Estimating Coal or Coke Consumption

Coal or coke consumption estimates can be made in exactly the same way as for oil. The uncorrected values of U are given in Table 7. *These constants apply only to inside design temperatures of 70 F and an outside design temperature of 0 F*, and correction must be made for other conditions by use of the multiplying factors in Table 5. Table 7 is based on 12,000 Btu per pound coal and for other heating values of coal, values in Table 7 must be multiplied by the ratio of 12,000 divided by the heating value of fuel used.

Example 9. A building in Marquette, Mich., has an hourly heat loss at design conditions of 240,000 Btu per hour. If the inside design temperature is to be 70 F and the outside design temperature is −10 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 7, U uncorrected, is 0.0666 lb of coal per 1000 Btu per hour heat loss. Correcting for the outside design temperature, Table 5, the corrected value of U is $0.875 \times 0.0666 = 0.0583$. From Table 3, D is 8721 and from the problem N is 240.

Substituting in Equation 3:

$$F = 0.0583 \times 240 \times 8721 = 122{,}024 \text{ lb.}$$

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 3, the average number of degree-days for November, December, and January in Marquette are 951, 1314, and 1510, a total of 3775. The yearly total is 8721, so that during these three months the estimated consumption is:

$$\frac{3775}{8721} \times 122{,}024 = 52{,}820 \text{ lb.}$$

Estimating Steam Consumption

In estimating steam consumption the efficiency is not ordinarily a factor and is assumed at 100 per cent. Ordinarily low pressure steam with a heating value of 1000 Btu per pound is used so that no correction is necessary for heating value in the usual case. In comparing values from different cities, correction should be made for design temperature (see Table 5) when the unit figures are in terms of square foot of radiator or 1000 Btu per hour calculated heat loss, but not when the values are in terms of building volume or floor space.

Consideration has been given to the difference in steam utilization of different types of buildings and Table 8[4] shows actual average units for these various types. These figures are obtained from operating results in 196 buildings located in 21 different cities in the United States. Being averages, and for small groups in each type, the figures may need considerable modification to allow for local variations. It should be especially noted that the steam used for heating hot water is included in the values given in Table 8, but in the case of office buildings, the steam for heating only is also shown. Presentation of the unit consumption in three ways permits making the estimate if either the calculated heat loss or the volume of net heated space in the building is known.

[4]The Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle (A.S.H.V.E. TRANSACTIONS, Vol. 41, 1935, p. 171).

TABLE 8. STEAM CONSUMPTION FOR VARIOUS CLASSES OF BUILDINGS[a]
(*Heating Season Only*)

BUILDING CLASSIFICATION	No. OF BUILDINGS LISTED	STEAM CONSUMPTION POUNDS PER DEGREE-DAY—65 F BASIS[d]		
		Per M Cu Ft of Heated Space	Per M Sq Ft of Radiator[c] Surface	Per M Btu per Hour of Heat Loss[b]
Apartments	16	1.78	97.5	0.359
Hotels	10	1.46	80.6	0.371
Residences	12	1.32	64.2	.....
Printing	7	1.25	105.5	.....
Clubs and Lodges	10	0.96	77.0	.....
Retail Stores	18	0.90	80.6	0.268
Theaters	6	0.90	75.0	0.498
Loft and Mfg.	16	0.89	72.3	0.283
Banks	7	0.88	45.2	.....
Auto Sales and Service	8	0.83	62.2	.....
Churches	6	0.58	49.4	.....
Department Stores	14	0.57	60.7	0.238
Garages (Storage)[e]	6	0.42	72.3	.....
Offices (Total)	35	1.09	70.0	0.283
Offices (Heating only)	35	0.975	65.4	0.256

[a]Includes steam for heating domestic water for heating season only.
[b]Heat loss calculated for maximum design condition (in most cases 70 F inside, zero outside).
[c]Equivalent steam radiator surface.
[d]The figures are a numerical—not a weighted—average for the several buildings in each class.
[e]Based on zero consumption at 55 F.

Example 10. A store in Detroit with a heating system designed to maintain 70 F inside in 0 F weather has 1700 sq ft of equivalent direct steam radiator surface, and uses only moderate quantities of hot water. What would be the estimated average yearly steam consumption of purchased steam for heating and for hot water during the heating season?

Solution. According to Table 8, a store (0 to 70 F conditions) would use 80.6 lb of steam per thousand square feet of radiation per degree-day, including winter hot water. From Table 3, Detroit has 6460 degree-days per normal year. Inserting in Equation 3:

$$F = 80.6 \times 1.7 \times 6460 = 885{,}149 \text{ lb of steam.}$$

TABLE 9. BUILDING LOAD FACTORS AND DEMANDS OF SOME DETROIT BUILDINGS[a]

BUILDING CLASSIFICATION	LOAD FACTOR	LB OF DEMAND PER HOUR PER SQ HOUR OF EQUIVALENT INSTALLED RADIATOR SURFACE
Clubs and Lodges	0.318	0.184
Hotels	0.316	0.207
Printing	0.287	0.217
Offices	0.263	0.209
Apartments	0.255	0.225
Retail Stores	0.238	0.182
Auto Sales and Service	0.223	0.248
Banks	0.203	0.158
Churches	0.158	0.152
Department Stores	0.138	0.145
Theaters	0.126	0.151

[a]Report of Commercial Relations Committee, *Proceedings, National District Heating Association*, 1932.