

coal having a calorific value of 12,500 Btu per pound is fired, and the over-all heating efficiency is assumed to be 60 per cent, how many tons of coal will be required for a normal heating season, neglecting other heat sources, and any loss of heat through open windows?

Solution. Since there are no partitions in this building, the entire heat loss is considered. The average outside temperature during the heating season (t_a) is 41.9 F (see Table 3, Chapter 2); $t = 60$ F; $N = 500,000$; $(t - t_a) = 66$ F; $C = 12,500$; $E = 0.60$. Substituting these values in Equation 1 and dividing by 2000 to change to tons:

$$F = \frac{500,000 \times 18.1 \times 5040}{66 \times 12,500 \times 0.60 \times 2000} = 46 \text{ tons of coal}$$

Inasmuch as the building will be heated to 50 F at night, the average inside temperature (at the breathing line) will be 55 F, and the percentage saving will be $\frac{60 - 55}{60 - 41.9} = 0.276$ or 27.6 per cent. The net fuel consumption will therefore be $46 - 0.276 \times 46$ or 33.3 tons.

Other Factors

There are many factors which would be likely to affect the theoretical fuel requirements of a building such as the opening of windows, abnormal inside temperatures, other heat sources, sun effect, wind, rain, etc. In many cases it is difficult accurately to evaluate these factors, particularly in the case of open windows and the results are correspondingly less accurate. The degree of refinement of the calculations should, of course, be consistent with the conditions involved. If the heat loss from the boiler and piping does not warm the building or is not included in H , the proper allowance should be made. In selecting a boiler, this allowance is frequently assumed to be 25 per cent of the total heat loss of the building, but in estimating fuel requirements, the more accurate procedure of computing the pipe and boiler losses should be used, unless this item is likely to be outweighed by other less tangible factors.

Where temperature control is installed the fuel consumption can obviously be predetermined with greater accuracy than where no such control has been provided. In fact the calculated requirements agree to a remarkable extent in many cases with the actual fuel consumption. This has been particularly true of gas-fired installations, with which effective temperature regulation usually is possible.

Where other heat sources are available it quite often is possible accurately to allow for the reduction in the fuel consumption resulting therefrom. These sources include the heat supplied by persons, lights, motors and machinery, and should also be ascertained in the case of theaters, assembly halls and industrial plants. (See Chapter 2). In many cases these heat sources should not be allowed to affect the size of the installation of heating equipment, although they may have a marked effect upon the fuel consumption. In residences this factor usually may be entirely neglected.

Degree-Day Method

A very useful unit for estimating fuel consumption, particularly for residences, is the degree-day. (See definition in Chapter 1). Degree-days for various cities in the United States and Canada are given in Table 6. The term degree-day originated in the gas industry and was later standardized by the American Gas Association.

TABLE 6. DEGREE-DAYS FOR CITIES IN THE UNITED STATES AND CANADA

COL. A	COL. B	COL. C	COL. A	COL. B	COL. C
State	City	Degree-Days	State	City	Degree-Days
Ala.....	Mobile.....	1,439	Nev.....	Tonapah.....	6,069
	Birmingham.....	2,527		Winnemucca.....	6,266
Ariz.....	Phoenix.....	1,446	N. H.....	Concord.....	7,335
	Flagstaff.....	10,913	N. J.....	Atlantic City.....	5,250
Ark.....	Hot Springs.....	2,665	N. Y.....	Albany.....	6,542
	Little Rock.....	2,861		Buffalo.....	6,750
Cal.....	San Francisco.....	3,450		New York.....	5,348
	Los Angeles.....	1,517	N. M.....	Santa Fe.....	6,064
Colo.....	Denver.....	5,880	N. C.....	Raleigh.....	3,287
	Grand Junction.....	5,570		Wilmington.....	2,493
Conn.....	New Haven.....	6,039	N. D.....	Bismark.....	8,498
D. C.....	Washington.....	4,562		Grand Forks.....	9,724
Fla.....	Jacksonville.....	1,080	Ohio.....	Cleveland.....	6,096
Ga.....	Atlanta.....	2,880		Columbus.....	5,426
	Savannah.....	1,517	Okla.....	Oklahoma City.....	3,827
Idaho.....	Lewiston.....	4,924	Ore.....	Portland.....	4,449
	Pocatello.....	6,459		Salem.....	4,629
Ill.....	Chicago.....	6,300	Pa.....	Philadelphia.....	4,950
	Springfield.....	5,495		Pittsburgh.....	5,327
Ind.....	Indianapolis.....	5,331	R. I.....	Providence.....	6,111
	Evansville.....	3,355	S. C.....	Charleston.....	1,770
Iowa.....	Des Moines.....	6,744		Columbus.....	2,600
	Des Moines.....	6,464	S. D.....	Pierre.....	7,213
Kans.....	Topeka.....	5,282		Sioux Falls.....	7,683
	Dodge City.....	5,035	Tenn.....	Knoxville.....	3,517
Ky.....	Louisville.....	4,366		Nashville.....	3,550
La.....	New Orleans.....	1,044	Texas.....	El Paso.....	1,912
	Shreveport.....	2,097		Galveston.....	1,050
Me.....	Eastport.....	8,676		San Antonio.....	1,362
	Portland.....	7,267	Utah.....	Salt Lake City.....	5,358
Md.....	Baltimore.....	4,591		Logan.....	6,750
Mass.....	Boston.....	6,055	Vt.....	Burlington.....	8,123
Mich.....	Alpena.....	8,319	Va.....	Richmond.....	3,789
	Detroit.....	6,202		Lynchburg.....	3,849
	Marquette.....	8,866		Danville.....	3,316
Minn.....	Duluth.....	9,650		Norfolk.....	3,349
	Minneapolis.....	7,953	Wash.....	Seattle.....	5,156
Miss.....	Jackson.....	1,920		Spokane.....	6,085
Mo.....	St. Joseph.....	5,289	W. Va.....	Elkins.....	5,813
	St. Louis.....	4,583		Parkersburg.....	4,884
	Springfield.....	4,650	Wis.....	Green Bay.....	8,201
Mont.....	Billings.....	6,983		La Crosse.....	7,309
	Havre.....	8,608		Milwaukee.....	7,366
Nebr.....	Lincoln.....	6,231	Wyo.....	Sheridan.....	8,113
	North Platte.....	6,479		Cheyenne.....	7,360

COL. A	COL. B	COL. C	COL. A	COL. B	COL. C
Province	City	Degree-Days	Province	City	Degree-Days
B. C.....	Victoria.....	5,777	Ont.....	Toronto.....	7,732
	Vancouver.....	5,976	Que.....	Montreal.....	8,705
	Kamloops.....	6,724		Quebec.....	8,628
Alb.....	Medicine Hat.....	8,152	N. B.....	Frederickton.....	9,099
Sask.....	Qu Appelle.....	11,261	N. S.....	Yarmouth.....	7,694
Man.....	Winnipeg.....	11,166	P. E. I.....	Charlottetown.....	8,485
Ont.....	Port Arthur.....	10,803			