TABLE 3. UNIT FUEL CONSUMPTION CONSTANTS (U) FOR GAS[a]

Based on 0 F Outside Temperature, 70 F Inside Temperature, and 8-Hour Reduction to 60 F.

Heating Value of Gas Btu per Cu Ft	Hot Water			Steam			Warm Air	
	Cu Ft Gas per Degree-Day per Sq Ft Radiator			Cu Ft Gas per Degree-Day per Sq Ft Radiator			Cu Ft Gas per Degree-Day per 1000 Btu Hourly Design Heat Loss	
	Up to 500 Sq Ft	500 to 1200 Sq Ft	Over 1200 Sq Ft	Up to 500 Sq Ft	300 to 700 Sq Ft	Over 700 Sq Ft	Gravity	Fan Systems
500	0.142	0.135	0.128	0.242	0.231	0.220	0.855	0.820
535	0.132	0.126	0.120	0.226	0.215	0.206	0.800	0.766
800	0.089	0.085	0.081	0.151	0.144	0.137	0.534	0.513
1000	0.071	0.068	0.065	0.121	0.115	0.110	0.428	0.410
1 Therm = 100,000 Btu	Gas Consumption in Therms per Degree-Day							
	0.000708	0.000675	0.000642	0.00121	0.00115	0.00110	0.00428	0.00409

[a]Abstracted from Comfort Heating, *American Gas Association*, 1938.

TABLE 4. UNIT FUEL CONSUMPTION[a] CONSTANTS (U) FOR OIL[b]

Based on 0 F Outside Temperature, 70 F Inside Temperature, and 8-Hour Reduction to 55 F.

Unit	Efficiency in Per Cent				
	40	50	60	70	80
Gal Oil per Sq Ft Steam Radiator	0.00172	0.00137	0.00114	0.00098	0.00086
Gal Oil per Sq Ft Hot Water Radiator	0.00108	0.00086	0.00072	0.00062	0.00054
Gal Oil per 1000 Btu per Hour Heat Loss	0.00715	0.00571	0.00476	0.00409	0.00358

[a]Based on a heating value of 140,000 Btu per gallon.

[b]Abstracted by permission from *Degree-Day Handbook* (Second Edition, 1937), by C. Strock and C. H. B. Hotchkiss.

TABLE 5. UNIT FUEL CONSUMPTION[a] CONSTANTS (U) FOR COAL[b]

Based on 0 F Outside Temperature, 70 F Inside Temperature, and 8-Hour Reduction to 55 F.

Unit	Efficiency in Per Cent				
	40	50	60	70	80
Lb Coal per Sq Ft Steam Radiator	0.0200	0.0160	0.0133	0.0114	0.0100
Lb Coal per Sq Ft Hot Water Radiator	0.0125	0.0100	0.0084	0.0072	0.0063
Lb Coal per 1000 Btu per Hour Heat Loss	0.0825	0.0666	0.0550	0.0471	0.0412

[a]Based on a heating value of 12,000 Btu per pound.

[b]Abstracted by permission from *Degree-Day Handbook*, (Second Edition, 1937), by C. Strock and C. H. B. Hotchkiss.

144,000 Btu per gallon oil and operating at a seasonal efficiency of 60 per cent. The outside design temperature for Minneapolis is −20 F, and the inside design temperature is 70 F.

Solution. From Table 4, under 60 per cent efficiency and opposite the bottom column, the value of U is found to be 0.00476 gal per 1000 Btu hourly heat loss for 0 F outside temperature.

The correction factor for −20 F outside design temperature from Table 6 is 0.778. Solving, $0.778 \times 0.00476 = 0.00370$. Making a further correction for the heating value:

$$0.0037 \times \frac{140{,}000}{144{,}000} = 0.0036 \text{ gal per 1000 Btu per hour calculated heat loss per degree-day.}$$

From Table 2, the normal degree-days for Minneapolis is 7989. Since U is expressed in 1000 Btu, N is equal to 192. Substituting in Equation 4:

$$F = 0.0036 \times 7989 \times 192 = 5525 \text{ gal.}$$

Estimating Coal or Coke Consumption

Coal or coke consumption estimates are made in exactly the same procedure as for oil. Values of U are given in Table 5 which only apply to inside design temperatures of 70 F and an outside design temperature of 0 F. A correction must be made for other conditions by use of the multiplying factors in Table 6. Data in Table 5 are based on 12,000 Btu per pound coal and for other heating values of coal they must be multiplied by the ratio of 12,000 divided by the heating value of fuel used.

TABLE 6. CORRECTION FACTORS FOR OUTSIDE DESIGN TEMPERATURES[a]

Outside Design Temp. Deg F	Inside Design Temp. Deg F	Multiply Values in Tables 3, 4 and 5 by
−20	70	0.778
−10	70	0.875
0	70	1.000
+10	70	1.167
+20	70	1.400

[a]The multipliers in Table 6, which are high for mild climates and low for cold regions are not in error as might appear. The unit figures in Tables 3, 4, and 5 are per square foot of radiator or thousand Btu heat loss per degree-day. For equivalent buildings and heating seasons, those in warm climates have lower design heat losses and smaller radiator quantities than those in cold cities. Consequently, the *unit* figure, in quantity of fuel per square foot of radiator per degree-day, is larger for warm localities than for colder regions. Since the northern cities have more radiator surface per given building and a higher seasonal degree-day total than cities in the south, the total fuel per season will be larger for the northern city.

Example 7. A building in Marquette, Mich., has an hourly heat loss at design conditions of 240,000 Btu per hour. Based on an inside design temperature of 70 F and an outside design temperature of −20 F, what will be the estimated normal seasonal coal consumption for heating if 12,000 Btu per pound fuel is burned at a 50 per cent seasonal efficiency, and what part of the total will be used during November, December, and January?

Solution. From Table 5, U is 0.0666 lb of coal per 1000 Btu per hour heat loss. Correcting for the outside design temperature of −20 F from Table 6, the value of U is $0.778 \times 0.0666 = 0.0518$. From Table 2, D is 8786 and from the problem, N is 240.

Substituting in Equation 4:

$$F = 0.0518 \times 240 \times 8786 = 109{,}200 \text{ lb.}$$

Fuel used over any period is, according to the theory of the degree-day, proportional to the number of degree-days during the period. From Table 2, the average numbers of degree-days for November, December, and January in Marquette are 927, 1306, and 1471, a total of 3704. The yearly total is 8786, so that during these three months the estimated consumption is:

$$\frac{3704}{8786} \times 109{,}200 = 46{,}200 \text{ lb.}$$