	4396.3	10.0967	5.414	3854.8	4396.1	9.7767
1000	58.757	4053.0	4640.6	11.0393	11.751	4052.9	4640.5	10.2964	5.875	4052.8	4640.3	9.9764
1100	63.372	4257.5	4891.2	11.2287	12.674	4257.4	4891.1	10.4859	6.337	4257.3	4891.0	10.1659
1200	67.987	4467.9	5147.8	11.4091	13.597	4467.8	5147.7	10.6662	6.799	4467.7	5147.6	10.3463
1300	72.602	4683.7	5409.7	11.5811	14.521	4683.6	5409.6	10.8382	7.260	4683.5	5409.5	10.5183
	$P = 0.20$ MPa (120.23 °C)				$P = 0.30$ MPa (133.55 °C)				$P = 0.40$ MPa (143.63 °C)			
Doy.	.8857	2529.5	2706.7	7.1272	.6058	2543.6	2725.3	6.9919	.4625	2553.6	2738.6	6.8959
150	.9596	2576.9	2768.8	7.2795	.6339	2570.8	2761.0	7.0778	.4708	2564.5	2752.8	6.9299
200	1.0803	2654.4	2870.5	7.5066	.7163	2650.7	2865.6	7.3115	.5342	2646.8	2860.5	7.1706
250	1.1988	2731.2	2971.0	7.7086	.7964	2728.7	2967.6	7.5166	.5951	2726.1	2964.2	7.3789
300	1.3162	2808.6	3071.8	7.8926	.8753	2806.7	3069.3	7.7022	.6548	2804.8	3066.8	7.5662
400	1.5493	2966.7	3276.6	8.2218	1.0315	2965.6	3275.6	8.0330	.7726	2964.4	3273.4	7.8985
500	1.7814	3130.8	3487.1	8.5133	1.1867	3130.0	3486.0	8.3251	.8893	3129.2	3484.9	8.1913
600	2.013	3301.4	3704.0	8.7770	1.3414	3300.8	3703.2	8.5892	1.0055	3300.2	3702.4	8.4558
700	2.244	3478.8	3927.6	9.0194	1.4957	3478.4	3927.1	8.8319	1.1215	3477.9	3926.5	8.6987
800	2.475	3663.1	4158.2	9.2449	1.6499	3662.9	4157.8	9.0576	1.2372	3662.4	4157.3	8.9244
900	2.706	3854.5	4395.8	9.4566	1.8041	3854.2	4395.4	9.2692	1.3529	3853.9	4395.1	9.1362
1000	2.937	4052.5	4640.0	9.6563	1.9581	4052.3	4639.7	9.4690	1.4685	4052.0	4639.4	9.3360
1100	3.168	4257.0	4890.7	9.8458	2.1121	4256.5	4890.4	9.6585	1.5840	4256.5	4890.2	9.5256
1200	3.399	4467.5	5147.3	10.0262	2.2661	4467.2	5147.1	9.8389	1.6996	4467.0	5146.8	9.7060
1300	3.630	4683.2	5409.3	10.1982	2.4201	4683.0	5409.0	10.0110	1.8151	4682.8	5408.8	9.8780
	$P = 0.50$ MPa (151.86 °C)				$P = 0.60$ MPa (158.85 °C)				$P = 0.80$ MPa (170.43 °C)			
Doy.	.3749	2561.2	2748.7	6.8213	.3157	2567.4	2756.8	6.7600	.2404	2576.8	2769.1	6.6628
200	.4249	2642.9	2855.4	7.0592	.3520	2638.9	2850.1	6.9665	.2608	2630.6	2839.3	6.8158
250	.4744	2723.5	2960.7	7.2709	.3938	2720.9	2957.2	7.1816	.2931	2715.5	2950.0	7.0384
300	.5226	2802.9	3064.2	7.4599	.4344	2801.0	3061.6	7.3724	.3241	2797.2	3056.5	7.2328
350	.5701	2882.6	3167.7	7.6329	.4742	2881.2	3165.7	7.5464	.3544	2878.2	3161.7	7.4089
400	.6173	2963.2	3271.9	7.7938	.5137	2962.1	3270.3	7.7079	.3843	2959.7	3267.1	7.5716
500	.7109	3128.4	3483.9	8.0873	.5920	3127.6	3482.8	8.0021	.4433	3126.0	3480.6	7.8673
600	.8041	3299.6	3701.7	8.3522	.6697	3299.1	3700.9	8.2674	.5018	3297.9	3699.4	8.1333
700	.8969	3477.5	3925.9	8.5952	.7472	3477.0	3925.3	8.5107	.5601	3476.2	3924.2	8.3770
800	.9896	3662.1	4156.9	8.8211	.8245	3661.8	4156.5	8.7367	.6181	3661.1	4155.6	8.6033
900	1.0822	3853.6	4394.7	9.0329	.9017	3853.4	4394.4	8.9486	.6761	3852.8	4393.7	8.8153
1000	1.1747	4051.8	4639.1	9.2328	.9788	4051.5	4638.8	9.1485	.7340	4051.0	4638.2	9.0153
1100	1.2672	4256.3	4889.9	9.4224	1.0559	4256.1	4889.6	9.3381	.7919	4255.6	4889.1	9.2050
1200	1.3596	4466.8	5146.6	9.6029	1.1330	4466.5	5146.3	9.5185	.8497	4466.1	5145.9	9.3855
1300	1.4521	4682.5	5408.6	9.7749	1.2101	4682.3	5408.3	9.6906	.9076	4681.8	5407.9	9.5575

Tablo C-3 (Devamı)

T	P = 1.00 MPa (179.91 °C)				P = 1.20 MPa (187.99 °C)				P = 1.40 MPa (195.07 °C)			
	v	u	h	s	v	u	h	s	v	u	h	s
Doy.	.19 444	2583.6	2778.1	6.5865	.163 33	2588.8	2784.8	6.5233	.140 84	2592.8	2790.0	6.4693
200	.2060	2621.9	2827.9	6.6940	.169 30	2612.8	2815.9	6.5898	.143 02	2603.1	2803.3	6.4975
250	.2327	2709.9	2942.6	6.9247	.192 34	2704.2	2935.0	6.8294	.163 50	2698.3	2927.2	6.7467
300	.2579	2793.2	3051.2	7.1229	.2138	2789.2	3045.8	7.0317	.182 28	2785.2	3040.4	6.9534
350	.2825	2875.2	3157.7	7.3011	.2345	2872.2	3153.6	7.2121	.2003	2869.2	3149.5	7.1360
400	.3066	2957.3	3263.9	7.4651	.2548	2954.9	3260.7	7.3774	.2178	2952.5	3257.5	7.3026
500	.3541	3124.4	3478.5	7.7622	.2946	3122.8	3476.3	7.6759	.2521	3321.1	3474.1	7.6027
600	.4011	3296.8	3697.9	8.0290	.3339	3295.6	3696.3	7.9435	.2860	3294.4	3694.8	7.8710
700	.4478	3475.3	3923.1	8.2731	.3729	3474.4	3922.0	8.1881	.3195	3473.6	3920.8	8.1160
800	.4943	3660.4	4154.7	8.4996	.4118	3659.7	4153.8	8.4148	.3528	3659.0	4153.0	8.8431
900	.5407	3852.2	4392.9	8.7118	.4505	3851.6	4392.2	8.6272	.3861	3851.1	4391.5	8.5556
1000	.5871	4050.5	4637.6	8.9119	.4892	4050.0	4637.0	8.8274	.4192	4049.5	4636.4	8.7559
1100	.6335	4255.1	4888.6	9.1017	.5278	4254.6	4888.0	9.0172	.4524	4254.1	4887.5	8.9457
1200	.6798	4465.6	5145.4	9.2822	.5665	4465.1	5144.9	9.1977	.4855	4464.7	5144.4	9.1262
1300	.7261	4681.3	5407.4	9.4543	.6051	4680.9	5407.0	9.3698	.5186	4680.4	5406.5	9.2984
	P = 1.60 MPa (201.41 °C)				P = 1.80 MPa (207.15 °C)				P = 2.00 MPa (212.42 °C)			
Doy.	.123 80	2596.0	2794.0	6.4218	.110 42	2598.4	2797.1	6.3794	.099 63	2600.3	2799.5	6.3409
225	.132 87	2644.7	2857.3	6.5518	.136 73	2636.6	2846.7	6.4808	.103 77	2628.3	2835.8	6.4147
250	.141 84	2692.3	2919.2	6.6732	.124 97	2686.0	2911.0	6.6066	.111 44	2679.6	2902.5	6.5453
300	.158 62	2781.1	3034.8	6.8844	.140 21	2776.9	3029.2	6.8226	.125 47	2772.6	3023.5	6.7664
350	.174 56	2866.1	3145.4	7.0694	.154 57	2863.0	3141.2	7.0100	.138 57	2859.8	3137.0	6.9563
400	.190 05	2950.1	3254.2	7.2374	.168 47	2947.7	3250.9	7.1794	.151 20	2945.2	3247.6	7.1271
500	.2203	3119.5	3472.0	7.5390	.195 50	3117.9	3469.8	7.4825	.175 68	3116.2	3467.6	7.4317
600	.2500	3293.3	3693.2	7.8080	.2220	3292.1	3691.7	7.7523	.199 60	3290.9	3690.1	7.7024
700	.2794	3472.7	3919.7	8.0535	.2482	3471.8	3918.5	7.9983	.2232	3470.9	3917.4	7.9487
800	.3086	3658.3	4152.1	8.2808	.2742	3657.6	4151.2	8.2258	.2467	3657.0	4150.3	8.1765
900	.3377	3850.5	4390.8	8.4935	.3001	3849.9	4390.1	8.4386	.2700	3849.3	4389.4	8.3895
1000	.5668	4049.0	4635.8	8.6938	.3260	4048.5	4635.2	8.6391	.2933	4048.0	4634.6	8.5901
1100	.3958	4253.7	4887.0	8.8837	.3518	4253.2	4886.4	8.8290	.3166	4252.7	4885.9	8.7800
1200	.4248	4464.2	5143.9	9.0643	.3776	4463.7	5143.4	9.0096	.3398	4463.3	5142.9	8.9607
1300	.4538	4679.9	5406.0	9.2364	.4034	4679.5	5405.6	9.1818	.3631	4679.0	5405.1	9.1329
	P = 2.50 MPa (233.99 °C)				P = 3.00 MPa (233.90 °C)				P = 3.50 MPa (242.60 °C)			
Doy.	.079 98	2603.1	2803.1	6.2575	.066 68	2604.1	2804.2	6.1869	.057 07	2603.7	2803.4	6.1253
225	.080 27	2605.6	2806.3	6.2639								
250	.087 00	2662.6	2880.1	6.4085	.070 58	2644.0	2855.8	6.2872	.058 72	2623.7	2829.2	6.1749
300	.098 90	2761.6	3008.8	6.6438	.081 14	2750.1	2993.5	6.5390	.068 42	2738.0	2977.5	6.4461
350	.109 76	2851.9	3126.3	6.8403	.090 53	2843.7	3115.3	6.7428	.076 78	2835.3	3104.0	6.6579
400	.120 10	2939.1	3239.3	7.0148	.099 36	2932.8	3230.9	6.9212	.084 53	2926.4	3222.3	6.8405
450	.130 14	3025.5	3350.8	7.1746	.107 87	3020.4	3344.0	7.0834	.091 96	3015.3	3337.2	7.0052
500	.139 98	3112.1	3462.1	7.3234	.116 19	3108.0	3456.5	7.2338	.099 18	3103.0	3450.9	7.1572
600	.159 30	3288.0	3686.3	7.5960	.132 43	3285.0	3682.3	7.5085	.113 24	3282.1	3678.4	7.4339
700	.178 32	3468.7	3914.5	7.8435	.148 38	3466.5	3911.7	7.7571	.126 99	3464.3	3908.8	7.6837
800	.197 16	3655.3	4148.2	8.0720	.164 14	3653.5	4145.9	7.9862	.140 56	3651.8	4143.7	7.9134
900	.215 90	3847.9	4387.6	8.2853	.179 80	3846.5	4385.9	8.1999	.154 02	3845.0	4384.1	8.1276
1000	.2346	4046.7	4633.1	8.4861	.195 41	4045.4	4631.6	8.4009	.167 43	4044.1	4630.1	8.3288
1100	.2532	4251.5	4884.6	8.6762	.210 98	4250.3	4883.3	8.5912	.180 80	4249.2	4881.9	8.5192
1200	.2718	4462.1	5141.7	8.8569	.226 52	4460.9	5140.5	8.7720	.194 15	4459.8	5139.3	8.7000
1300	.2905	4677.8	5404.0	9.0291	.242 06	4676.6	5402.8	8.9442	.207 49	4675.5	5401.7	8.8723

Tablo C-3 (Devamı)

<i>T</i>	<i>v</i>	<i>u</i>	<i>h</i>	<i>s</i>	<i>v</i>	<i>u</i>	<i>h</i>	<i>s</i>	<i>v</i>	<i>u</i>	<i>h</i>	<i>s</i>
	<i>P</i> = 4.0 MPa (250.40 °C)				<i>P</i> = 4.5 MPa (257.49 °C)				<i>P</i> = 5.0 MPa (263.99 °C)			
	<i>P</i> = 6.0 MPa (275.64 °C)				<i>P</i> = 7.0 MPa (285.88 °C)				<i>P</i> = 8.0 MPa (295.06 °C)			
Doy.	.049 78	2602.3	2801.4	6.0701	.044 06	2600.1	2798.3	6.0198	.039 44	2597.1	2794.3	5.9734
275	.054 57	2667.9	2886.2	6.2285	.047 30	2650.3	2863.2	6.1401	.041 41	2631.3	2838.3	6.0544
300	.058 84	2725.3	2960.7	6.3615	.051 35	2712.0	2943.1	6.2828	.045 32	2698.0	2924.5	6.2084
350	.066 45	2826.7	3092.5	6.5821	.058 40	2817.8	3080.6	6.5131	.051 94	2808.7	3068.4	6.4493
400	.073 41	2919.9	3213.6	6.7690	.064 75	2913.3	3204.7	6.7047	.057 81	2906.6	3195.7	6.6459
450	.080 02	3010.2	3330.3	6.9363	.070 74	3005.0	3323.3	6.8746	.063 30	2999.7	3316.2	6.8186
500	.086 43	3099.5	3445.3	7.0901	.076 51	3095.3	3439.6	7.0301	.068 57	3091.0	3433.8	6.9759
600	.098 85	3279.1	3674.4	7.3688	.087 65	3276.0	3670.5	7.3110	.078 69	3273.0	3666.5	7.2589
700	.110 95	3462.1	3905.9	7.6198	.098 47	3459.9	3903.0	7.5631	.088 49	3457.6	3900.1	7.5122
800	.122 87	3650.0	4141.5	7.8502	.109 11	3648.3	4139.3	7.7942	.098 11	3646.6	4137.1	7.7440
900	.134 69	3843.6	4382.3	8.0647	.119 65	3842.2	4380.6	8.0091	.107 62	3840.7	4378.8	7.9593
1000	.146 45	4042.9	4628.7	8.2662	.130 13	4041.6	4627.2	8.2108	.117 07	4040.4	4625.7	8.1612
1100	.158 17	4248.0	4880.6	8.4567	.140 56	4246.8	4879.3	8.4015	.126 48	4245.6	4878.0	8.3520
1200	.169 87	4458.6	5138.1	8.6376	.150 98	4457.5	5136.9	8.5825	.135 87	4456.3	5135.7	8.5331
1300	.181 56	4674.3	5400.5	8.8100	.161 39	4673.1	5399.4	8.7549	.145 26	4672.0	5398.2	8.7055
Doy.	.032 44	2589.7	2784.3	5.8892	.027 37	2580.5	2772.1	5.8133	.023 52	2569.8	2758.0	5.7432
300	.036 16	2667.2	2884.2	6.0674	.029 47	2632.2	2838.4	5.9305	.024 26	2590.9	2785.0	5.7906
350	.042 23	2789.6	3043.0	6.3335	.035 24	2769.4	3016.0	6.2283	.029 95	2747.7	2987.3	6.1301
400	.047 39	2892.9	3177.2	6.5408	.039 93	2878.6	3158.1	6.4478	.034 32	2863.8	3138.3	6.3634
450	.052 14	2988.9	3301.8	6.7193	.044 16	2978.0	3287.1	6.6327	.038 17	2966.7	3272.0	6.5551
500	.056 65	3082.2	3422.2	6.8803	.048 14	3073.4	3410.3	6.7975	.041 75	3064.3	3398.3	6.7240
550	.061 01	3174.6	3540.6	7.0288	.051 95	3167.2	3530.9	6.9486	.045 16	3159.8	3521.0	6.8778
600	.065 25	3266.9	3658.4	7.1677	.055 65	3260.7	3650.3	7.0894	.048 45	3254.4	3642.0	7.0206
700	.073 52	3453.1	3894.2	7.4234	.062 83	3448.5	3888.3	7.3476	.054 81	3443.9	3882.4	7.2812
800	.081 60	3643.1	4132.7	7.6566	.069 81	3639.5	4128.2	7.5822	.060 97	3636.0	4123.8	7.5173
900	.089 58	3837.8	4375.3	7.8727	.076 69	3835.0	4371.8	7.7991	.067 02	3832.1	4368.3	7.7351
1000	.097 49	4037.8	4622.7	8.0751	.083 50	4035.3	4619.8	8.0020	.073 01	4032.8	4616.9	7.9384
1100	.105 36	4243.3	4875.4	8.2661	.090 27	4240.9	4872.8	8.1933	.078 96	4238.6	4870.3	8.1300
1200	.113 21	4454.0	5133.3	8.4474	.097 03	4451.7	5130.9	8.3747	.084 89	4449.5	5128.5	8.3115
1300	.121 06	4669.6	5396.0	8.6199	.103 77	4667.3	5393.7	8.5473	.090 80	4665.0	5391.5	8.4842
Doy.	.020 48	2557.8	2742.1	5.6772	.018 026	2544.4	2724.7	5.6141	.013 495	2505.1	2673.8	5.4624
325	.023 27	2646.6	2856.0	5.8712	.019 861	2610.4	2809.1	5.7568	.016 126	2624.6	2826.2	5.7118
350	.025 80	2724.4	2956.6	6.0361	.022 42	2699.4	2923.4	5.9443	.020 00	2789.3	3039.3	6.0417
400	.029 93	2848.4	3117.8	6.2854	.026 41	2832.4	3096.5	6.2120	.022 99	2912.5	3199.8	6.2719
450	.033 50	2955.2	3256.6	6.4844	.029 75	2943.4	3240.9	6.4190	.025 60	3021.7	3341.8	6.4618
500	.036 77	3055.2	3336.1	6.6576	.032 79	3045.8	3373.7	6.5966	.028 01	3125.0	3475.2	6.6290
550	.039 87	3152.2	3511.0	6.8142	.035 64	3144.6	3500.9	6.7561	.030 29	3225.4	3604.0	6.7810
600	.042 85	3248.1	3633.7	6.9589	.038 37	3241.7	3625.3	6.9029	.032 48	3324.4	3730.4	6.9218
650	.045 74	3343.6	3755.3	7.0943	.041 01	3338.2	3748.2	7.0398	.034 60	3422.9	3855.3	7.0536
700	.048 57	3439.3	3876.5	7.2221	.043 58	3434.7	3870.5	7.1687	.038 69	3620.0	4103.6	7.2965
800	.054 09	3632.5	4119.3	7.4596	.048 59	3628.9	4114.8	7.4077	.042 67	3819.1	4352.5	7.5182
900	.059 50	3829.2	4364.3	7.6783	.053 49	3826.3	4361.2	7.6272	.046 58	4021.6	4603.8	7.7237
1000	.064 85	4030.3	4614.0	7.8821	.058 32	4027.8	4611.0	7.8315	.050 45	4228.2	4858.8	7.9165
1100	.070 16	4236.3	4867.7	8.0740	.063 12	4234.0	4865.1	8.0237	.054 30	4439.3	5118.0	8.0987
1200	.075 44	4447.2	5126.2	8.2556	.067 89	4444.9	5123.8	8.2055	.058 13	4654.8	5381.4	8.2717
1300	.080 72	4662.7	5389.2	8.4284	.072 65	4460.5	5387.0	8.3783				

Tablo C-3 (Devamı)

T	P = 15.0 MPa (342.24°C)				P = 17.5 MPa (354.75°C)				P = 20.0 MPa (365.81°C)			
	v	u	h	s	v	u	h	s	v	u	h	s
	Doy.	.010 337	2455.5	2610.5	5.3098	.0079 20	2390.2	2528.8	5.1419	.005 834	2293.0	2409.7
350	.011 470	2520.4	2692.4	5.4421								
400	.015 649	2740.7	2975.5	5.8811	.012 447	2685.0	2902.9	5.7213	.009 942	2619.3	2818.1	5.5540
450	.018 445	2879.5	3156.2	6.1404	.015 174	2844.2	3109.7	6.0184	.012 695	2806.2	3060.1	5.9017
500	.020 80	2996.6	3308.6	6.3443	.017 358	2970.3	3274.1	6.2383	.014 768	2942.9	3238.2	6.1401
550	.022 93	3104.7	3448.6	6.5199	.019 288	3083.9	3421.4	6.4230	.016 555	3062.4	3393.5	6.3348
600	.024 91	3208.6	3582.3	6.6776	.021 06	3191.5	3560.2	6.5866	.018 178	3174.0	3537.6	6.5048
650	.026 80	3310.3	3712.3	6.8224	.022 74	3296.0	3693.9	6.7357	.019 693	3281.4	3675.3	6.6582
700	.028 61	3410.9	3840.1	6.9572	.024 34	3398.7	3824.6	6.8736	.021 13	3386.4	3809.0	6.7993
800	.032 10	3610.9	4092.4	7.2040	.027 38	3601.8	4081.1	7.1244	.023 85	3592.7	4069.7	7.0544
900	.035 46	3811.9	4343.8	7.4279	.030 31	3804.7	4335.1	7.3507	.026 45	3797.5	4326.4	7.2830
1000	.038 75	4015.4	4596.6	7.6348	.033 16	4009.3	4589.5	7.5589	.028 97	4003.1	4582.5	7.4925
1100	.042 00	4222.6	4852.6	7.8283	.035 97	4216.9	4846.4	7.7531	.031 45	4211.3	4840.2	7.6874
1200	.045 23	4433.8	5112.3	8.0108	.038 76	4428.3	5106.6	7.9360	.033 91	4422.8	5101.0	7.8707
1300	.048 45	4649.1	5376.0	8.1840	.041 54	4643.5	5370.5	8.1093	.036 36	4638.0	5365.1	8.0442
	P = 25.0 MPa				P = 30.0 MPa				P = 40.0 MPa			
375	.001 9731	1798.7	1848.0	4.0320	.001 789 2	1737.8	1791.5	3.9305	.001 640 7	1677.1	1742.8	3.8290
400	.006 004	2430.1	2580.2	5.1418	.002 790	2067.4	2151.1	4.4728	.001 907 7	1854.6	1930.9	4.1135
425	.007 881	2609.2	2806.3	5.4723	.005 303	2455.1	2614.2	5.1504	.002 532	2096.9	2198.1	4.5029
450	.009 162	2720.7	2949.7	5.6744	.006 735	2619.3	2821.4	5.4424	.003 693	2365.1	2512.8	4.9459
500	.011 123	2884.3	3162.4	5.9592	.008 678	2820.7	3081.1	5.7905	.005 622	2678.4	2903.3	5.4700
550	.012 724	3017.5	3335.6	6.1765	.010 168	2970.3	3275.4	6.0342	.006 984	2869.7	3149.1	5.7785
600	.014 137	3137.9	3491.4	6.3602	.011 446	3100.5	3443.9	6.2331	.008 094	3022.6	3346.4	6.0114
650	.015 433	3251.6	3637.4	6.5229	.012 596	3221.0	3598.9	6.4058	.009 063	3158.0	3520.6	6.2054
700	.016 646	3361.3	3777.5	6.6707	.013 661	3335.8	3745.6	6.5606	.009 941	3283.6	3681.2	6.3750
800	.018 912	3574.3	4047.1	6.9345	.015 623	3555.5	4024.2	6.8332	.011 523	3517.8	3978.7	6.6662
900	.021 045	3783.0	4309.1	7.1680	.017 448	3768.5	4291.9	7.0718	.012 962	3739.4	4257.9	6.9150
1000	.023 10	3990.9	4568.5	7.3802	.019 196	3978.8	4554.7	7.2867	.014 324	3954.6	4527.6	7.1356
1100	.025 12	4200.2	4828.2	7.5765	.020 903	4189.2	4816.3	7.4845	.015 642	4167.4	4793.1	7.3364
1200	.027 11	4412.0	5089.9	7.7605	.022 589	4401.3	5079.0	7.6692	.016 940	4380.1	5057.7	7.5224
1300	.029 10	4626.9	5354.4	7.9342	.024 266	4616.0	5344.0	7.8432	.018 229	4594.3	5323.5	7.6969

KAYNAK: Keenan, Keyes, Hill, and Moore, *Steam Tables*, Wiley, New York, 1969; G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1973.

Tablo C-4 Sıkıştırılmış Sıvı

T	P = 5 MPa (263.99°C)				P = 10 MPa (311.06°C)				P = 15 MPa (342.42°C)			
	v	u	h	s	v	u	h	s	v	u	h	s
0	0.000 997 7	0.04	5.04	0.0001	0.000 995 2	0.09	10.04	0.0002	0.000 992 8	0.15	15.05	0.0004
20	0.000 999 5	83.65	88.65	0.2956	0.000 997 2	83.36	93.33	0.2945	0.000 995 0	83.06	97.99	0.2934
40	0.001 005 6	166.95	171.97	0.5705	0.001 003 4	166.35	176.38	0.5686	0.001 001 3	165.76	180.78	0.5666
60	0.001 014 9	250.23	255.30	0.8285	0.001 012 7	249.36	259.49	0.8258	0.001 010 5	248.51	263.67	0.8232
80	0.001 026 8	333.72	338.85	1.0720	0.001 024 5	332.59	342.83	1.0688	0.001 022 2	331.48	346.81	1.0656
100	0.001 041 0	417.52	422.72	1.3030	0.001 038 5	416.12	426.50	1.2992	0.001 036 1	414.74	430.28	1.2955
120	0.001 057 6	501.80	507.09	1.5233	0.001 054 9	500.08	510.64	1.5189	0.001 052 2	498.40	514.19	1.5145
140	0.001 076 8	586.76	592.15	1.7343	0.001 073 7	584.68	595.42	1.7292	0.001 070 7	582.66	598.72	1.7242
160	0.001 098 8	672.62	678.12	1.9375	0.001 095 3	670.13	681.08	1.9317	0.001 091 8	667.71	684.09	1.9260
180	0.001 124 0	759.63	765.25	2.1341	0.001 119 9	756.65	767.84	2.1275	0.001 115 9	753.76	770.50	2.1210
200	0.001 153 0	848.1	853.9	2.3255	0.001 148 0	844.5	856.0	2.3178	0.001 143 3	841.0	858.2	2.3104
220	0.001 186 6	938.4	944.4	2.5128	0.001 180 5	934.1	945.9	2.5039	0.001 174 8	929.9	947.5	2.4953
240	0.001 226 4	1031.4	1037.5	2.6979	0.001 218 7	1026.0	1038.1	2.6872	0.001 211 4	1020.8	1039.0	2.6771
260	0.001 274 9	1127.9	1134.3	2.8830	0.001 264 5	1121.1	1133.7	2.8699	0.001 255 0	1114.6	1133.4	2.8576
T	P = 20 MPa (365.81°C)				P = 30 MPa				P = 50 MPa			
	v	u	h	s	v	u	h	s	v	u	h	s
0	0.000 990 4	0.19	20.01	0.0004	0.000 985 6	0.25	29.82	0.0001	0.000 976 6	0.20	49.03	0.0014
20	0.000 992 8	82.77	102.62	0.2923	0.000 988 6	82.17	111.84	0.2899	0.000 980 4	81.00	130.02	0.2848
40	0.000 999 2	165.17	185.16	0.5646	0.000 995 1	164.04	193.89	0.5607	0.000 987 2	161.86	211.21	0.5527
60	0.001 008 4	247.68	267.85	0.8206	0.001 004 2	246.06	276.19	0.8154	0.000 996 2	242.98	292.79	0.8052
80	0.001 019 9	330.40	350.80	1.0624	0.001 015 6	328.30	358.77	1.0561	0.001 007 3	324.34	374.70	1.0440
100	0.001 033 7	413.39	434.06	1.2917	0.001 029 0	410.78	441.66	1.2844	0.001 020 1	405.88	456.89	1.2703
120	0.001 049 6	496.76	517.76	1.5102	0.001 044 5	493.59	524.93	1.5018	0.001 034 8	487.65	539.39	1.4857
140	0.001 067 8	580.69	602.04	1.7193	0.001 062 1	576.88	608.75	1.7098	0.001 051 5	569.77	622.35	1.6915
160	0.001 088 5	665.35	687.12	1.9204	0.001 082 1	660.82	693.28	1.9096	0.001 070 3	652.41	705.92	1.8891
180	0.001 112 0	750.95	773.20	2.1147	0.001 104 7	745.59	778.73	2.1024	0.001 091 2	735.69	790.25	2.0794
200	0.001 138 8	837.7	860.5	2.3031	0.001 130 2	831.4	865.3	2.2893	0.001 114 6	819.7	875.5	2.2634
240	0.001 204 6	1016.0	1040.0	2.6674	0.001 192 0	1006.9	1042.6	2.6490	0.001 170 2	990.7	1049.2	2.6158
280	0.001 296 5	1204.7	1230.6	3.0248	0.001 275 5	1190.7	1229.0	2.9986	0.001 241 5	1167.2	1229.3	2.9537
320	0.001 443 7	1415.7	1444.6	3.3979	0.001 399 7	1390.7	1432.7	3.3539	0.001 338 8	1353.3	1420.2	3.2868
360	0.001 822 6	1702.8	1739.3	3.8772	0.001 626 5	1626.6	1675.4	3.7494	0.001 483 8	1556.0	1630.2	3.6291

KAYNAK: Keenan, Keyes, Hill, and Moore, *Steam Tables*, Wiley, New York, 1969; G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1973.

Tablo C-5 Doymuş Katı—Buhar

T, °C	P, kPa	Hacim, m ³ /kg		Enerji, kJ/kg			Entalpi, kJ/kg			Entropi, kJ/kg·K		
		Doy. Katı $v_i \times 10^3$	Doy. Buhar v_g	Doy. Katı u_i	Sübl. u_{ig}	Doy. Buhar u_g	Doy. Katı h_i	Sübl. h_{ig}	Doy. Buhar h_g	Doy. Katı s_i	Sübl. s_{ig}	Doy. Buhar s_g
0.01	0.6113	1.0908	206.1	-333.40	2708.7	2375.3	-333.40	2834.8	2501.4	-1.221	10.378	9.156
0	0.6108	1.0908	206.3	-333.43	2708.8	2375.3	-333.43	2834.8	2501.3	-1.221	10.378	9.157
-2	0.5176	1.0904	241.7	-337.62	2710.2	2372.6	-337.62	2835.3	2497.7	-1.237	10.456	9.219
-4	0.4375	1.0901	283.8	-341.78	2711.6	2369.8	-341.78	2835.7	2494.0	-1.253	10.536	9.283
-6	0.3689	1.0898	334.2	-345.91	2712.9	2367.0	-345.91	2836.2	2490.3	-1.268	10.616	9.348
-8	0.3102	1.0894	394.4	-350.02	2714.2	2364.2	-350.02	2836.6	2486.6	-1.284	10.698	9.414
-10	0.2602	1.0891	466.7	-354.09	2715.5	2361.4	-354.09	2837.0	2482.9	-1.299	10.781	9.481
-12	0.2176	1.0888	553.7	-358.14	2716.8	2358.7	-358.14	2837.3	2479.2	-1.315	10.865	9.550
-14	0.1815	1.0884	658.8	-362.15	2718.0	2355.9	-362.15	2837.6	2475.5	-1.331	10.950	9.619
-16	0.1510	1.0881	786.0	-366.14	2719.2	2353.1	-366.14	2837.9	2471.8	-1.346	11.036	9.690
-20	0.1035	1.0874	1128.6	-374.03	2721.6	2347.5	-374.03	2838.4	2464.3	-1.377	11.212	9.835
-24	0.0701	1.0868	1640.1	-381.80	2723.7	2342.0	-381.80	2838.7	2456.9	-1.408	11.394	9.985
-28	0.0469	1.0861	2413.7	-389.45	2725.8	2336.4	-389.45	2839.0	2449.5	-1.439	11.580	10.141
-32	0.0309	1.0854	3600	-396.98	2727.8	2330.8	-396.98	2839.1	2442.1	-1.471	11.773	10.303
-36	0.0201	1.0848	5444	-404.40	2729.6	2325.2	-404.40	2839.1	2434.7	-1.501	11.972	10.470
-40	0.0129	1.0841	8354	-411.70	2731.3	2319.6	-411.70	2838.9	2427.2	-1.532	12.176	10.644

KAYNAK: Keenan, Keyes, Hill, and Moore, *Steam Tables*, Wiley, New York, 1969; G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley, New York, 1973.

EK D

R134a'nın Termodinamik Özellikleri

Tablo D-1 Doymuş R134a—Sıcaklık Tablosu

Sıcaklık °C	Basınç kPa	Özgül Hacim m ³ /kg		İç Enerji kJ/kg		Entalpi kJ/kg			Entropi kJ/kg·K	
		Doymuş Sıvı $v_f \times 10^3$	Doymuş Buhar v_g	Doymuş Sıvı u_f	Doymuş Buhar u_g	Doymuş Sıvı h_f	Buhar- laşma h_{fg}	Doymuş Buhar h_g	Doymuş Sıvı s_f	Doymuş Buhar s_g
-40	51.64	0.7055	0.3569	-0.04	204.45	0.00	222.88	222.88	0.0000	0.9560
-36	63.32	0.7113	0.2947	4.68	206.73	4.73	220.67	225.40	0.0201	0.9506
-32	77.04	0.7172	0.2451	9.47	209.01	9.52	218.37	227.90	0.0401	0.9456
-28	93.05	0.7233	0.2052	14.31	211.29	14.37	216.01	230.38	0.0600	0.9411
-26	101.99	0.7265	0.1882	16.75	212.43	16.82	214.80	231.62	0.0699	0.9390
-24	111.60	0.7296	0.1728	19.21	213.57	19.29	213.57	232.85	0.0798	0.9370
-22	121.92	0.7328	0.1590	21.68	214.70	21.77	212.32	234.08	0.0897	0.9351
-20	132.99	0.7361	0.1464	24.17	215.84	24.26	211.05	235.31	0.0996	0.9332
-18	144.83	0.7395	0.1350	26.67	216.97	26.77	209.76	236.53	0.1094	0.9315
-16	157.48	0.7428	0.1247	29.18	218.10	29.30	208.45	237.74	0.1192	0.9298
-12	185.40	0.7498	0.1068	34.25	220.36	34.39	205.77	240.15	0.1388	0.9267
-8	217.04	0.7569	0.0919	39.38	222.60	39.54	203.00	242.54	0.1583	0.9239
-4	252.74	0.7644	0.0794	44.56	224.84	44.75	200.15	244.90	0.1777	0.9213
0	292.82	0.7721	0.0689	49.79	227.06	50.02	197.21	247.23	0.1970	0.9190
4	337.65	0.7801	0.0600	55.08	229.27	55.35	194.19	249.53	0.2162	0.9169
8	387.56	0.7884	0.0525	60.43	231.46	60.73	191.07	251.80	0.2354	0.9150
12	442.94	0.7971	0.0460	65.83	233.63	66.18	187.85	254.03	0.2545	0.9132
16	504.16	0.8062	0.0405	71.29	235.78	71.69	184.52	256.22	0.2735	0.9116
20	571.60	0.8157	0.0358	76.80	237.91	77.26	181.09	258.36	0.2924	0.9102
24	645.66	0.8257	0.0317	82.37	240.01	82.90	177.55	260.45	0.3113	0.9089
26	685.30	0.8309	0.0298	85.18	241.05	85.75	175.73	261.48	0.3208	0.9082
28	726.75	0.8362	0.0281	88.00	242.08	88.61	173.89	262.50	0.3302	0.9076
30	770.06	0.8417	0.0265	90.84	243.10	91.49	172.00	263.50	0.3396	0.9070
32	815.28	0.8473	0.0250	93.70	244.12	94.39	170.09	264.48	0.3490	0.9064
34	862.47	0.8530	0.0236	96.58	245.12	97.31	168.14	265.45	0.3584	0.9058
36	911.68	0.8590	0.0223	99.47	246.11	100.25	166.15	266.40	0.3678	0.9053
38	962.98	0.8651	0.0210	102.38	247.09	103.21	164.12	267.33	0.3772	0.9047

Sıcaklık °C	Basınç kPa	Özgül Hacim m ³ /kg		İç Enerji kJ/kg		Entalpi kJ/kg			Entropi kJ/kg·K	
		Doymuş Sıvı	Doymuş Buhar	Doymuş Sıvı	Doymuş Buhar	Doymuş Sıvı	Buhar- laşma	Doymuş Buhar	Doymuş Sıvı	Doymuş Buhar
		$v_f \times 10^3$	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_g
40	1016.4	0.8714	0.0199	105.30	248.06	106.19	162.05	268.24	0.3866	0.9041
42	1072.0	0.8780	0.0188	108.25	249.02	109.19	159.94	269.14	0.3960	0.9035
44	1129.9	0.8847	0.0177	111.22	249.96	112.22	157.79	270.01	0.4054	0.9030
48	1252.6	0.8989	0.0159	117.22	251.79	118.35	153.33	271.68	0.4243	0.9017
52	1385.1	0.9142	0.0142	123.31	253.55	124.58	148.66	273.24	0.4432	0.9004
56	1527.8	0.9308	0.0127	129.51	255.23	130.93	143.75	274.68	0.4622	0.8990
60	1681.3	0.9488	0.0114	135.82	256.81	137.42	138.57	275.99	0.4814	0.8973
70	2116.2	1.0027	0.0086	152.22	260.15	154.34	124.08	278.43	0.5302	0.8918
80	2632.4	1.0766	0.0064	169.88	262.14	172.71	106.41	279.12	0.5814	0.8827
90	3243.5	1.1949	0.0046	189.82	261.34	193.69	82.63	276.32	0.6380	0.8655
100	3974.2	1.5443	0.0027	218.60	248.49	224.74	34.40	259.13	0.7196	0.8117

KAYNAK: Tablo D-1'den D-3'e D. P. Wilson and R. S. Basu, "Thermodynamic Properties of a New Stratospherically Safe Working Fluid—Refrigerant 134a," *ASHRAE Trans.*, Vol. 94, Pt. 2, 1988, pp. 2095–2118'den alınan denklemlere dayanmaktadır.

Tablo D-2 Doymuş R134a—Basınç Tablosu

Basınç kPa	Sıcaklık °C	Özgül Hacim m ³ /kg		İç Enerji kJ/kg		Entalpi kJ/kg			Entropi kJ/kg·K	
		Doymuş Sıvı	Doymuş Buhar	Doymuş Sıvı	Doymuş Buhar	Doymuş Sıvı	Buhar- laşma	Doymuş Buhar	Doymuş Sıvı	Doymuş Buhar
		$v_f \times 10^3$	v_g	u_f	u_g	h_f	h_{fg}	h_g	s_f	s_g
60	-37.07	0.7097	0.3100	3.14	206.12	3.46	221.27	224.72	0.0147	0.9520
80	-31.21	0.7184	0.2366	10.41	209.46	10.47	217.92	228.39	0.0440	0.9447
100	-26.43	0.7258	0.1917	16.22	212.18	16.29	215.06	231.35	0.0678	0.9395
120	-22.36	0.7323	0.1614	21.23	214.50	21.32	212.54	233.86	0.0879	0.9354
140	-18.80	0.7381	0.1395	25.66	216.52	25.77	210.27	236.04	0.1055	0.9322
160	-15.62	0.7435	0.1229	29.66	218.32	29.78	208.19	237.97	0.1211	0.9295
180	-12.73	0.7485	0.1098	33.31	219.94	33.45	206.26	239.71	0.1352	0.9273
200	-10.09	0.7532	0.0993	36.69	221.43	36.84	204.46	241.30	0.1481	0.9253
240	-5.37	0.7618	0.0834	42.77	224.07	42.95	201.14	244.09	0.1710	0.9222
280	-1.23	0.7697	0.0719	48.18	226.38	48.39	198.13	246.52	0.1911	0.9197
320	2.48	0.7770	0.0632	53.06	228.43	53.31	195.35	248.66	0.2089	0.9177
360	5.84	0.7839	0.0564	57.54	230.28	57.82	192.76	250.58	0.2251	0.9160
400	8.93	0.7904	0.0509	61.69	231.97	62.00	190.32	252.32	0.2399	0.9145
500	15.74	0.8056	0.0409	70.93	235.64	71.33	184.74	256.07	0.2723	0.9117
600	21.58	0.8196	0.0341	78.99	238.74	79.48	179.71	259.19	0.2999	0.9097
700	26.72	0.8328	0.0292	86.19	241.42	86.78	175.07	261.85	0.3242	0.9080
800	31.33	0.8454	0.0255	92.75	243.78	93.42	170.73	264.15	0.3459	0.9066
900	35.53	0.8576	0.0226	98.79	245.88	99.56	166.62	266.18	0.3656	0.9054
1000	39.39	0.8695	0.0202	104.42	247.77	105.29	162.68	267.97	0.3838	0.9043
1200	46.32	0.8928	0.0166	114.69	251.03	115.76	155.23	270.99	0.4164	0.9023
1400	52.43	0.9159	0.0140	123.98	253.74	125.26	148.14	273.40	0.4453	0.9003
1600	57.92	0.9392	0.0121	132.52	256.00	134.02	141.31	275.33	0.4714	0.8982
1800	62.91	0.9631	0.0105	140.49	257.88	142.22	134.60	276.83	0.4954	0.8959
2000	67.49	0.9878	0.0093	148.02	259.41	149.99	127.95	277.94	0.5178	0.8934
2500	77.59	1.0562	0.0069	165.48	261.84	168.12	111.06	279.17	0.5687	0.8854
3000	86.22	1.1416	0.0053	181.88	262.16	185.30	92.71	278.01	0.6156	0.8735

Tablo D-3 Kızgın Buhar R134a

$T, ^\circ\text{C}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ}/\text{kg}$	$h, \text{kJ}/\text{kg}$	$s, \text{kJ}/\text{kg}\cdot\text{K}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ}/\text{kg}$	$h, \text{kJ}/\text{kg}$	$s, \text{kJ}/\text{kg}\cdot\text{K}$
$P = 0.06 \text{ MPa } (-37.07 ^\circ\text{C})$					$P = 0.10 \text{ MPa } (-26.43 ^\circ\text{C})$			
Doy.	0.31003	206.12	224.72	0.9520	0.19170	212.18	231.35	0.9395
-20	0.33536	217.86	237.98	1.0062	0.19770	216.77	236.54	0.9602
-10	0.34992	224.97	245.96	1.0371	0.20686	224.01	244.70	0.9918
0	0.36433	232.24	254.10	1.0675	0.21587	231.41	252.99	1.0227
10	0.37861	239.69	262.41	1.0973	0.22473	238.96	261.43	1.0531
20	0.39279	247.32	270.89	1.1267	0.23349	246.67	270.02	1.0829
30	0.40688	255.12	279.53	1.1557	0.24216	254.54	278.76	1.1122
40	0.42091	263.10	288.35	1.1844	0.25076	262.58	287.66	1.1411
50	0.43487	271.25	297.34	1.2126	0.25930	270.79	296.72	1.1696
60	0.44879	279.58	306.51	1.2405	0.26779	279.16	305.94	1.1977
70	0.46266	288.08	315.84	1.2681	0.27623	287.70	315.32	1.2254
80	0.47650	296.75	325.34	1.2954	0.28464	296.40	324.87	1.2528
90	0.49031	305.58	335.00	1.3224	0.29302	305.27	334.57	1.2799
$P = 0.14 \text{ MPa } (-18.80 ^\circ\text{C})$					$P = 0.18 \text{ MPa } (-12.73 ^\circ\text{C})$			
Doy.	0.13945	216.52	236.04	0.9322	0.10983	219.94	239.71	0.9273
-10	0.14519	223.03	243.40	0.9606	0.11135	222.02	242.06	0.9362
0	0.15219	230.55	251.86	0.9922	0.11678	229.67	250.69	0.9684
10	0.15875	238.21	260.43	1.0230	0.12207	237.44	259.41	0.9998
20	0.16520	246.01	269.13	1.0532	0.12723	245.33	268.23	1.0304
30	0.17155	253.96	277.97	1.0828	0.13230	253.36	277.17	1.0604
40	0.17783	262.06	286.96	1.1120	0.13730	261.53	286.24	1.0898
50	0.18404	270.32	296.09	1.1407	0.14222	269.85	295.45	1.1187
60	0.19020	278.74	305.37	1.1690	0.14710	278.31	304.79	1.1472
70	0.19633	287.32	314.80	1.1969	0.15193	286.93	314.28	1.1753
80	0.20241	296.06	324.39	1.2244	0.15672	295.71	323.92	1.2030
90	0.20846	304.95	334.14	1.2516	0.16148	304.63	333.70	1.2303
100	0.21449	314.01	344.04	1.2785	0.16622	313.72	343.63	1.2573
$P = 0.20 \text{ MPa } (-10.09 ^\circ\text{C})$					$P = 0.24 \text{ MPa } (-5.37 ^\circ\text{C})$			
Doy.	0.09933	221.43	241.30	0.9253	0.08343	224.07	244.09	0.9222
-10	0.09938	221.50	241.38	0.9256				
0	0.10438	229.23	250.10	0.9582	0.08574	228.31	248.89	0.9399
10	0.10922	237.05	258.89	0.9898	0.08993	236.26	257.84	0.9721
20	0.11394	244.99	267.78	1.0206	0.09399	244.30	266.85	1.0034
30	0.11856	253.06	276.77	1.0508	0.09794	252.45	275.95	1.0339
40	0.12311	261.26	285.88	1.0804	0.10181	260.72	285.16	1.0637
50	0.12758	269.61	295.12	1.1094	0.10562	269.12	294.47	1.0930
60	0.13201	278.10	304.50	1.1380	0.10937	277.67	303.91	1.1218
70	0.13639	286.74	314.02	1.1661	0.11307	286.35	313.49	1.1501
80	0.14073	295.53	323.68	1.1939	0.11674	295.18	323.19	1.1780
90	0.14504	304.47	333.48	1.2212	0.12037	304.15	333.04	1.2055
100	0.14932	313.57	343.43	1.2483	0.12398	313.27	343.03	1.2326

Tablo D-3 (Devamı)

$T, ^\circ\text{C}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ/kg}$	$h, \text{kJ/kg}$	$s, \text{kJ/kg}\cdot\text{K}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ/kg}$	$h, \text{kJ/kg}$	$s, \text{kJ/kg}\cdot\text{K}$
$P = 0.28 \text{ MPa } (-1.23 ^\circ\text{C})$					$P = 0.32 \text{ MPa } (2.48 ^\circ\text{C})$			
Doy.	0.07193	226.38	246.52	0.9197	0.06322	228.43	248.66	0.917
0	0.07240	227.37	247.64	0.9238				
10	0.07613	235.44	256.76	0.9566	0.06576	234.61	255.65	0.942
20	0.07972	243.59	265.91	0.9883	0.06901	242.87	264.95	0.974
30	0.08320	251.83	275.12	1.0192	0.07214	251.19	274.28	1.006
40	0.08660	260.17	284.42	1.0494	0.07518	259.61	283.67	1.036
50	0.08992	268.64	293.81	1.0789	0.07815	268.14	293.15	1.066
60	0.09319	277.23	303.32	1.1079	0.08106	276.79	302.72	1.095
70	0.09641	285.96	312.95	1.1364	0.08392	285.56	312.41	1.124
80	0.09960	294.82	322.71	1.1644	0.08674	294.46	322.22	1.152
90	0.10275	303.83	332.60	1.1920	0.08953	303.50	332.15	1.180
100	0.10587	312.98	342.62	1.2193	0.09229	312.68	342.21	1.207
110	0.10897	322.27	352.78	1.2461	0.09503	322.00	352.40	1.234
120	0.11205	331.71	363.08	1.2727	0.09774	331.45	362.73	1.261
$P = 0.40 \text{ MPa } (8.93 ^\circ\text{C})$					$P = 0.50 \text{ MPa } (15.74 ^\circ\text{C})$			
Doy.	0.05089	231.97	252.32	0.9145	0.04086	235.64	256.07	0.911
10	0.05119	232.87	253.35	0.9182				
20	0.05397	241.37	262.96	0.9515	0.04188	239.40	260.34	0.926
30	0.05662	249.89	272.54	0.9837	0.04416	248.20	270.28	0.959
40	0.05917	258.47	282.14	1.0148	0.04633	256.99	280.16	0.991
50	0.06164	267.13	291.79	1.0452	0.04842	265.83	290.04	1.022
60	0.06405	275.89	301.51	1.0748	0.05043	274.73	299.95	1.053
70	0.06641	284.75	311.32	1.1038	0.05240	283.72	309.92	1.082
80	0.06873	293.73	321.23	1.1322	0.05432	292.80	319.96	1.111
90	0.07102	302.84	331.25	1.1602	0.05620	302.00	330.10	1.139
100	0.07327	312.07	341.38	1.1878	0.05805	311.31	340.33	1.167
110	0.07550	321.44	351.64	1.2149	0.05988	320.74	350.68	1.194
120	0.07771	330.94	362.03	1.2417	0.06168	330.30	361.14	1.221
130	0.07991	340.58	372.54	1.2681	0.06347	339.98	371.72	1.248
140	0.08208	350.35	383.18	1.2941	0.06524	349.79	382.42	1.274
$P = 0.60 \text{ MPa } (21.58 ^\circ\text{C})$					$P = 0.70 \text{ MPa } (26.72 ^\circ\text{C})$			
Doy.	0.03408	238.74	259.19	0.9097	0.02918	241.42	261.85	0.9080
30	0.03581	246.41	267.89	0.9388	0.02979	244.51	265.37	0.9197
40	0.03774	255.45	278.09	0.9719	0.03157	253.83	275.93	0.9539
50	0.03958	264.48	288.23	1.0037	0.03324	263.08	286.35	0.9867
60	0.04134	273.54	298.35	1.0346	0.03482	272.31	296.69	1.0182
70	0.04304	282.66	308.48	1.0645	0.03634	281.57	307.01	1.0487
80	0.04469	291.86	318.67	1.0938	0.03781	290.88	317.35	1.0784
90	0.04631	301.14	328.93	1.1225	0.03924	300.27	327.74	1.1074
100	0.04790	310.53	339.27	1.1505	0.04064	309.74	338.19	1.1358
110	0.04946	320.03	349.70	1.1781	0.04201	319.31	348.71	1.1637
120	0.05099	329.64	360.24	1.2053	0.04335	328.98	359.33	1.1910
130	0.05251	339.38	370.88	1.2320	0.04468	338.76	370.04	1.2179
140	0.05402	349.23	381.64	1.2584	0.04599	348.66	380.86	1.2444
150	0.05550	359.21	392.52	1.2844	0.04729	358.68	391.79	1.2706
160	0.05698	369.32	403.51	1.3100	0.04857	368.82	402.82	1.2963

Tablo D-3 (Devamı)

$T, ^\circ\text{C}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ/kg}$	$h, \text{kJ/kg}$	$s, \text{kJ/kg}\cdot\text{K}$	$v, \text{m}^3/\text{kg}$	$u, \text{kJ/kg}$	$h, \text{kJ/kg}$	$s, \text{kJ/kg}\cdot\text{K}$
$P = 0.80 \text{ MPa} (31.33 ^\circ\text{C})$					$P = 0.90 \text{ MPa} (35.53 ^\circ\text{C})$			
Doy.	0.02547	243.78	264.15	0.9066	0.02255	245.88	266.18	0.9054
40	0.02691	252.13	273.66	0.9374	0.02325	250.32	271.25	0.9217
50	0.02846	261.62	284.39	0.9711	0.02472	260.09	282.34	0.9566
60	0.02992	271.04	294.98	1.0034	0.02609	269.72	293.21	0.9897
70	0.03131	280.45	305.50	1.0345	0.02738	279.30	303.94	1.0214
80	0.03264	289.89	316.00	1.0647	0.02861	288.87	314.62	1.0521
90	0.03393	299.37	326.52	1.0940	0.02980	298.46	325.28	1.0819
100	0.03519	308.93	337.08	1.1227	0.03095	308.11	335.96	1.1109
110	0.03642	318.57	347.71	1.1508	0.03207	317.82	346.68	1.1392
120	0.03762	328.31	358.40	1.1784	0.03316	327.62	357.47	1.1670
130	0.03881	338.14	369.19	1.2055	0.03423	337.52	368.33	1.1943
140	0.03997	348.09	380.07	1.2321	0.03529	347.51	379.27	1.2211
150	0.04113	358.15	391.05	1.2584	0.03633	357.61	390.31	1.2475
160	0.04227	368.32	402.14	1.2843	0.03736	367.82	401.44	1.2735
170	0.04340	378.61	413.33	1.3098	0.03838	378.14	412.68	1.2992
180	0.04452	389.02	424.63	1.3351	0.03939	388.57	424.02	1.3245
$P = 1.00 \text{ MPa} (39.39 ^\circ\text{C})$					$P = 1.20 \text{ MPa} (46.32 ^\circ\text{C})$			
Doy.	0.02020	247.77	267.97	0.9043	0.01663	251.03	270.99	0.9023
40	0.02029	248.39	268.68	0.9066				
50	0.02171	258.48	280.19	0.9428	0.01712	254.98	275.52	0.9164
60	0.02301	268.35	291.36	0.9768	0.01835	265.42	287.44	0.9527
70	0.02423	278.11	302.34	1.0093	0.01947	275.59	298.96	0.9868
80	0.02538	287.82	313.20	1.0405	0.02051	285.62	310.24	1.0192
90	0.02649	297.53	324.01	1.0707	0.02150	295.59	321.39	1.0503
100	0.02755	307.27	334.82	1.1000	0.02244	305.54	332.47	1.0804
110	0.02858	317.06	345.65	1.1286	0.02335	315.50	343.52	1.1096
120	0.02959	326.93	356.52	1.1567	0.02423	325.51	354.58	1.1381
130	0.03058	336.88	367.46	1.1841	0.02508	335.58	365.68	1.1660
140	0.03154	346.92	378.46	1.2111	0.02592	345.73	376.83	1.1933
150	0.03250	357.06	389.56	1.2376	0.02674	355.95	388.04	1.2201
160	0.03344	367.31	400.74	1.2638	0.02754	366.27	399.33	1.2465
170	0.03436	377.66	412.02	1.2895	0.02834	376.69	410.70	1.2724
180	0.03528	388.12	423.40	1.3149	0.02912	387.21	422.16	1.2980
$P = 1.40 \text{ MPa} (52.43 ^\circ\text{C})$					$P = 1.60 \text{ MPa} (57.92 ^\circ\text{C})$			
Doy.	0.01405	253.74	273.40	0.9003	0.01208	256.00	275.33	0.8982
60	0.01495	262.17	283.10	0.9297	0.01233	258.48	278.20	0.9069
70	0.01603	272.87	295.31	0.9658	0.01340	269.89	291.33	0.9457
80	0.01701	283.29	307.10	0.9997	0.01435	280.78	303.74	0.9813
90	0.01792	293.55	318.63	1.0319	0.01521	291.39	315.72	1.0148
100	0.01878	303.73	330.02	1.0628	0.01601	301.84	327.46	1.0467
110	0.01960	313.88	341.32	1.0927	0.01677	312.20	339.04	1.0773
120	0.02039	324.05	352.59	1.1218	0.01750	322.53	350.53	1.1069
130	0.02115	334.25	363.86	1.1501	0.01820	332.87	361.99	1.1357
140	0.02189	344.50	375.15	1.1777	0.01887	343.24	373.44	1.1638
150	0.02262	354.82	386.49	1.2048	0.01953	353.66	384.91	1.1912
160	0.02333	365.22	397.89	1.2315	0.02017	364.15	396.43	1.2181
170	0.02403	375.71	409.36	1.2576	0.02080	374.71	407.99	1.2445
180	0.02472	386.29	420.90	1.2834	0.02142	385.35	419.62	1.2704
190	0.02541	396.96	432.53	1.3088	0.02203	396.08	431.33	1.2960
200	0.02608	407.73	444.24	1.3338	0.02263	406.90	443.11	1.3212

EK E

İdeal Gaz Tabloları

Tablo E-1 Havanın Özellikleri

T, K	$h, kJ/kg$	P_r	$u, kJ/kg$	v_r	$s^\circ, kJ/kg \cdot K$	T, K	$h, kJ/kg$	P_r	$u, kJ/kg$	v_r	$s^\circ, kJ/kg \cdot K$
200	199.97	0.3363	142.56	1707	1.29559	780	800.03	43.35	576.12	51.64	2.69013
220	219.97	0.4690	156.82	1346	1.39105	820	843.98	52.49	608.59	44.84	2.74504
240	240.02	0.6355	171.13	1084	1.47824	860	888.27	63.09	641.40	39.12	2.79783
260	260.09	0.8405	185.45	887.8	1.55848	900	932.93	75.29	674.58	34.31	2.84856
280	280.13	1.0889	199.75	738.0	1.63279	940	977.92	89.28	708.08	30.22	2.89748
290	290.16	1.2311	206.91	676.1	1.66802	980	1023.25	105.2	741.98	26.73	2.94468
300	300.19	1.3860	214.07	621.2	1.70203	1020	1068.89	123.4	776.10	23.72	2.99034
310	310.24	1.5546	221.25	572.3	1.73498	1060	1114.86	143.9	810.62	21.14	3.03449
320	320.29	1.7375	228.43	528.6	1.76690	1100	1161.07	167.1	845.33	18.896	3.07732
340	340.42	2.149	242.82	454.1	1.82790	1140	1207.57	193.1	880.35	16.946	3.11883
360	360.58	2.626	257.24	393.4	1.88543	1180	1254.34	222.2	915.57	15.241	3.15916
380	380.77	3.176	271.69	343.4	1.94001	1220	1301.31	254.7	951.09	13.747	3.19834
400	400.98	3.806	286.16	301.6	1.99194	1260	1348.55	290.8	986.90	12.435	3.23638
420	421.26	4.522	300.69	266.6	2.04142	1300	1395.97	330.9	1022.82	11.275	3.27345
440	441.61	5.332	315.30	236.8	2.08870	1340	1443.60	375.3	1058.94	10.247	3.30959
460	462.02	6.245	329.97	211.4	2.13407	1380	1491.44	424.2	1095.26	9.337	3.34474
480	482.49	7.268	344.70	189.5	2.17760	1420	1539.44	478.0	1131.77	8.526	3.37901
500	503.02	8.411	359.49	170.6	2.21952	1460	1587.63	537.1	1168.49	7.801	3.41247
520	523.63	9.684	374.36	154.1	2.25997	1500	1635.97	601.9	1205.41	7.152	3.44516
540	544.35	11.10	389.34	139.7	2.29906	1540	1684.51	672.8	1242.43	6.569	3.47712
560	565.17	12.66	404.42	127.0	2.33685	1580	1733.17	750.0	1279.65	6.046	3.50829
580	586.04	14.38	419.55	115.7	2.37348	1620	1782.00	834.1	1316.96	5.574	3.53879
600	607.02	16.28	434.78	105.8	2.40902	1660	1830.96	925.6	1354.48	5.147	3.56867
620	628.07	18.36	450.09	96.92	2.44356	1700	1880.1	1025	1392.7	4.761	3.5979
640	649.22	20.65	465.05	88.99	2.47716	1800	2003.3	1310	1487.2	3.944	3.6684
660	670.47	23.13	481.01	81.89	2.50985	1900	2127.4	1655	1582.6	3.295	3.7354
680	691.82	25.85	496.62	75.50	2.54175	2000	2252.1	2068	1678.7	2.776	3.7994
700	713.27	28.80	512.33	69.76	2.57277	2100	2377.4	2559	1775.3	2.356	3.8605
720	734.82	32.02	528.14	64.53	2.60319	2200	2503.2	3138	1872.4	2.012	3.9191
740	756.44	35.50	544.02	59.82	2.63280						

KAYNAK: J. H. Keenan and J. Kaye, *Gas Tables*, Wiley, New York, 1945.

Tablo E-2 Azotun (N₂) Mol Özellikleri

$\bar{h}_f^\circ = 0 \text{ kJ/kmol}$							
T, K	\bar{h} , kJ/kmol	\bar{u} , kJ/kmol	\bar{s} , ° kJ/kmol·K	T, K	\bar{h} , kJ/kmol	\bar{u} , kJ/kmol	\bar{s} , ° kJ/kmol·K
0	0	0	0	1000	30 129	21 815	228.057
220	6 391	4 562	182.639	1020	30 784	22 304	228.706
240	6 975	4 979	185.180	1040	31 442	22 795	229.344
260	7 558	5 396	187.514	1060	32 101	23 288	229.973
280	8 141	5 813	189.673	1080	32 762	23 782	230.591
298	8 669	6 190	191.502	1100	33 426	24 280	231.199
300	8 723	6 229	191.682	1120	34 092	24 780	231.799
320	9 306	6 645	193.562	1140	34 760	25 282	232.391
340	9 888	7 061	195.328	1160	35 430	25 786	232.973
360	10 471	7 478	196.995	1180	36 104	26 291	233.549
380	11 055	7 895	198.572	1200	36 777	26 799	234.115
400	11 640	8 314	200.071	1240	38 129	27 819	235.223
420	12 225	8 733	201.499	1260	38 807	28 331	235.766
440	12 811	9 153	202.863	1280	39 488	28 845	236.302
460	13 399	9 574	204.170	1300	40 170	29 361	236.831
480	13 988	9 997	205.424	1320	40 853	29 878	237.353
500	14 581	10 423	206.630	1340	41 539	30 398	237.867
520	15 172	10 848	207.792	1360	42 227	30 919	238.376
540	15 766	11 277	208.914	1380	42 915	31 441	238.878
560	16 363	11 707	209.999	1400	43 605	31 964	239.375
580	16 962	12 139	211.049	1440	44 988	33 014	240.350
600	17 563	12 574	212.066	1480	46 377	34 071	241.301
620	18 166	13 011	213.055	1520	47 771	35 133	242.228
640	18 772	13 450	214.018	1560	49 168	36 197	243.137
660	19 380	13 892	214.954	1600	50 571	37 268	244.028
680	19 991	14 337	215.866	1700	54 099	39 965	246.166
700	20 604	14 784	216.756	1800	57 651	42 685	248.195
720	21 220	15 234	217.624	1900	61 220	45 423	250.128
740	21 839	15 686	218.472	2000	64 810	48 181	251.969
760	22 460	16 141	219.301	2100	68 417	50 957	253.726
780	23 085	16 599	220.113	2200	72 040	53 749	255.412
800	23 714	17 061	220.907	2300	75 676	56 553	257.02
820	24 342	17 524	221.684	2400	79 320	59 366	258.580
840	24 974	17 990	222.447	2500	82 981	62 195	260.073
860	25 610	18 459	223.194	2600	86 650	65 033	261.512
880	26 248	18 931	223.927	2700	90 328	67 880	262.902
900	26 890	19 407	224.647	2800	94 014	70 734	264.241
920	27 532	19 883	225.353	2900	97 705	73 593	265.538
940	28 178	20 362	226.047	3000	101 407	76 464	266.793
960	28 826	20 844	226.728	3100	105 115	79 341	268.007
980	29 476	21 328	227.398	3200	108 830	82 224	269.186

KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971.

Tablo E-3 Oksijenin (O₂) Mol Özellikleri

$\bar{h}_f^\circ = 0 \text{ kJ/kmol}$							
T	\bar{h}	\bar{u}	\bar{s}°	T	\bar{h}	\bar{u}	\bar{s}°
0	0	0	0	1020	32 088	23 607	244.164
220	6 404	4 575	196.171	1040	32 789	24 142	244.844
240	6 984	4 989	198.696	1060	33 490	24 677	245.513
260	7 566	5 405	201.027	1080	34 194	25 214	246.171
280	8 150	5 822	203.191	1100	34 899	25 753	246.818
298	8 682	6 203	205.033	1120	35 606	26 294	247.454
300	8 736	6 242	205.213	1140	36 314	26 836	248.081
320	9 325	6 664	207.112	1160	37 023	27 379	248.698
340	9 916	7 090	208.904	1180	37 734	27 923	249.307
360	10 511	7 518	210.604	1200	38 447	28 469	249.906
380	11 109	7 949	212.222	1220	39 162	29 018	250.497
400	11 711	8 384	213.765	1240	39 877	29 568	251.079
420	12 314	8 822	215.241	1260	40 594	30 118	251.653
440	12 923	9 264	216.656	1280	41 312	30 670	252.219
460	13 535	9 710	218.016	1300	42 033	31 224	252.776
480	14 151	10 160	219.326	1320	42 753	31 778	253.325
500	14 770	10 614	220.589	1340	43 475	32 334	253.868
520	15 395	11 071	221.812	1360	44 198	32 891	254.404
540	16 022	11 533	222.997	1380	44 923	33 449	254.932
560	16 654	11 998	224.146	1400	45 648	34 008	255.454
580	17 290	12 467	225.262	1440	47 102	35 129	256.475
600	17 929	12 940	226.346	1480	48 561	36 256	257.474
620	18 572	13 417	227.400	1520	50 024	37 387	258.450
640	19 219	13 898	228.429	1540	50 756	37 952	258.928
660	19 870	14 383	229.430	1560	51 490	38 520	259.402
680	20 524	14 871	230.405	1600	52 961	39 658	260.333
700	21 184	15 364	231.358	1700	56 652	42 517	262.571
720	21 845	15 859	232.291	1800	60 371	45 405	264.701
740	22 510	16 357	233.201	1900	64 116	48 319	266.722
760	23 178	16 859	234.091	2000	67 881	51 253	268.655
780	23 850	17 364	234.960	2100	71 668	54 208	270.504
800	24 523	17 872	235.810	2200	75 484	57 192	272.278
820	25 199	18 382	236.644	2300	79 316	60 193	273.981
840	25 877	18 893	237.462	2400	83 174	63 219	275.625
860	26 559	19 408	238.264	2500	87 057	66 271	277.207
880	27 242	19 925	239.051	2600	90 956	69 339	278.738
900	27 928	20 445	239.823	2700	94 881	72 433	280.219
920	28 616	20 967	240.580	2800	98 826	75 546	281.654
940	29 306	21 491	241.323	2900	102 793	78 682	283.048
960	29 999	22 017	242.052	3000	106 780	81 837	284.399
980	30 692	22 544	242.768	3100	110 784	85 009	285.713
1000	31 389	23 075	243.471	3200	114 809	88 203	286.989

KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971.

Tablo E-3 Karbondioksidin (CO₂) Mol Özellikleri

$\bar{h}_f^\circ = -393\,520 \text{ kJ/kmol}$							
T	\bar{h}	\bar{u}	\bar{s}°	T	\bar{h}	\bar{u}	\bar{s}°
0	0	0	0	1020	43 859	35 378	270.293
220	6 601	4 772	202.966	1040	44 953	36 306	271.354
240	7 280	5 285	205.920	1060	46 051	37 238	272.400
260	7 979	5 817	208.717	1080	47 153	38 174	273.430
280	8 697	6 369	211.376	1100	48 258	39 112	274.445
298	9 364	6 885	213.685	1120	49 369	40 057	275.444
300	9 431	6 939	213.915	1140	50 484	41 006	276.430
320	10 186	7 526	216.351	1160	51 602	41 957	277.403
340	10 959	8 131	218.694	1180	52 724	42 913	278.361
360	11 748	8 752	220.948	1200	53 848	43 871	279.307
380	12 552	9 392	223.122	1220	54 977	44 834	280.238
400	13 372	10 046	225.225	1240	56 108	45 799	281.158
420	14 206	10 714	227.258	1260	57 244	46 768	282.066
440	15 054	11 393	229.230	1280	58 381	47 739	282.962
460	15 916	12 091	231.144	1300	59 522	48 713	283.847
480	16 791	12 800	233.004	1320	60 666	49 691	284.722
500	17 678	13 521	234.814	1340	61 813	50 672	285.586
520	18 576	14 253	236.575	1360	62 963	51 656	286.439
540	19 485	14 996	238.292	1380	64 116	52 643	287.283
560	20 407	15 751	239.962	1400	65 271	53 631	288.106
580	21 337	16 515	241.602	1440	67 586	55 614	289.743
600	22 280	17 291	243.199	1480	69 911	57 606	291.333
620	23 231	18 076	244.758	1520	72 246	59 609	292.888
640	24 190	18 869	246.282	1560	74 590	61 620	294.411
660	25 160	19 672	247.773	1600	76 944	63 741	295.901
680	26 138	20 484	249.233	1700	82 856	68 721	299.482
700	27 125	21 305	250.663	1800	88 806	73 840	302.884
720	28 121	22 134	252.065	1900	94 793	78 996	306.122
740	29 124	22 972	253.439	2000	100 804	84 185	309.210
760	30 135	23 817	254.787	2100	106 864	89 404	312.160
780	31 154	24 669	256.110	2200	112 939	94 648	314.988
800	32 179	25 527	257.408	2300	119 035	99 912	317.695
820	33 212	26 394	258.682	2400	125 152	105 197	320.302
840	34 251	27 267	259.934	2500	131 290	110 504	322.308
860	35 296	28 125	261.164	2600	137 449	115 832	325.222
880	36 347	29 031	262.371	2700	143 620	121 172	327.549
900	37 405	29 922	263.559	2800	149 808	126 528	329.800
920	38 467	30 818	264.728	2900	156 009	131 898	331.975
940	39 535	31 719	265.877	3000	162 226	137 283	334.084
960	40 607	32 625	267.007	3100	168 456	142 681	336.126
980	41 685	33 537	268.119	3200	174 695	148 089	338.109
1000	42 769	34 455	269.215				

KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971.

Tablo E-5 Karbonmonoksidin (CO) Mol Özellikleri

$\bar{h}_f^\circ = -110530 \text{ kJ/kmol}$							
T	\bar{h}	\bar{u}	\bar{s}°	T	\bar{h}	\bar{u}	\bar{s}°
0	0	0	0	1040	31 688	23 041	235.728
220	6 391	4 562	188.683	1060	32 357	23 544	236.364
240	6 975	4 979	191.221	1080	33 029	24 049	236.992
260	7 558	5 396	193.554	1100	33 702	24 557	237.609
280	8 140	5 812	195.713	1120	34 377	25 065	238.217
300	8 723	6 229	197.723	1140	35 054	25 575	238.817
320	9 306	6 645	199.603	1160	35 733	26 088	239.407
340	9 889	7 062	201.371	1180	36 406	26 602	239.989
360	10 473	7 480	203.040	1200	37 095	27 118	240.663
380	11 058	7 899	204.622	1220	37 780	27 637	241.128
400	11 644	8 319	206.125	1240	38 466	28 426	241.686
420	12 232	8 740	207.549	1260	39 154	28 678	242.236
440	12 821	9 163	208.929	1280	39 844	29 201	242.780
460	13 412	9 587	210.243	1300	40 534	29 725	243.316
480	14 005	10 014	211.504	1320	41 226	30 251	243.844
500	14 600	10 443	212.719	1340	41 919	30 778	244.366
520	15 197	10 874	213.890	1360	42 613	31 306	244.880
540	15 797	11 307	215.020	1380	43 309	31 836	245.388
560	16 399	11 743	216.115	1400	44 007	32 367	245.889
580	17 003	12 181	217.175	1440	45 408	33 434	246.876
600	17 611	12 622	218.204	1480	46 813	34 508	247.839
620	18 221	13 066	219.205	1520	48 222	35 584	248.778
640	18 833	13 512	220.179	1560	49 635	36 665	249.695
660	19 449	13 962	221.127	1600	51 053	37 750	250.592
680	20 068	14 414	222.052	1700	54 609	40 474	252.751
700	20 690	14 870	222.953	1800	58 191	43 225	254.797
720	21 315	15 328	223.833	1900	61 794	45 997	256.743
740	21 943	15 789	224.692	2000	65 408	48 780	258.600
760	22 573	16 255	225.533	2100	69 044	51 584	260.370
780	23 208	16 723	226.357	2200	72 688	54 396	262.065
800	23 844	17 193	227.162	2300	76 345	57 222	263.692
820	24 483	17 665	227.952	2400	80 015	60 060	265.253
840	25 124	18 140	228.724	2500	83 692	62 906	266.755
860	25 768	18 617	229.482	2600	87 383	65 766	268.202
880	26 415	19 099	230.227	2700	91 077	68 628	269.596
900	27 066	19 583	230.957	2800	94 784	71 504	270.943
920	27 719	20 070	231.674	2900	98 495	74 383	272.249
940	28 375	20 559	232.379	3000	102 210	77 267	273.508
960	29 033	21 051	233.072	3100	105 939	80 164	274.730
980	29 693	21 545	233.752	3150	107 802	81 612	275.326
1000	30 355	22 041	234.421	3200	109 667	83 061	275.914
1020	31 020	22 540	235.079				

KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971.

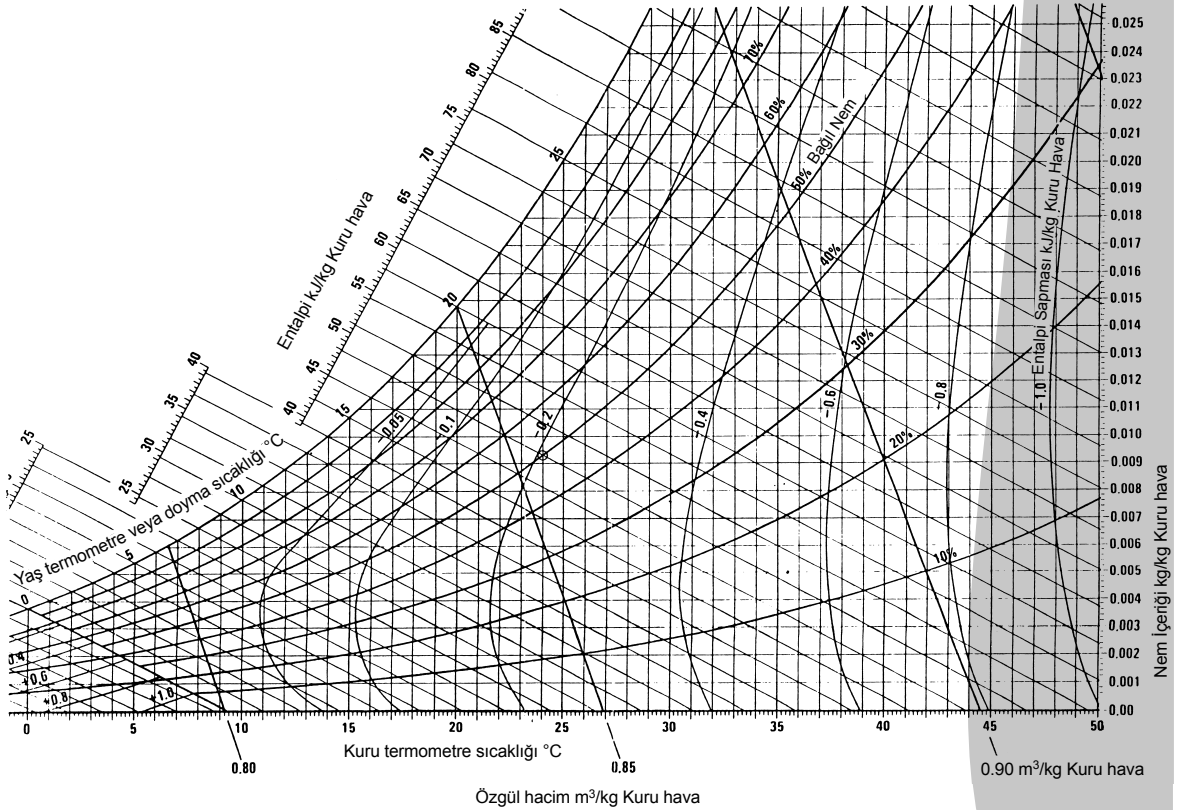
Tablo E-6 Suyun (H₂O) Mol Özellikleri

$\bar{h}_f^\circ = -241\,810 \text{ kJ/kmol}$							
T	\bar{h}	\bar{u}	\bar{s}°	T	\bar{h}	\bar{u}	\bar{s}°
0	0	0	0	1020	36 709	28 228	233.415
220	7 295	5 466	178.576	1040	37 542	28 895	234.223
240	7 961	5 965	181.471	1060	38 380	29 567	235.020
260	8 627	6 466	184.139	1080	39 223	30 243	235.806
280	9 296	6 968	186.616	1100	40 071	30 925	236.584
298	9 904	7 425	188.720	1120	40 923	31 611	237.352
300	9 966	7 472	188.928	1140	41 780	32 301	238.110
320	10 639	7 978	191.098	1160	42 642	32 997	238.859
340	11 314	8 487	193.144	1180	43 509	33 698	239.600
360	11 992	8 998	195.081	1200	44 380	34 403	240.333
380	12 672	9 513	196.920	1220	45 256	35 112	241.057
400	13 356	10 030	198.673	1240	46 137	35 827	241.773
420	14 043	10 551	200.350	1260	47 022	36 546	242.482
440	14 734	11 075	201.955	1280	47 912	37 270	243.183
460	15 428	11 603	203.497	1300	48 807	38 000	243.877
480	16 126	12 135	204.982	1320	49 707	38 732	244.564
500	16 828	12 671	206.413	1340	50 612	39 470	245.243
520	17 534	13 211	207.799	1360	51 521	40 213	245.915
540	18 245	13 755	209.139	1400	53 351	41 711	247.241
560	18 959	14 303	210.440	1440	55 198	43 226	248.543
580	19 678	14 856	211.702	1480	57 062	44 756	249.820
600	20 402	15 413	212.920	1520	58 942	46 304	251.074
620	21 130	15 975	214.122	1560	60 838	47 868	252.305
640	21 862	16 541	215.285	1600	62 748	49 445	253.513
660	22 600	17 112	216.419	1700	67 589	53 455	256.450
680	23 342	17 688	217.527	1800	72 513	57 547	259.262
700	24 088	18 268	218.610	1900	77 517	61 720	261.969
720	24 840	18 854	219.668	2000	82 593	65 965	264.571
740	25 597	19 444	220.707	2100	87 735	70 275	267.081
760	26 358	20 039	221.720	2200	92 940	74 649	269.500
780	27 125	20 639	222.717	2300	98 199	79 076	271.839
800	27 896	21 245	223.693	2400	103 508	83 553	274.098
820	28 672	21 855	224.651	2500	108 868	88 082	276.286
840	29 454	22 470	225.592	2600	114 273	92 656	278.407
860	30 240	23 090	226.517	2700	119 717	97 269	280.462
880	31 032	23 715	227.426	2800	125 198	101 917	282.453
900	31 828	24 345	228.321	2900	130 717	106 605	284.390
920	32 629	24 980	229.202	3000	136 264	111 321	286.273
940	33 436	25 621	230.070	3100	141 846	116 072	288.102
960	34 247	26 265	230.924	3150	144 648	118 458	288.9
980	35 061	26 913	231.767	3200	147 457	120 851	289.884
1000	35 882	27 568	232.597	3250	150 250	123 250	290.7

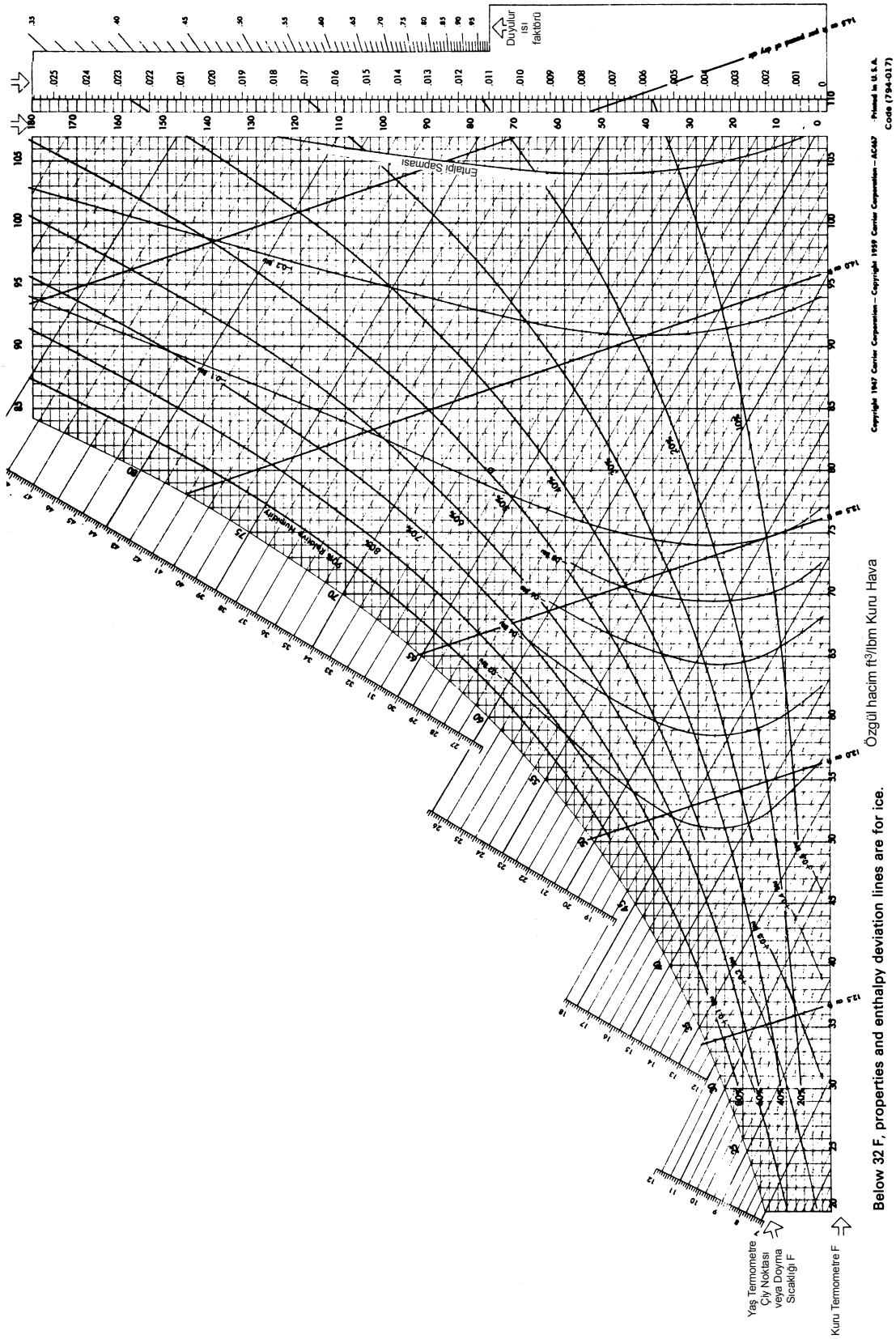
KAYNAK: JANAF Thermochemical Tables, NSRDS-NBS-37, 1971.

EK F

Psikrometrik Diyagram



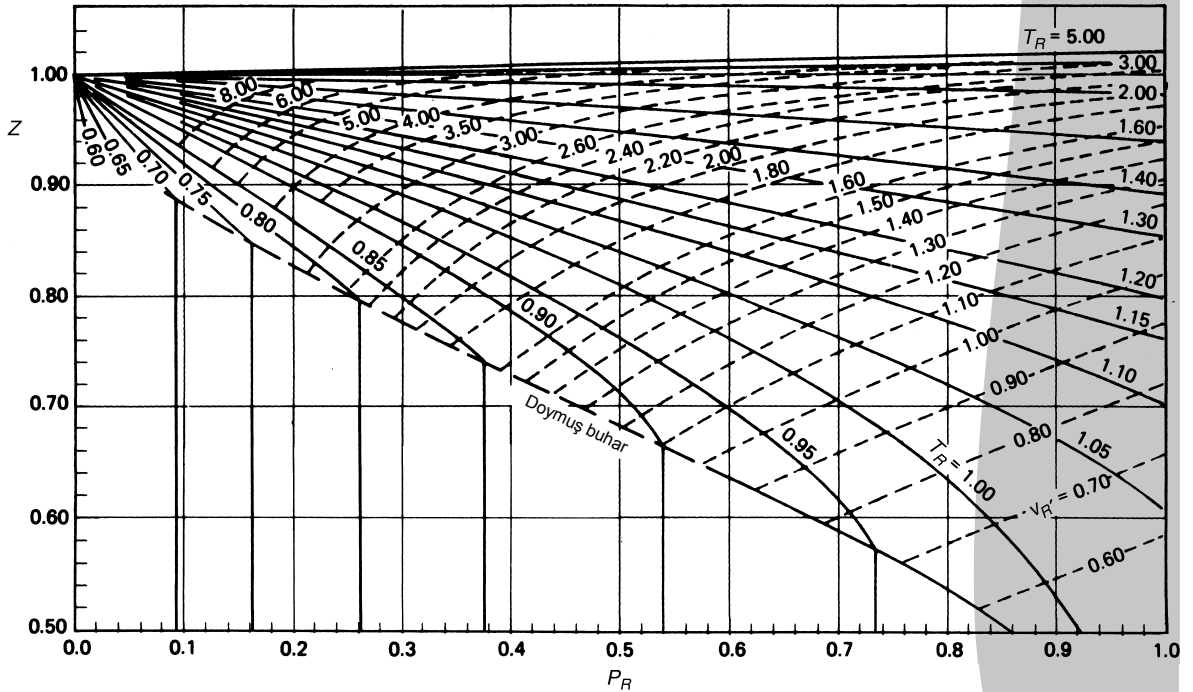
Şekil F-1 Psikrometrik diyagram, $P = 1$ atm. (Carrier Şirketi)



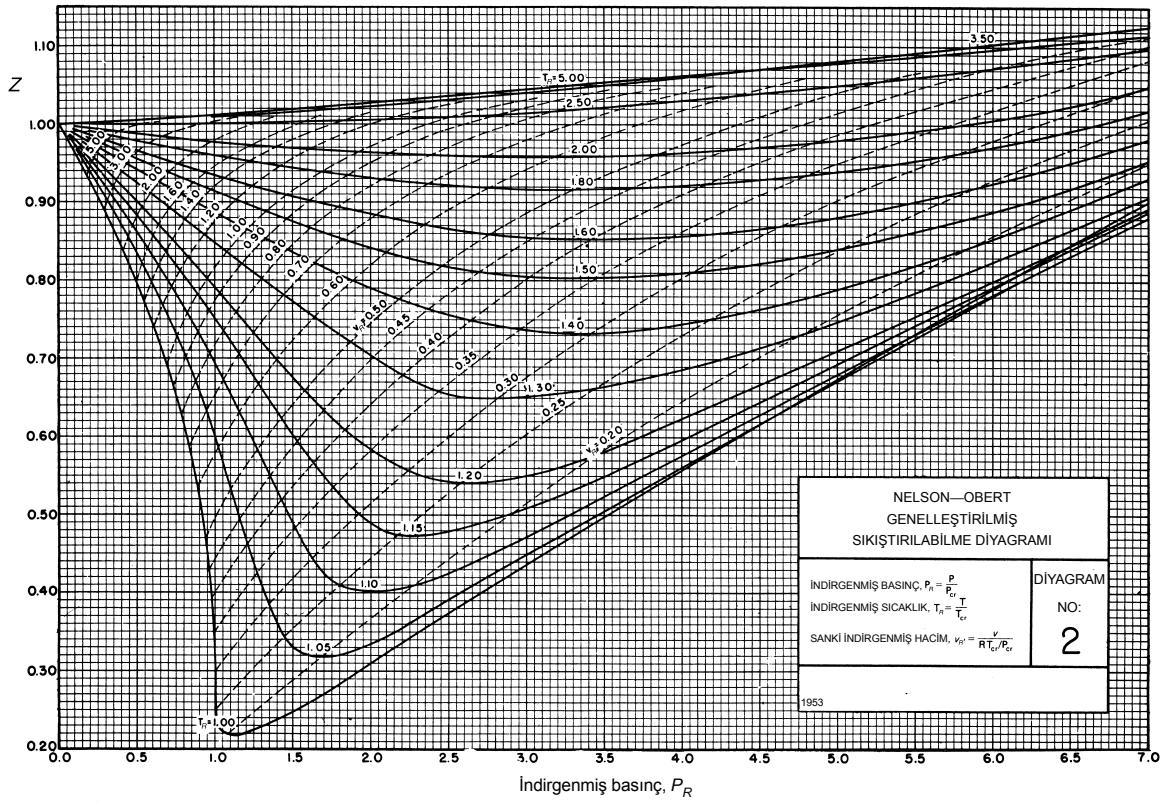
Şekil F-1E Psikrometrik diyagram, $P = 1$ atm. (Carrier Şirketi)

EKG

Sıkıştırılabilirlik Diyagramı



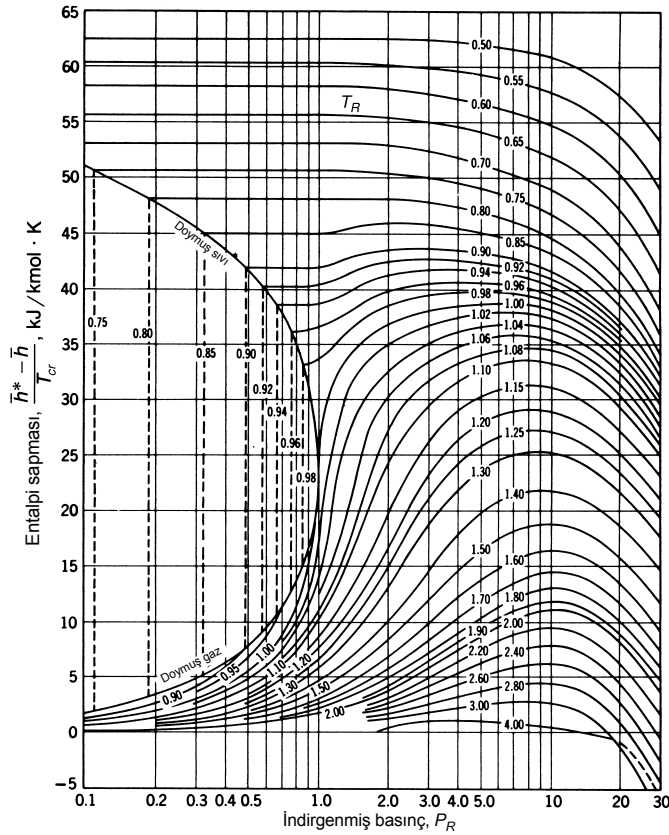
Şekil G-1 Sıkıştırılabilirlik diyagramı.



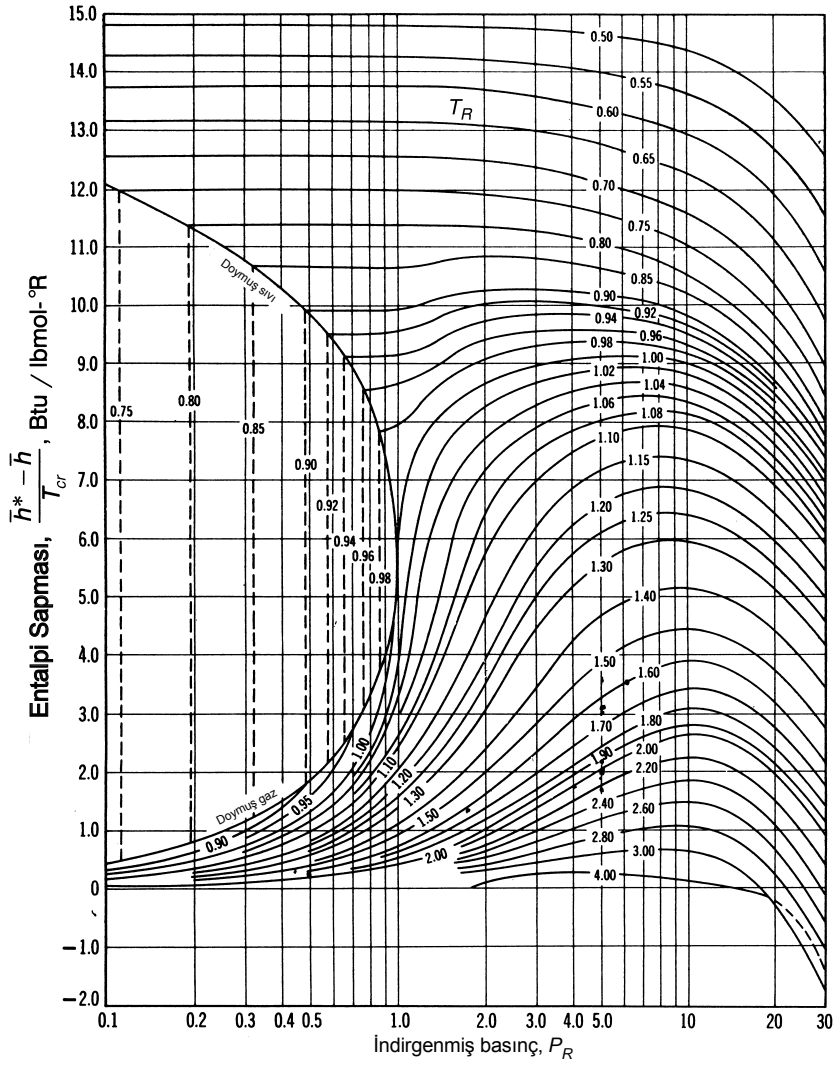
Şekil G-2 Sıkıştırılabilme diyagramı (devam). [V. M. Faires, *Problems on Thermodynamics*, Macmillan, New York, 1962. Data from L. C. Nelson and E. F. Obert, *Generalized Compressibility Charts*, *Chem. Eng.* **61**: 203 (1954).]

EK H

Entalpi Sapma Diyagramları



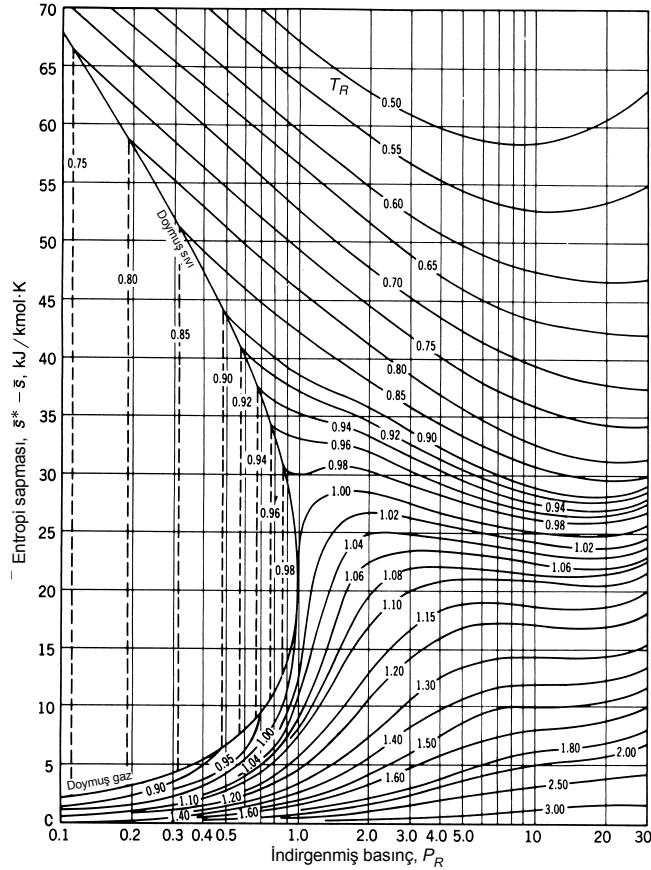
Şekil H-1 Entalpi Sapma Diyagramı. [G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, 3d ed., Wiley, New York.]



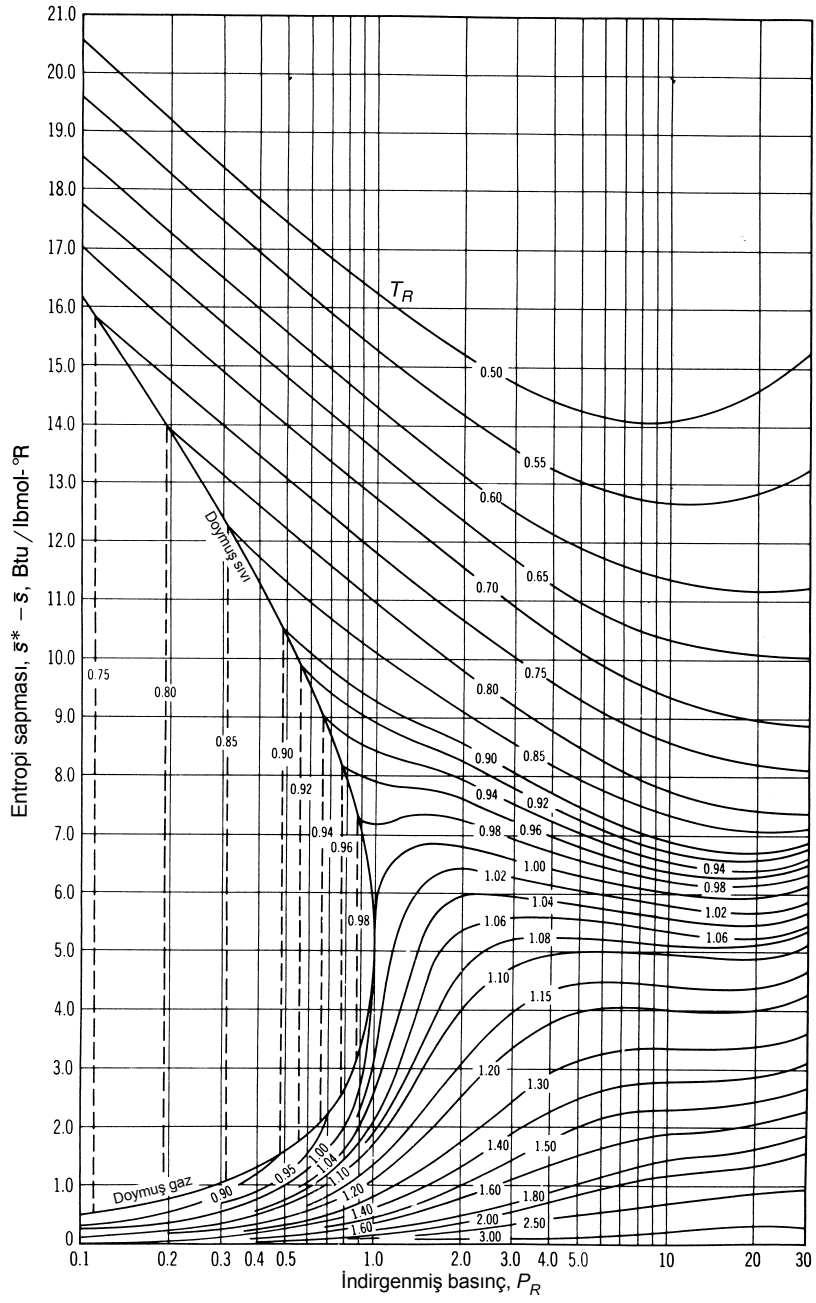
Şekil H-1E Entalpi Sapma Diyagramı. [G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, 3d ed., Wiley, New York.]

EK I

Entropi Sapma Diyagramları



Şekil I-1 [G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, 3d ed., Wiley, New York.]



Şekil I-1E [G. J. Van Wylen and R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, 3d ed., Wiley, New York.]