TABLE 2. AVERAGE MONTHLY AND YEARLY DEGREE-DAYS FOR CITIES IN THE UNITED STATES AND CANADA [a, b] (CONCLUDED)

STATE	STATION	YEARS	NO. OF SEASONS	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	YEARLY TOTAL
P.E.I.	Charlottetown			5*	57*	222	539	858	1246	1463	1338	1203	858	536	213	8,538
P.Q.	Montreal			7*	20*	180	561	948	1407	1587	1392	1209	702	298	88	8,399
	Quebec			17*	43	276	651	1050	1534	1696	1481	1311	849	428	102	9,438
Sask.	Saskatoon			16*	68	396	781	1305	1767	2027	1635	1445	725	397	138	10,700
Y. T.	Dawson			167	322	687	1209	1908	2440	2656	2159	1879	1092	580	246	15,355

Degree-days for cities in Canada were supplied by the *Canadian Meteorological Division, Department of Transport*, and were computed from mean temperature normals. * Indicates actual degree-days for 1947.

being prepared and must be found by surveying plans, by observation, or by measurement of the building. Values of U for use in this equation are the unit fuel consumptions per degree-day, obtained as a result of the collection of operating information and listed in Tables 4, 5 and 6. Attention is directed to the nature of these units in the next following sections.

Unit Fuel Consumptions per Degree-Day

The quantity of fuel used per degree-day in a given heating plant can be reduced to a unit basis in terms of quantity of fuel or steam per degree-day per thousand Btu hourly heat loss at design conditions. A less frequently used basis is quantity of fuel per (degree-day) (square foot of floor area). In fact any convenient unit can be used to relate the consumption to the degree-day and to the building.

The choice of these units requires explanation, and some discrimination and judgment. If the volume basis is used, the net heated space is preferable to the gross building cubage, since gross cubage includes outer walls and certain portions of attic and basement space which are usually unheated. In the absence of data on net heated volume, a figure of 80 percent of the gross volume may be used to obtain the estimated net heated volume. The volume basis has been rather widely used primarily because it is simple to apply. In industrial buildings it is usually easier to obtain the correct volume of a given building than to measure and evaluate the heating capacity of its heating system, or calculate its maximum hourly Btu loss. The comparison of buildings on a straight volume basis does not allow for variation in exposure, type of construction, ratio of exposed area to cubical contents, and type of occupancy. It is inaccurate for estimating purposes unless the buildings are of very similar nature.

The calculated heat loss or the heating capacity of the installed radiation may be used as the unit. The use of the heating capacity of the installed radiation is of questionable value when referring to heat transfer surfaces

TABLE 3. CORRECTION FACTORS FOR OUTSIDE DESIGN TEMPERATURES[a]

OUTSIDE DESIGN TEMP F	−20	−10	0	+10	20
Correction Factor	0.778	0.875	1.000	1.167	1.400

[a] The multipliers in Table 3, which are high for mild climates and low for cold regions, are not in error as might appear. The unit figures in Tables 4, 5, and 6 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) (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.

used in warm air furnace or central air conditioning systems. Where steam or hot water radiation is already installed, care should be exercised in using the installed radiation as the basis for estimating, since actual installed radiation may differ considerably from the exact radiation requirements. In view of all these considerations, it is believed that the unit based on *thousands of Btu of hourly calculated heat loss for the design hour* is probably the most desirable.

Estimating Gas Consumption

Values of the Unit Fuel Consumption Constant (U) for gas are given in Table 4 for various gas heating values, and different types and sizes of heating plants. They are based on an inside design temperature of 70 F and an outside design temperature of 0 F, and apply only to these conditions. For other outside design conditions corrections must be made by applying factors given in Table 3.

The factors in Table 4, as corrected if necessary, are satisfactory for regions having 3500 to 6500 degree-days per heating season. In regions with less than 3500 degree-days the unit gas consumption is higher than given; where over 6500, the unit is less than given. Ten percent addition or deduction in these cases is recommended by *A.G.A.* publications. This table cannot be used for making estimates for industrial buildings where low inside temperatures are maintained.

For gas heat values other than those given in Table 4, simply interpolate or extrapolate. It will also be noted that Table 4 applies only to small installations. In general, the larger the installation, the smaller the unit gas consumption becomes, and the values in the table should be used with care, if at all, in large gas-burning installations.

Example 4: Estimate the gas required to heat a building located in Chicago, Ill., where the heating season has 6282 degree-days and the gas heating value is 800 Btu per cu ft. The calculated heating requirements are 1000 sq ft of hot water radiation based on design temperature of −10 F and 70 F.

Solution: From Table 4, the fuel consumption for a design temperature of 0 F with 800 Btu gas is found to be 0.087 cu ft of gas per (degree-day) (square foot of hot water radiation). From Table 3, the correction factor is 0.875 for −10 F outside design temperature, hence, $0.875 \times 0.087 = 0.076$. By Equation 4,

$$F = 0.076 \times 1000 \times 6282 = 478{,}000 \text{ cu ft.}$$

Estimating Oil Consumption

Table 5 gives unit fuel consumption factors for oil, similar to those given for gas in Table 4.

The factors in Table 5 apply only to an inside design temperature of 70 F and an outside design temperature of 0 F. For other outside design temperatures, the constants in Table 5 must be multiplied by the values in Table 3 as explained under Estimating Gas Consumption.

Values given in Table 5 assume the use of oil with a heating value of 141,000 Btu per gallon. For other heating values, multiply the values in Table 5 by the ratio of 141,000 divided by the heating value per gallon of fuel being used.

Example 5: Estimate the seasonal oil consumption of a boiler, designed for oil firing, in a building located in Toledo, Ohio. The building has a calculated heat loss of 240,000 Btu per hr. The oil heat value is 144,000 Btu per gal, and the assumed seasonal efficiency is 80. The outside design temperature for Toledo is −10 F, and the inside design temperature is 70 F.

Solution: From Table 5, under 80 percent efficiency and in the bottom line, the value of U is found to be 0.00383 gal per 1000 Btu hourly heat loss for 0 F outside temperature. The correction factor for −10 F outside design temperature