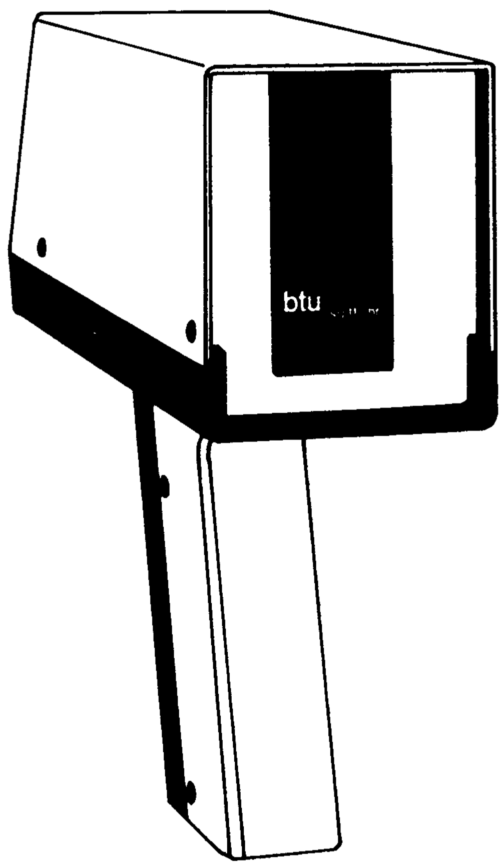
OS-650 Series

Energy Conservation and Plant Maintenance Kits



OMEGA®

An OMEGA Technologies Company

Operator's Manual

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OS-650 ENERGY CONSERVATION AND PLANT MAINTENANCE KIT

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SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OS-650 Energy Conservation and Plant Maintenance Kit combines both temperature measurement with heat flow measurement. It is designed specifically for performing energy audits, insulation inspection, and general plant maintenance. The temperature meter uses a non-contact sensor to measure temperatures on surfaces that are moving, inaccessible, fragile, or in hazardous areas. The energy (heat flow) meter is an infrared radiometer designed to measure heat loss (or gain) through building walls and windows. The LCD readout shows accurate heat flow data which is readily translated into usable information to determine energy costs. These devices are drift-free, and readouts will not vary with time.

Each OS-650 kit is supplied with:

- Temperature Meter
- Heat Flow Meter
- Carrying Case
- 9V alkaline batteries
- Analog output cable
- Operator's manual

1.2 FEATURES

- Non-contact digital displays of temperature and heat flow
- Easy to use
- -20 to 2000°F temperature range with Peak Hold
- Direct indication of heat flow in BTU/(sq. ft.-hr.) with Scanning mode and Differential Mode
- Fast response for rapid scanning
- Rugged construction
- 0.1 millivolt per degree analog output

1.3 APPLICATIONS

- Energy audits
- Determine heating and cooling costs
- Measure energy loss through walls and windows
- Locate insulation defects
- Estimate insulation R-value
- Find hotspots on machinery or electrical equipment

SECTION 2 OPERATION

2.1 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of the shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

> The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 BATTERY INSTALLATION

The battery compartment is located within the handle. The battery used is a 9 volt alkaline (part no. MN1604). To remove cover, unscrew the allen screws.

2.3 ANALOG OUTPUT

The analog output jack will supply a 0.1 millivolt per degree signal in both the °F and °C modes. The analog output cable can be used to provide for recording temperature. Simply plug the cable into the analog output jack (bottom of case) and connect the wires to your recorder.

SECTION 3 OPERATION

3.1 PRINCIPLE OF OPERATION

Each unit contains a passive sensor which receives infrared (heat) radiation from an object. A lens focuses this energy onto a detector. Signal processing circuits convert this into a usable temperature or heat flow reading and display the information via the large LCD display. Virtually maintenance-free, each unit is powered by a single 9-volt alkaline battery. When the battery voltage drops below the required 7 volts, a warning arrow appears on the display.

3.2 OPERATION OF THE TEMPERATURE METER

The Model OS-651 is a drift-free infrared thermometer which was developed to measure temperature without contact. It is ideal for use in plant process control and maintenance. When used in conjunction with the Heat Flow meter, complete energy audits and R-value estimations can be completed.

Temperature can be displayed in either Celsius or Fahrenheit. A pushbutton located on the display panel is used for this selection. Emissivity adjustment is accomplished by pushbuttons located on the side of the thermometer. Refer to the section on Emissivity Adjustment for proper setting.

An analog output jack is located on the right side of the unit. This provides 0.1 millivolts per degree which can be interfaced to a chart recorder or a signal conditioning device.

There are two modes of temperature measurement: Scan Measurement and Peak Hold. By pressing the trigger only halfway in, scanning and normal temperature measurement is accomplished. By pressing the trigger all the way in, Peak Hold can be used to record maximum temperature.

3.3 OPERATION OF THE ENERGY METER

The Model OS-652 is an infrared radiometer designed to detect insulation defects, estimate R-Values, and measure heat loss (or gain) through walls and windows without contact. It is drift-free so that the readout will not vary with temperature or time. Energy cost analyses are greatly simplified because the required data is displayed directly in BTU's per sq. ft.-hr.

There are two modes of operation: Scan mode and Differential mode. The Scan mode is enabled by pressing the trigger to the first position (halfway in). This allows the user to scan and rapidly locate insulation voids and infiltration. Initially, all decimal points will appear on the display. After about three seconds, the decimals will disappear. This indicates that the instrument has stabilized and that readings may be taken. The Differential mode can now be enabled by pressing the trigger in fully. All decimal points will be displayed, and after three seconds, all but one will disappear. This will now allow the user to measure heat loss through walls, windows and ceilings. Direct readings of heat loss, multiplied by the wall or window areas, make it possible to estimate BTU loss per month or year.

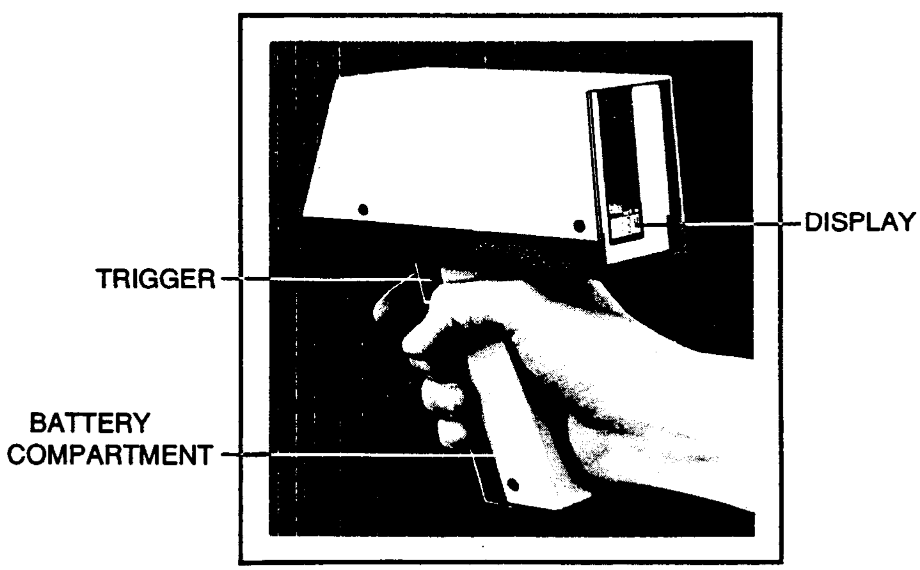


Figure 3-1. Controls and Indicators

3.4 CALCULATING DISTANCE

Measurements can be made at virtually any distance from the target. However, as the distance from the target is increased, the diameter of the measured area increases proportionally. The OS-650 Temperature and Energy meters have different fields of view. The target must be larger than the field of view for accurate readings. Please refer to the Field of View diagrams. Any measurement taken at an angle other than perpendicular to the target will slightly increase the measured area. However, when measuring large, uniform surfaces, the reading will be unaffected by angle or distance.

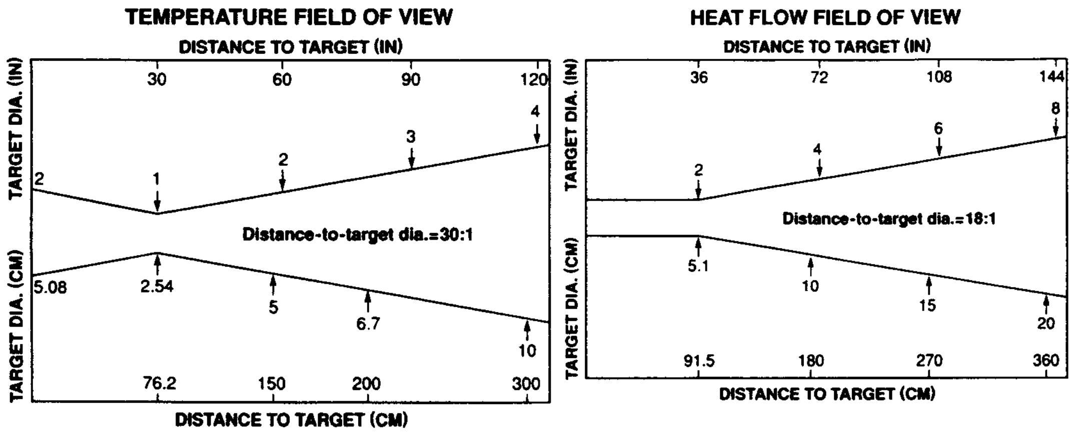


Figure 3-2. Field of View Diagrams

3.5 EMISSIVITY ADJUSTMENT FOR THE TEMPERATURE METER

Emissivity is a measure of an object's ability to absorb and emit infrared energy. The emissivity of a surface is a measure of it's radiating efficiency as compared to an ideal blackbody source. It can have a value from 0.1 (shiny mirror) to 1.0 (blackbody). If a higher than actual value of emissivity is set in, the display will read low, and vice versa. A value of 0.95 is the setting for most organic substances such as wood, cloth, plastics, and most paints. It is also applicable to corroded or heavily oxidized metal surfaces. Metals with smooth, polished surfaces have values that are much lower.

This adjustment is not necessary on the Energy meter. When using the OS-651 Temperature meter to measure the temperature of objects, the proper adjustment must be made. If the emissivity is known, you can change the settings with the pushbuttons on the side of the instrument. Check the Emissivity Table for a list of common materials.

If the emissivity of the material is unknown, you can determine it in one of the following two ways:

1. Place a piece of tape, or paint a small area using flat black paint, on the surface to be measured. Set the emissivity to 95% and measure the temperature of that area. Now measure the temperature of an area next to the paint or tape. Change the emissivity value until this second temperature reading is the same as the first. At this point the correct value is set.

2. Determine the actual temperature of the surface using a sensor such as a thermocouple or RTD. Next, measure the surface with the OS-651 Temperature meter. Adjust the emissivity setting until the same temperature reading appears on the display. The correct emissivity value is now set.

TABLE 3-1
EMISSIVITY TABLE

MATERIAL	EMISSIVITY (%)
Asbestos	
Board	96
Paper	94
Slate	96
Brick	
Glazed, rough	85
Fireclay	85
Masonry	94
Red, rough	90
Carbon, purified	80
Cement	54
Charcoal, powder	96
Clay, fired	91
Enamel	90
Lacquer	90
Fabric, asbestos	78
Glass	92
Frosted	96
Graphite, powder	97
Gypsum	85
Ice	97
Lacquer, bakelite	93
Black, dull	97
Black, shiny (on metal)	87
White	87
Lampblack	96
Oil Paint, various colors	94
Paper, black, shiny	90
Black, dull	94
White	90
Porcelain, glazed	92
Quartz	93
Rubber	95
Shellac, black, dull	91
Black, shiny, on tin plate	82
Snow	80
Tar Paper	92
Water	98
Wood, planed	85

MATERIAL	EMISSIVITY (%)
PURE AND OXIDIZED METALS	
Aluminum, polished	5
Rough surface	7
Strongly oxidized	25
Brass, dull, tarnished	22
Polished	3
Bronze, polished	10
Porous, rough	55
Cast iron, casting	81
Polished	21
Chromium, polished	10
Copper, commercial, burnished	7
Electrolytic, polished	2
Oxidized	65
Oxidized to black	88
Gold, polished	2
Iron, hot rolled	77
Oxidized	74
Sheet, galvanized, burnished	23
Sheet, galvanized, oxidized	28
Shiny, etched	16
Wrought, polished	28
Lead, gray	28
Oxidized	63
Red, powder	93
Shiny	8
Mercury, pure	10
Nickel, on cast-iron	5
Pure, polished	5
Platinum, pure, polished	8
Steel, galvanized	28
Oxidized strongly	88
Rolled freshly	24
Rough surface	96
Rusty, red	69
Sheet, nickel plated	11
Sheet, rolled	56
Tin, burnished	5
Tungsten	5
Zinc, sheet	20

SECTION 4 SPECIFICATIONS

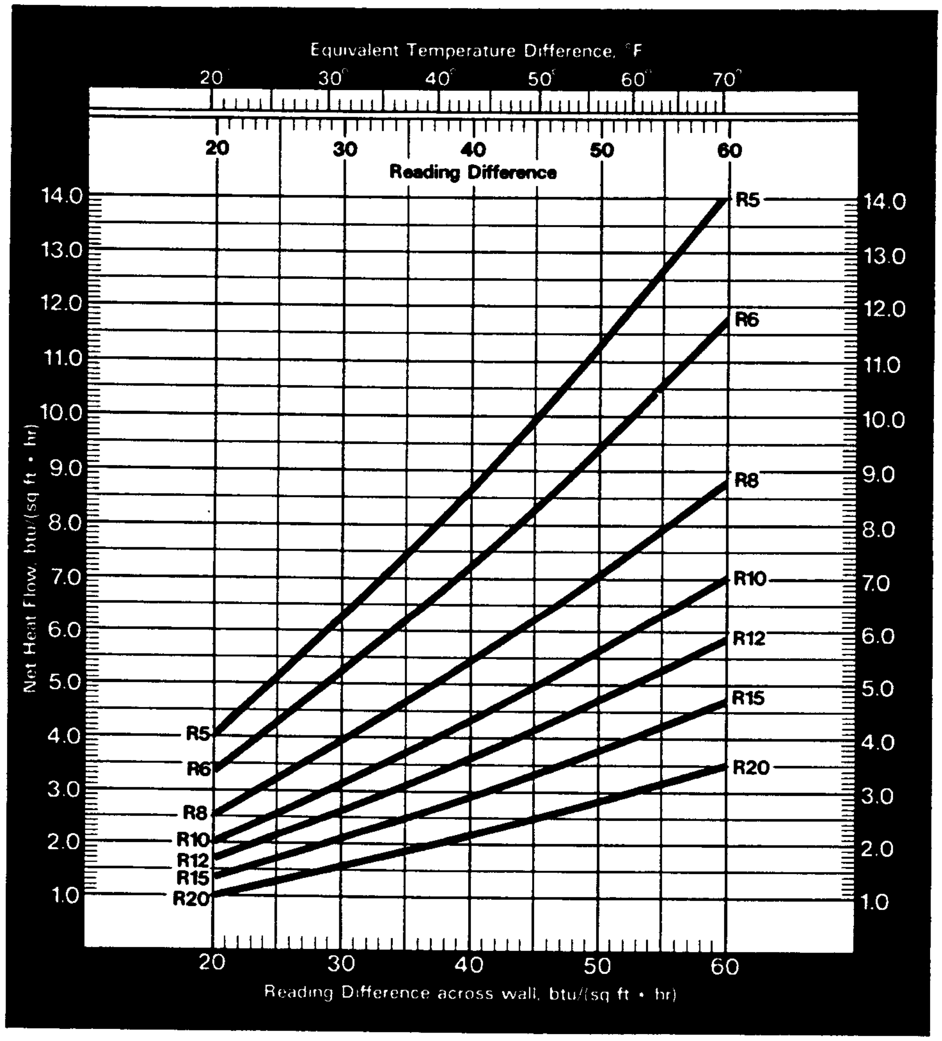
	Temperature Meter	Heat Flow Meter
Range	-20 to 1999°F (-29 to 1093°C)	0 to 1999 BTU Scan Mode 0 to 199.9 BTU Differential Mode
Accuracy	±1% of reading ±1 digit ±1° +1 digit below 100°	±1% of reading ±1 digit
Repeatability	±0.5% of reading	±0.5% of reading ±1 digit
Resolution	1°F or 1°C	1 BTU/sq. ft-hr Scan Mode 0.1 BTU/sq. ft-hr Differential Mode
Response Time	1 second	1 second Scan Mode 3 seconds Differential Mode
Emissivity Compensation	0 to .99 in .01 steps	None needed
Spectral Response	8 to 14 microns	8 to 14 microns
Minimum Target Size	1" dia. at 30" distance	2" dia. up to 36" distance
Distance to Target Ratio	30 to 1	18 to 1
Ambient Operating Temperature	40 to 110°F (4 to 43°C)	0 to 110°F (-18 to 43°C)
Power Source	9 V alkaline battery (included)	9 V alkaline battery (included)
Battery Life	200 hours	150 hours
Low Power Indication	Arrow appears on display when battery voltage falls below 7 volts.	
Dimensions	6"H x 9"W x 2.5"D (15 x 23 x 6 cm)	
Weight	2 lbs (0.9 kg)	2 lbs (0.9 kg)
Analog Output	0.1 mV/°F or °C	N/A

APPENDIX A APPLICATIONS

A.1 R-VALUE ESTIMATION

The thermal resistance (R-Value) of an exterior wall can be estimated using the OS-652 Energy Meter with the accompanying chart. To use the chart, two quantities, Net Heat Flow (see Section A.2), and Reading Difference (Section A.3), are evaluated by using the following procedure. Then the numerical value for Net Heat Flow is located on the vertical scale, and the value for Reading Difference is located on the horizontal scale on the bottom. The curve closest to the intersection of these two measured quantities is the estimated R-Value. For accurate R-Value estimates, there should be at least 20°F difference between indoor and outdoor temperatures.

TABLE A-1
R-VALUE CHART



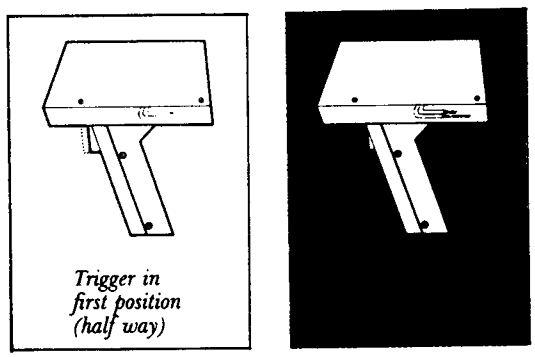
A.2 MEASURING NET HEAT FLOW

To measure Net Heat Flow, perform the following steps:

1. Aim the OS-652 Energy Meter at a convenient reference source, such as an inside wall (see Figure A). Following the procedure described in Section A.1, press the trigger to the second (full-on) position (include the 3-second pause), so that the meter reads within ±00.2.

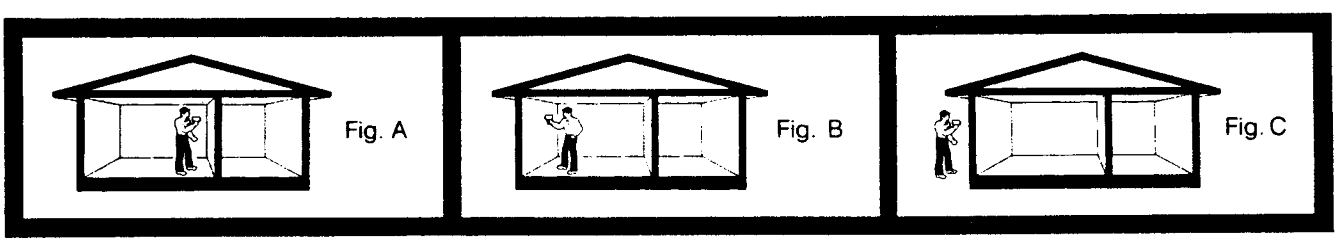
NOTE
Do not release the trigger; proceed to Step 2.

2. While holding the trigger in the second position, aim the meter at the inside surface of the outer wall selected (see Figure B). Aim at the same height as in Step 1.



3. Read the meter. It will show a minus (-) number when the outside temperature is below the ambient room temperature. This reading indicates the amount of heat loss through the wall.

Having completed Step 3, release the trigger and proceed to measure the Reading Difference across the selected outer wall.



A.3 READING DIFFERENCE

The Reading Difference, using the OS-652 Heat Flow Meter, is related to the temperature difference between the inside of an outer wall and the outside of the same wall. This difference is determined as follows:

4. Aim the meter at the inner surface of the selected outside wall (see Figure B). Press the trigger (halfway) to the first position. Note reading. Release trigger.

5. Move outside the building and aim the meter at a position on the outside wall surface corresponding to the area selected in Step 4 (see Figure C). Press the trigger to the first position and note the reading. Release the trigger.

6. Calculate the Reading Difference by subtracting the value obtained in Step 5 from the value of Step 4. The result of the subtraction is the Reading Difference.

Example: A typical indoor reading for Step 4 might be 140. The outdoor reading for Step 5, at a temperature near 25°F, would be about 95. In this example, the Reading Difference is 45 BTU/(sq. ft-hr).

7. Using the Net Heat Flow scale on the "R-Value Estimator" chart, locate the heat flow value from Step 3. Next, find where that value intersects with the Reading Difference value on the horizontal scale. The line which is closest to the intersection of the two readings is the Estimated R-Value.

Example: Assume that by following the procedures described in Step 1 (Figure A), and Step 2 (Figure B), the Net Heat Flow measurement is 10.0 BTU/(sq. ft-hr); the meter reading for Step 4 (Figure B) is 140; and the reading for Step 5 (Figure C) is 95. Then the Reading Difference across the wall is 140 minus 95, which equals 45 BTU/(sq. ft-hr). To estimate the R-Value using these measurements, enter the Net Heat Flow value of 10.0 BTU/(sq. ft-hr) on the vertical scale and find the Reading Difference value on the horizontal scale - which is 45 in this example. Where the 10.0 vertical reading intersects with 45 on the horizontal scale, the R-Value is approximately 5.

APPENDIX B HEATING COST ESTIMATION

The Heating Cost Estimator provides a simple step-by-step procedure for calculating the cost of energy loss through walls and windows. This calculation is based on the Degree-day method. U-Values, required for the heat loss computation, are determined using the OS-652 Energy Meter and the R-Value Chart shown in Section A.1. A form for tabulating each step of the energy loss and associated cost is located in Table B-2. The example entries on the form are derived from the calculation shown in Sections B-1 through B-10.

The number of Degree-days for a geographical location is a measure of the requirement for building heat based on the difference between 65°F and the average daily temperature. The greater the number of Degree-days, the lower the average temperature throughout the year and the more heat required. Average monthly and yearly Degree-days for cities in the U.S. and Canada are listed in Table B-3.

The basic expression for computing heat loss, based on the Degree-day method, is given by:

BTU's = U (Value) x Area (wall or window) x Degree-days x 24. Each term in this expression is evaluated in the following procedure, together with the cost of fuel required to replace the energy lost.

B.1 MEASURE NET HEAT LOW

Measure Net Heat Flow following the instructions on the R-Value Estimator Chart. Enter this reading of Net Heat Flow on Line 1 of the Estimator Form.

Example: For near steady-state conditions (see Note below), the Net Heat Flow through an uninsulated wall is measured at -10.0 BTU/(sq. ft-hr). The minus sign (-) preceding the meter reading indicates heat loss through the wall.

NOTE

Measurements of Net Heat Flow and Reading Difference with the OS-652 Energy Meter should be made during periods that are "near steady-state". During these periods there is uniform, steady heat flow from the inside of the building to the outer walls and then through the walls to the outside environment. "Near steady-state" conditions occur in the period from several hours after sunset to sunrise and during long-term, cloudy or overcast daytime periods. Well-insulated walls will require several hours to stabilize after sunset, while windows will stabilize in a relatively short time. For reasonably accurate measurements of Net Heat Flow, there should be a difference between indoor and outdoor temperatures of at least 20°F. Avoid measurements of windows and walls under direct sunlight. Finally, fans and blowers should be turned off prior to making indoor measurements. This insures free air convection.

B.2 MEASURE READING DIFFERENCE ACROSS WALL

At a distance of four or five feet, aim at the indoor surface of an outer wall and press trigger to first (half-on) position. Meter should read between 125 and 145 BTU/(sq. ft.-hr) for the normal range of room temperatures. Enter reading on Line 2a.

Move outside building and aim at surface of wall with trigger in first (half-on) position. Enter reading on Line 2b. Subtract the value on Line 2b from that on Line 2a and enter on Line 2c.

Example: The reading of the inner surface is 140 BTU/(sq. ft-hr) and that of the outer surface is 95 BTU/(sq. ft-hr). The Reading Difference is 45 on Line 2c.

B.3 R-VALUE OF WALL

For a wall, the R-Value is determined from the R-Value Estimator Chart and entered on Line 3.

Example: For a Reading Difference of 45 across a wall and Net Heat Flow of 10.0, the R-Value is determined to be 5.0, using the R-Value Estimator Chart.

B.4 U-VALUE OF WALL AND WINDOW

The U-Value of a wall is calculated from $\frac{1}{\text{R(Value)} + 0.85}$

and entered on Line 4.

Example: For R-Value of 5.0, the U-Value is $\frac{1}{5.0 + 0.85}$

or 0.17.

The V-Value for windows is selected from the following table and entered on Line 4:**

Windows 1/8" or 1/4" thick	U-Value BTU/(sq. ft-hr°F)
Single glass (or plastic)	1.1
Double glazed	0.6
Triple glazed	0.4

**Note: For windows, entries are not required for lines 1, 2, or 3 on Heating Cost Estimator Form.

B.5 AREA OF WALL OR WINDOW

Measure or estimate the area of wall or window and enter on Line 5.

Example: Let us assume that the walls of a house have a total area of 1500 sq. ft.

B.6 DEGREE-DAYS

Select either the average monthly or yearly Degree-days for the city nearest to your measurement site, using either Table B-3 or local information sources. Enter the number of Degree-days on Line 6.

Example: For the month of January in Toledo, Ohio, there are 1200 Degree-days.

B.7 BTU'S LOST THROUGH WALL OR WINDOW

Multiply the following values:

Line 4 x Line 5 x Line 6 x 24 = BTU's lost. Enter result on Line 7.

Example: Find the heat lost through a 1500 sq. ft. wall, with U=0.17 for the month of January in Toledo, Ohio.

Heat lost = 0.17 x 1500 x 1200 x 24 = 7,344,000 BTU's.

B.8 BTU'S SUPPLIED BY HEATER OR FURNACE

Enter the heater or furnace efficiency on Line 8, using a known value or a typical value from Table B-4. Then divide the BTU's lost from Line 7 by efficiency (%) and multiply by 100. Enter the result on Line 9.

Example: For an oil furnace, with an efficiency of 60%, and a heat loss of 7,344,000 BTU's, the energy supplied by the furnace is $\frac{7{,}344{,}000 \times 100}{60}$

or 12,240,000 BTU's.

B.9 AMOUNT OF FUEL REQUIRED

Enter the energy per unit of fuel (Table B-4) on Line 10. Divide the energy supplied on Line 9 by the fuel value on Line 10 and enter the result of Line 11.

Example: For oil fuel (144,000 BTU's/gal) and a required energy supply of 12,240,000 BTU's, the amount of oil required is $\frac{12{,}240{,}000}{144{,}000}$

or 85 gallons.

B.10 COST ESTIMATION

To estimate the fuel cost, using the local costs or the approximate value listed in Table B-4, enter the cost per unit of fuel on Line 12. Then multiply the fuel required on Line 11 by the cost per unit of fuel (Line 12) and enter the result on Line 13.

Example: For oil at $1.20 per gallon, the cost of 85 gallons is $102.00. This is the cost associated with the heat loss through 1500 sq. ft. of wall area during January, in Toledo, Ohio.

Note that if insulation is added to increase the R-Value from R-5 to R-15, the heat loss through the wall area is reduced to 2,721,600 BTU's, the amount of fuel required decreases to 31.5 gallons and the cost is reduced from $102.00 to $37.80 per month, a net saving of $64.20 per month.

TABLE B-1
ENERGY COST ESTIMATOR FORM EXAMPLE

Name: ____
Address: ____
City: Toledo State: Ohio
Phone: ____

Date: January
Time: ____
HVAC System: ____
Type of Fuel: Oil

	FOR WALLS:	FOR WINDOWS:
Net Heat Flow (using OS-652)	1 10.0 BTU/(sq ft-hr)	**Note:** No entries are required on lines 1, 2, and 3 for windows.
Reading of indoor surface of outdoor wall	2a 140	
Reading of outdoor surface of outdoor wall	2b 95	
Reading Difference: 2a-2b = 2c	2c 45	
R-Value from Estimator Chart (of walls)	3 5.0	
U-Value	4 0.17 BTU/(sq ft-hr-°F)	4 ____
Area of Wall(s)/Window(s)	5 1500 sq. ft.	5 ____
Degree-days (from Table B-3)	6 1200	6 ____
BTU's lost through wall(s)/window(s) = Line 4 x Line 5 x Line 6 x 24	7 7,344,000 BTU's	7 ____
Efficiency of furnace or heater (see Table B-4)	8 60 %	8 ____
BTU's supplied by heater = $\frac{\text{Line 7} \times 100}{\text{Line 8}}$	9 12,240,000 BTU's	9 ____
Energy per unit of fuel (see Table B-4)	10 144,000	10 ____
Fuel required (Line 9 divided by Line 10)	11 85	11 ____
Cost per unit of fuel (see Table B-4)	12 $1.20 per gal.	12 ____
Cost for heat loss through wall(s)/window(s) = Line 11 x Line 12	13 $102.00	13 ____

TABLE B-2
ENERGY COST ESTIMATOR FORM

Name: ______________________
Address: ______________________
City: ______________ State: ________
Phone: ______________________

Date: ______________________
Time: ______________________
HVAC System: ______________________
Type of Fuel: ______________________

	FOR WALLS:	FOR WINDOWS:
Net Heat Flow (using OS-652)	1 ________ BTU/(sq ft-hr)	**Note:** No entries are required on lines 1, 2, and 3 for windows.
Reading of indoor surface of outdoor wall	2a ________	
Reading of outdoor surface of outdoor wall	2b ________	
Reading Difference: 2a-2b = 2c	2c ________	
R-Value from Estimator Chart (of walls)	3 ________	
U-Value	4 ________ BTU/(sq ft-hr-°F)	4 ________
Area of Wall(s)/Window(s)	5 ________ sq. ft.	5 ________
Degree-days (from Table B-3)	6 ________	6 ________
BTU's lost through wall(s)/window(s) = Line 4 x Line 5 x Line 6 x 24	7 ________ BTU's	7 ________
Efficiency of furnace or heater (see Table B-4)	8 ________ %	8 ________
BTU's supplied by heater = $\frac{\text{Line 7} \times 100}{\text{Line 8}}$	9 ________ BTU's	9 ________
Energy per unit of fuel (see Table B-4)	10 ________	10 ________
Fuel required (Line 9 divided by Line 10)	11 ________	11 ________
Cost per unit of fuel (see Table B-4)	12 ________	12 ________
Cost for heat loss through wall(s)/window(s) = Line 11 x Line 12	13 ________	13 ________

TABLE B-3
AVERAGE MONTHLY AND YEARLY DEGREE-DAYS FOR CITIES IN THE UNITED STATES AND CANADA (BASE 65°F)

Data for United States cities from a publication of the United States Weather Bureau, *Monthly Normals of Temperature, Precipitation and Heating Degree Days*, 1962, are for the period 1931 to 1960 inclusive. These data also include information from the 1963 revisions to this publication, where available.

Data for airport stations, A, and city stations, C, are both given where available.

Data for Canadian cities were computed by the Climatology Division, Department of Transport from normal monthly mean temperatures, and the monthly values of heating degree days data were obtained using the National Research Council computer and a method devised by H.C.S. Thom of the United States Weather Bureau. The heating degree days are based on the period from 1931 to 1960.

For period October to April, inclusive.

STATE	STATION	AVG. WINTER TEMP.	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	YEARLY TOTAL
Ala.	Birmingham . . . . . A	54.2	0	0	6	93	363	555	592	462	363	108	9	0	2551
	Huntsville . . . . . A	51.3	0	0	12	127	426	663	694	557	434	138	19	0	3070
	Mobile . . . . . A	59.9	0	0	0	22	213	357	415	300	211	42	0	0	1560
	Montgomery . . . . . A	55.4	0	0	0	68	330	527	543	417	316	90	0	0	2291
Alas.	Anchorage . . . . . A	23.0	246	291	516	930	1284	1572	1631	1316	1293	879	592	315	10864
	Fairbanks . . . . . A	6.7	171	332	642	1203	1833	2254	2359	1901	1739	1068	555	222	14279
	Juneau . . . . . A	32.1	301	338	483	725	921	1135	1237	1070	1073	810	601	381	9075
	Nome . . . . . A	13.1	481	496	693	1094	1455	1820	1879	1666	1770	1314	930	573	14171
Ariz.	**Flagstaff . . . . . A**	**35.6**	**46**	**68**	**201**	**558**	**867**	**1073**	**1169**	**991**	**911**	**651**	**437**	**180**	**7152**
	Phoenix . . . . . A	**58.5**	**0**	**0**	**0**	**22**	**234**	**415**	**474**	**328**	**217**	**75**	**0**	**0**	**1765**
	Tucson . . . . . A	**58.1**	**0**	**0**	**0**	**25**	**231**	**406**	**471**	**344**	**242**	**75**	**6**	**0**	**1800**
	Winslow . . . . . A	**43.0**	**0**	**0**	**6**	**245**	**711**	**1008**	**1054**	**770**	**601**	**291**	**96**	**0**	**4782**
	Yuma . . . . . A	**64.2**	**0**	**0**	**0**	**0**	**108**	**264**	**307**	**190**	**90**	**15**	**0**	**0**	**974**
Ark.	Fort Smith . . . . . A	50.3	0	0	12	127	450	704	781	596	456	144	22	0	3292
	Little Rock . . . . . A	50.5	0	0	9	127	465	716	756	577	434	126	9	0	3219
	Texarkana . . . . . A	54.2	0	0	0	78	345	561	626	468	350	105	0	0	2533
Calif.	Bakersfield . . . . . A	55.4	0	0	0	37	282	502	546	364	267	105	19	0	2122
	Bishop . . . . . A	46.0	0	0	48	260	576	797	874	680	555	306	143	36	4275
	Blue Canyon . . . . . A	42.2	28	37	108	347	594	781	896	795	806	597	412	195	5596
	Burbank . . . . . A	58.6	0	0	6	43	177	301	366	277	239	138	81	18	1646
	Eureka C	49.9	270	257	258	329	414	499	546	470	505	438	372	285	4643
	Fresno . . . . . A	53.3	0	0	0	84	354	577	605	426	335	162	62	6	2611
	Long Beach . . . . . A	57.8	0	0	9	47	171	316	397	311	264	171	93	24	1803
	Los Angeles . . . . . A	57.4	28	28	42	78	180	291	372	302	288	219	158	81	2061
	Los Angeles C	60.3	0	0	6	31	132	229	310	230	202	123	68	18	1349
	Mt. Shasta C	41.2	25	34	123	406	696	902	983	784	738	525	347	159	5722
	Oakland . . . . . A	53.5	53	50	45	127	309	481	527	400	353	255	180	90	2870
	Red Bluff . . . . . A	53.8	0	0	0	53	318	555	605	428	341	168	47	0	2515
	Sacramento . . . . . A	53.9	0	0	0	56	321	546	583	414	332	178	72	0	2502
	Sacramento C	54.4	0	0	0	62	312	533	561	392	310	173	76	0	2419
	Sandberg C	46.8	0	0	30	202	480	691	778	661	620	426	264	57	4209
	San Diego . . . . . A	59.5	9	0	21	43	135	236	298	235	214	135	90	42	1458
	San Francisco . . . . . A	53.4	81	78	60	143	306	462	508	395	363	279	214	126	3015
	San Francisco C	55.1	192	174	102	118	231	388	443	336	319	279	239	180	3001
	Santa Maria . . . . . A	54.3	99	93	96	146	270	391	459	370	363	282	233	165	2967

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Colo.	Alamosa A	29.7	65	99	279	639	1065	1420	1476	1162	1020	696	440	168	8529
	Colorado Springs A	37.3	9	25	132	456	825	1032	1128	938	893	582	319	84	6423
	Denver A	37.6	6	9	117	428	819	1035	1132	938	887	558	288	66	6283
	Denver C	40.8	0	0	90	366	714	905	1004	851	800	492	254	48	5524
	Grand Junction A	39.3	0	0	30	313	786	1113	1209	907	729	387	146	21	5641
	Pueblo A	40.4	0	0	54	326	750	986	1085	871	772	429	174	15	5462
Conn.	Bridgeport A	39.9	0	0	66	307	615	986	1079	966	853	510	208	27	5617
	Hartford A	37.3	0	12	117	394	714	1101	1190	1042	908	519	205	33	6235
	New Haven A	39.0	0	12	87	347	648	1011	1097	991	871	543	245	45	5897
Del.	Wilmington A	42.5	0	0	51	270	588	927	980	874	735	387	112	6	4930
D.C.	Washington A	45.7	0	0	33	217	519	834	871	762	626	288	74	0	4224
Fla.	Apalachicola C	61.2	0	0	0	16	153	319	347	260	180	33	0	0	1308
	Daytona Beach A	64.5	0	0	0	0	75	211	248	190	140	15	0	0	879
	Fort Myers A	68.6	0	0	0	0	24	109	146	101	62	0	0	0	442
	Jacksonville A	61.9	0	0	0	12	144	310	332	246	174	21	0	0	1239
	Key West A	73.1	0	0	0	0	0	28	40	31	9	0	0	0	108
	Lakeland C	66.7	0	0	0	0	57	164	195	146	99	0	0	0	661
	Miami A	71.1	0	0	0	0	0	65	74	56	19	0	0	0	214
	Miami Beach C	72.5	0	0	0	0	0	40	56	36	9	0	0	0	141
	Orlando A	65.7	0	0	0	0	72	198	220	165	105	6	0	0	766
	Pensacola A	60.4	0	0	0	19	195	353	400	277	183	36	0	0	1463
	Tallahassee A	60.1	0	0	0	28	198	360	375	286	202	36	0	0	1485
	Tampa A	66.4	0	0	0	0	60	171	202	148	102	0	0	0	683
	West Palm Beach A	68.4	0	0	0	0	6	65	87	64	31	0	0	0	253
Ga.	Athens A	51.8	0	0	12	115	405	632	642	529	431	141	22	0	2929
	Atlanta A	51.7	0	0	18	124	417	648	636	518	428	147	25	0	2961
	Augusta A	54.5	0	0	0	78	333	552	549	445	350	90	0	0	2397
	Columbus A	54.8	0	0	0	87	333	543	552	434	338	96	0	0	2383
	Macon A	56.2	0	0	0	71	297	502	505	403	295	63	0	0	2136
	Rome A	49.9	0	0	24	161	474	701	710	577	468	177	34	0	3326
	Savannah A	57.8	0	0	0	47	246	437	437	353	254	45	0	0	1819
	Thomasville C	60.0	0	0	0	25	198	366	394	305	208	33	0	0	1529
Hi.	Lihue A	72.7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Honolulu A	74.2	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hilo A	71.9	0	0	0	0	0	0	0	0	0	0	0	0	0

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Id.	Boise A	39.7	0	0	132	415	792	1017	1113	854	722	438	245	81	5809
	Lewiston A	41.0	0	0	123	403	756	933	1063	815	694	426	239	90	5542
	Pocatello A	34.8	0	0	172	493	900	1166	1324	1058	905	555	319	141	7033
Ill.	Cairo C	47.9	0	0	36	164	513	791	856	680	539	195	47	0	3821
	Chicago (O'Hare) A	35.8	0	12	117	381	807	1166	1265	1086	939	534	260	72	6639
	Chicago (Midway) A	37.5	0	0	81	326	753	1113	1209	1044	890	480	211	48	6155
	Chicago C	38.9	0	0	66	279	705	1051	1150	1000	868	489	226	48	5882
	Moline A	36.4	0	9	99	335	774	1181	1314	1100	918	450	189	39	6408
	Peoria A	38.1	0	6	87	326	759	1113	1218	1025	849	426	183	33	6025
	Rockford A	34.8	6	9	114	400	837	1221	1333	1137	961	516	236	60	6830
	Springfield A	40.6	0	0	72	291	696	1023	1135	935	769	354	136	18	5429
Ind.	Evansville A	45.0	0	0	66	220	606	896	955	767	620	237	68	0	4435
	Fort Wayne A	37.3	0	9	105	378	783	1135	1178	1028	890	471	189	39	6205
	Indianapolis A	39.6	0	0	90	316	723	1051	1113	949	809	432	177	39	5699
	South Bend A	36.6	0	6	111	372	777	1125	1221	1070	933	525	239	60	6439
Ia.	Burlington A	37.6	0	0	93	322	768	1135	1259	1042	859	426	177	33	6114
	Des Moines A	35.5	0	6	96	363	828	1225	1370	1137	915	438	180	30	6588
	Dubuque A	32.7	12	31	156	450	906	1287	1420	1204	1026	546	260	78	7376
	Sioux City A	34.0	0	9	108	369	867	1240	1435	1198	989	483	214	39	6951
	Waterloo A	32.6	12	19	138	428	909	1296	1460	1221	1023	531	229	54	7320
Kans.	Concordia A	40.4	0	0	57	276	705	1023	1163	935	781	372	149	18	5479
	Dodge City A	42.5	0	0	33	251	666	939	1051	840	719	354	124	9	4986
	Goodland A	37.8	0	6	81	381	810	1073	1166	955	884	507	236	42	6141
	Topeka A	41.7	0	0	57	270	672	980	1122	893	722	330	124	12	5182
	Wichita A	44.2	0	0	33	229	618	905	1023	804	645	270	87	6	4620
Ky.	Covington A	41.4	0	0	75	291	669	983	1035	893	756	390	149	24	5265
	Lexington A	43.8	0	0	54	239	609	902	946	818	685	325	105	0	4683
	Louisville A	44.0	0	0	54	248	609	890	930	818	682	315	105	9	4660
La.	Alexandria A	57.5	0	0	0	56	273	431	471	361	260	69	0	0	1921
	Baton Rouge A	59.8	0	0	0	31	216	369	409	294	208	33	0	0	1560
	Lake Charles A	60.5	0	0	0	19	210	341	381	274	195	39	0	0	1459
	New Orleans A	61.0	0	0	0	19	192	322	363	258	192	39	0	0	1385
	New Orleans C	61.8	0	0	0	12	165	291	344	241	177	24	0	0	1254
	Shreveport A	56.2	0	0	0	47	297	477	552	426	304	81	0	0	2184

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Me.	Caribou . . . . A	24.4	78	115	336	682	1044	1535	1690	1470	1308	858	468	183	9767
	Portland . . . . A	33.0	12	53	195	508	807	1215	1339	1182	1042	675	372	111	7511
Md.	Baltimore . . . . A	43.7	0	0	48	264	585	905	936	820	679	327	90	0	4654
	Baltimore C	46.2	0	0	27	189	486	806	859	762	629	288	65	0	4111
	Frederich . . . . A	42.0	0	0	66	307	624	955	995	876	741	384	127	12	5087
Mass.	Boston . . . . A	40.0	0	9	60	316	603	983	1088	972	846	513	208	36	5634
	Nantucket . . . . A	40.2	12	22	93	332	573	896	992	941	896	621	384	129	5891
	Pittsfield . . . . A	32.6	25	59	219	524	831	1231	1339	1196	1063	660	326	105	7578
	Worcester . . . . A	34.7	6	34	147	450	774	1172	1271	1123	998	612	304	78	6969
Mich.	Alpena . . . . A	29.7	68	105	273	580	912	1268	1404	1299	1218	777	446	156	8506
	Detroit (City) . . . . A	37.2	0	0	87	360	738	1088	1181	1058	936	522	220	42	6232
	Detroit (Wayne) . . . . A	37.1	0	0	96	353	738	1088	1194	1061	933	534	239	57	6293
	Detroit (Willow Run) . . . . A	37.2	0	0	90	357	750	1104	1190	1053	921	519	229	45	6258
	Escanaba C	29.6	59	87	243	539	924	1293	1445	1296	1203	777	456	159	8481
	Flint . . . . A	33.1	16	40	159	465	843	1212	1330	1198	1066	639	319	90	7377
	Grand Rapids . . . . A	34.9	9	28	135	434	804	1147	1259	1134	1011	579	279	75	6894
	Lansing . . . . A	34.8	6	22	138	431	813	1163	1262	1142	1011	579	273	69	6909
	Marquette C	30.2	59	81	240	527	936	1268	1411	1268	1187	771	468	177	8393
	Muskegon . . . . A	36.0	12	28	120	400	762	1088	1209	1100	995	594	310	78	6696
	Sault Ste. Marie . . . . A	27.7	96	105	279	580	951	1367	1525	1380	1277	810	477	201	9048
Minn.	**Duluth . . . . A**	**23.4**	**71**	**109**	**330**	**632**	**1131**	**1581**	**1745**	**1518**	**1355**	**840**	**490**	**198**	**10000**
	Minneapolis . . . . A	**28.3**	**22**	**31**	**189**	**505**	**1014**	**1454**	**1631**	**1380**	**1166**	**621**	**288**	**81**	**8382**
	Rochester . . . . A	**28.8**	**25**	**34**	**186**	**474**	**1005**	**1438**	**1593**	**1366**	**1150**	**630**	**301**	**93**	**8295**
Miss.	Jackson . . . . A	55.7	0	0	0	65	315	502	546	414	310	87	0	0	2239
	Meridian . . . . A	55.4	0	0	0	81	339	518	543	417	310	81	0	0	2289
	Vicksburg C	56.9	0	0	0	53	279	462	512	384	282	69	0	0	2041
Mo.	**Columbia . . . . A**	**42.3**	**0**	**0**	**54**	**251**	**651**	**967**	**1076**	**874**	**716**	**324**	**121**	**12**	**5046**
	Kansas City . . . . A	**43.9**	**0**	**0**	**39**	**220**	**612**	**905**	**1032**	**818**	**682**	**294**	**109**	**0**	**4711**
	St. Joseph . . . . A	**40.3**	**0**	**6**	**60**	**285**	**708**	**1039**	**1172**	**949**	**769**	**348**	**133**	**15**	**5484**
	St. Louis . . . . A	**43.1**	**0**	**0**	**60**	**251**	**627**	**936**	**1026**	**848**	**704**	**312**	**121**	**15**	**4900**
	St. Louis C	**44.8**	**0**	**0**	**36**	**202**	**576**	**884**	**977**	**801**	**651**	**270**	**87**	**0**	**4484**
	Springfield . . . . A	**44.5**	**0**	**0**	**45**	**223**	**600**	**877**	**973**	**781**	**660**	**291**	**105**	**6**	**4900**

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Mont.	Billings . . . . A	34.5	6	15	186	487	897	1135	1296	1100	970	570	285	102	7049
	Glasgow . . . . A	26.4	31	47	270	608	1104	1466	1711	1439	1187	648	335	150	8996
	Great Falls . . . . A	32.8	28	53	258	543	921	1169	1349	1154	1063	642	384	186	7750
	Havre . . . . A	28.1	28	53	306	595	1065	1367	1584	1364	1181	657	338	162	8700
	Havre. C	29.8	19	37	252	539	1014	1321	1528	1305	1116	612	304	135	8182
	Helena . . . . A	31.1	31	59	294	601	1002	1265	1438	1170	1042	651	381	195	8129
	Kalispell . . . . A	31.4	50	99	321	654	1020	1240	1401	1134	1029	639	397	207	8191
	Miles City. . . . . A	31.2	6	6	174	502	972	1296	1504	1252	1057	579	276	99	7723
	Missoula. . . . . A	31.5	34	74	303	651	1035	1287	1420	1120	970	621	391	219	8125
Neb.	Grand Island. . . . . A	36.0	0	6	108	381	834	1172	1314	1089	908	462	211	45	6530
	Lincoln C	38.8	0	6	75	301	726	1066	1237	1016	834	402	171	30	5864
	Norfolk . . . . A	34.0	9	0	111	397	873	1234	1414	1179	983	498	233	48	6979
	North Platte . . . . A	35.5	0	6	123	440	885	1166	1271	1039	930	519	248	57	6684
	Omaha . . . . A	35.6	0	12	105	357	828	1175	1355	1126	939	465	208	42	6612
	Scottsbluff . . . . A	35.9	0	0	138	459	876	1128	1231	1008	921	552	285	75	6673
	Valentine . . . . A	32.6	9	12	165	493	942	1237	1395	1176	1045	579	288	84	7425
Nev.	Elko . . . . A	34.0	9	34	225	561	924	1197	1314	1036	911	621	409	192	7433
	Ely . . . . A	33.1	28	43	234	592	939	1184	1308	1075	977	672	456	225	7733
	Las Vegas. . . . . A	53.5	0	0	0	78	387	617	688	487	335	111	6	0	2709
	Reno . . . . A	39.3	43	87	204	490	801	1026	1073	823	729	510	357	189	6332
	Winnemucca . . . . A	36.7	0	34	210	536	876	1091	1172	916	837	573	363	153	6761
N.H.	Concord . . . . A	33.0	6	50	177	505	822	1240	1358	1184	1032	636	298	75	7383
	Mt. Washington Obsv	15.2	493	536	720	1057	1341	1742	1820	1663	1652	1260	930	603	13817
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	741	420	133	15	4812
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	876	729	381	118	0	4589
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	753	399	121	12	4980
N.M.	Albuquerque. . . . . A	45.0	0	0	12	229	642	868	930	703	595	288	81	0	4348
	Clayton . . . . A	42.0	0	6	66	310	699	899	986	812	747	429	183	21	5158
	Raton . . . . A	38.1	9	28	126	431	825	1048	1116	904	834	543	301	63	6228
	Roswell. . . . . A	47.5	0	0	18	202	573	806	840	641	481	201	31	0	3793
	Silver City. . . . . A	48.0	0	0	6	183	525	729	791	605	518	261	87	0	3705

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N.Y.	Albany	A	34.6	0	19	138	440	777	1194	1311	1156	992	564	239	45	6875
	Albany	C	37.2	0	9	102	375	699	1104	1218	1072	908	498	186	30	6201
	Binghamton	A	33.9	22	65	201	471	810	1184	1277	1154	1045	645	313	99	7286
	Binghamton	C	36.6	0	28	141	406	732	1107	1190	1081	949	543	229	45	6451
	Buffalo	A	34.5	19	37	141	440	777	1156	1256	1145	1039	645	329	78	7062
	New York (Cent. Park)	C	42.8	0	0	30	233	540	902	986	885	760	408	118	9	4871
	New York (La Guardia)	A	43.1	0	0	27	223	528	887	973	879	750	414	124	6	4811
	New York (Kennedy)	A	41.4	0	0	36	248	564	933	1029	935	815	480	167	12	5219
	Rochester	A	35.4	9	31	126	415	747	1125	1234	1123	1014	597	279	48	6748
	Schenectady	C	35.4	0	22	123	422	756	1159	1283	1131	970	543	211	30	6650
	Syracuse	A	35.2	6	28	132	415	744	1153	1271	1140	1004	570	248	45	6756
N.C.	Ashville	C	46.7	0	0	48	245	555	775	784	683	592	273	87	0	4042
	Cape Hatteras		53.3	0	0	0	78	273	521	580	518	440	177	25	0	2612
	Charlotte	A	50.4	0	0	6	124	438	691	691	582	481	156	22	0	3191
	Greensboro	A	47.5	0	0	33	192	513	778	784	672	552	234	47	0	3805
	Raleigh	A	49.4	0	0	21	164	450	716	725	616	487	180	34	0	3393
	Wilmington	A	54.6	0	0	0	74	291	521	546	462	357	96	0	0	2347
	Winston-Salem	A	48.4	0	0	21	171	483	747	753	652	524	207	37	0	3595
N.D.	Bismarck	A	26.6	34	28	222	577	1083	1463	1708	1442	1203	645	329	117	8851
	Devils Lake	C	22.4	40	53	273	642	1191	1634	1872	1579	1345	753	381	138	9901
	Fargo	A	24.8	28	37	219	574	1107	1569	1789	1520	1262	690	332	99	9226
	Williston	A	25.2	31	43	261	601	1122	1513	1758	1473	1262	681	357	141	9243
Oh.	Akron-Canton	A	38.1	0	9	96	381	726	1070	1138	1016	871	489	202	39	6037
	Cinncinnati	C	45.1	0	0	39	208	558	862	915	790	642	294	96	6	4410
	Cleveland	A	37.2	9	25	105	384	738	1088	1159	1047	918	552	260	66	6351
	Columbus	A	39.7	0	6	84	347	714	1039	1088	949	809	426	171	27	5660
	Columbus	C	41.5	0	0	57	285	651	977	1032	902	760	396	136	15	5211
	Dayton	A	39.8	0	6	78	310	696	1045	1097	955	809	429	167	30	5622
	Mansfield	A	36.9	9	22	114	397	768	1110	1169	1042	924	543	245	60	6403
	Sandusky	C	39.1	0	6	66	313	684	1032	1107	991	868	495	198	36	5796
	Toledo	A	36.4	0	16	117	406	792	1138	1200	1056	924	543	242	60	6494
	Youngstown	A	36.8	6	19	120	412	771	1104	1169	1047	921	540	248	60	6417
Okla.	Oklahoma City	A	48.3	0	0	15	164	498	766	868	664	527	189	34	0	3725
	Tulsa	A	47.7	0	0	18	158	522	787	893	683	539	213	47	0	3860

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Ore.	**Astoria** . . . . . A	45.6	146	130	210	375	561	679	753	622	636	480	363	231	5186
	Burns C	35.9	12	37	210	515	867	1113	1246	988	856	570	366	177	6957
	Eugene . . . . . A	45.6	34	34	129	366	585	719	803	627	589	426	279	135	4726
	Meacham . . . . . A	34.2	84	124	288	580	918	1091	1209	1005	983	726	527	339	7874
	Medford . . . . . A	43.2	0	0	78	372	678	871	918	697	642	432	242	78	5008
	Pendleton . . . . . A	42.6	0	0	111	350	711	884	1017	773	617	396	205	63	5127
	Portland . . . . . A	45.6	25	28	114	335	597	735	825	644	586	396	245	105	4635
	Portland C	47.4	12	16	75	267	534	679	769	594	536	351	198	78	4109
	Roseburg . . . . . A	46.3	22	16	105	329	567	713	766	608	570	405	267	123	4491
	Salem . . . . . A	45.4	37	31	111	338	594	729	822	647	611	417	273	144	4754
Pa.	Allentown . . . . . A	38.9	0	0	90	353	693	1045	1116	1002	849	471	167	24	5810
	Erie . . . . . A	36.8	0	25	102	391	714	1063	1169	1081	973	585	288	60	6451
	Harrisburg . . . . . A	41.2	0	0	63	298	648	992	1045	907	766	396	124	12	5251
	Philadelphia . . . . . A	41.8	0	0	60	297	620	965	1016	889	747	392	118	40	5144
	Philadelphia C	44.5	0	0	30	205	513	856	924	823	691	351	93	0	4486
	Pittsburgh . . . . . A	38.4	0	9	105	375	726	1063	1119	1002	874	480	195	39	5987
	Pittsburgh C	42.2	0	0	60	291	615	930	983	885	763	390	124	12	5053
	Reading C	42.4	0	0	54	257	597	939	1001	885	735	372	105	0	4945
	Scranton . . . . . A	37.2	0	19	132	434	762	1104	1156	1028	893	498	195	33	6254
	Williamsport . . . . . A	38.5	0	9	111	375	717	1073	1122	1002	856	468	177	24	5934
R.I.	**Block Island** . . . . . A	40.1	0	16	78	307	594	902	1020	955	877	612	344	99	5804
	Providence . . . . . A	38.8	0	16	96	372	660	1023	1110	988	868	534	236	51	5954
S.C.	Charleston . . . . . A	56.4	0	0	0	59	282	471	487	389	291	54	0	0	2033
	Charleston C	57.9	0	0	0	34	210	425	443	367	273	42	0	0	1794
	Columbia . . . . . A	54.0	0	0	0	84	345	577	570	470	357	81	0	0	2484
	Florence . . . . . A	54.5	0	0	0	78	315	552	552	459	347	84	0	0	2387
	Greenville-Spartenburg . . . . . A	51.6	0	0	6	121	399	651	660	546	446	132	19	0	2980
S.D.	Huron . . . . . A	28.8	9	12	165	508	1014	1432	1628	1355	1125	600	288	87	8223
	Rapid City . . . . . A	33.4	22	12	165	481	897	1172	1333	1145	1051	615	326	126	7345
	Sioux Falls . . . . . A	30.6	19	25	168	462	972	1361	1544	1285	1082	573	270	78	7839
Tenn.	Bristol . . . . . A	46.2	0	0	51	236	573	828	828	700	598	261	68	0	4143
	Chattanooga . . . . . A	50.3	0	0	18	143	468	698	722	577	453	150	25	0	3254
	Knoxville . . . . . A	49.2	0	0	30	171	489	725	732	613	493	198	43	0	3494
	Memphis . . . . . A	50.5	0	0	18	130	447	698	729	585	456	147	22	0	3232
	Memphis C	51.6	0	0	12	102	396	648	710	568	434	129	16	0	3015
	Nashville . . . . . A	48.9	0	0	30	158	495	732	778	644	512	189	40	0	3578
	Oak Ridge C	47.7	0	0	39	192	531	772	778	669	552	228	56	0	3817

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Tex.	Abilene . . . . . A	53.9	0	0	0	99	366	586	642	470	347	114	0	0	2624
	Amarillo . . . . . A	47.0	0	0	18	205	570	797	877	664	546	252	56	0	3985
	Austin . . . . . A	59.1	0	0	0	31	225	388	468	325	223	51	0	0	1711
	Brownsville . . . . . A	67.7	0	0	0	0	66	149	205	106	74	0	0	0	600
	Corpus Christi . . . . . A	64.6	0	0	0	0	120	220	291	174	109	0	0	0	914
	Dallas . . . . . A	55.3	0	0	0	62	321	524	601	440	319	90	6	0	2363
	El Paso . . . . . A	52.9	0	0	0	84	414	648	685	445	319	105	0	0	2700
	Fort Worth . . . . . A	55.1	0	0	0	65	324	536	614	448	319	99	0	0	2405
	Galveston . . . . . A	62.2	0	0	0	6	147	276	360	263	189	33	0	0	1274
	Galveston C	62.0	0	0	0	0	138	270	350	258	189	30	0	0	1235
	Houston . . . . . A	61.0	0	0	0	6	183	307	384	288	192	36	0	0	1396
	Houston C	62.0	0	0	0	0	165	288	363	258	174	30	0	0	1278
	Laredo . . . . . A	66.0	0	0	0	0	105	217	267	134	74	0	0	0	797
	Lubbock . . . . . A	48.8	0	0	18	174	513	744	800	613	484	201	31	0	3578
	Midland . . . . . A	53.8	0	0	0	87	381	592	651	468	322	90	0	0	2591
	Port Arthur . . . . . A	60.5	0	0	0	22	207	329	384	274	192	39	0	0	1447
	San Angelo . . . . . A	56.0	0	0	0	68	318	536	567	412	288	66	0	0	2255
	San Antonio . . . . . A	60.1	0	0	0	31	204	363	428	286	195	39	0	0	1546
	Victoria . . . . . A	62.7	0	0	0	6	150	270	344	230	152	21	0	0	1178
	Waco . . . . . A	57.2	0	0	0	43	270	456	536	389	270	66	0	0	2030
	Wichita Falls . . . . . A	53.0	0	0	0	99	381	632	698	518	378	120	6	0	2832
Ut.	Milford . . . . . A	36.5	0	0	99	443	867	1141	1252	988	822	519	279	87	6497
	Salt Lake City . . . . . A	38.4	0	0	81	419	849	1082	1172	910	763	459	233	84	6052
	Wendover . . . . . A	39.1	0	0	48	372	822	1091	1178	902	729	408	177	51	5778
Vt.	**Burlington . . . . . A**	**29.4**	**28**	**65**	**207**	**539**	**891**	**1349**	**1513**	**1333**	**1187**	**714**	**353**	**90**	**8269**
Va.	Cape Henry C	50.0	0	0	0	112	360	645	694	633	536	246	53	0	3279
	Lynchburg . . . . . A	46.0	0	0	51	223	540	822	849	731	605	267	78	0	4166
	Norfolk . . . . . A	49.2	0	0	0	136	408	698	738	655	533	216	37	0	3421
	Richmond . . . . . A	47.3	0	0	36	214	495	784	815	703	546	219	53	0	3865
	Roanoke . . . . . A	46.1	0	0	51	229	549	825	834	722	614	261	65	0	4150
Wash.	Olympia . . . . . A	44.2	68	71	198	422	636	753	834	675	645	450	307	177	5236
	Seattle-Tacoma . . . . . A	44.2	56	62	162	391	633	750	828	678	657	474	295	159	5145
	Seattle C	46.9	50	47	129	329	543	657	738	599	577	396	242	117	4424
	Spokane . . . . . A	36.5	9	25	168	493	879	1082	1231	980	834	531	288	135	6655
	Walla Walla C	43.8	0	0	87	310	681	843	986	745	589	342	177	45	4805
	Yakima . . . . . A	39.1	0	12	144	450	828	1039	1163	868	713	435	220	69	5941

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W. Va.	Charleston	A	44.8	0	0	63	254	591	865	880	770	648	300	96	9	4476
	Elkins	A	40.1	9	25	135	400	729	992	1008	896	791	444	198	48	5675
	Huntington	A	45.0	0	0	63	257	585	856	880	764	636	294	99	12	4446
	Parkersburg	C	43.5	0	0	60	264	606	905	942	826	691	339	115	6	4754
Wisc.	Green Bay	A	30.3	28	50	174	484	924	1333	1494	1313	1141	654	335	99	8029
	La Crosse	A	31.5	12	19	153	437	924	1339	1504	1277	1070	540	245	69	7589
	Madison	A	30.9	25	40	174	474	930	1330	1473	1274	1113	618	310	102	7863
	Milwaukee	A	32.6	43	47	174	471	876	1252	1376	1193	1054	642	372	135	7635
Wyo.	Casper	A	33.4	6	16	192	524	942	1169	1290	1084	1020	657	381	129	7410
	Cheyenne	A	34.2	28	37	219	543	909	1085	1212	1042	1026	702	428	150	7381
	Lander	A	31.4	6	19	204	555	1020	1299	1417	1145	1017	654	381	153	7870
	Sheridan	A	32.5	25	31	219	539	948	1200	1355	1154	1051	642	366	150	7680

CANADA

PROV.	STATION	AVG. WINTER TEMP.	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	YEARLY TOTAL
Alta.	Banff C	–	220	295	498	797	1185	1485	1624	1364	1237	855	589	402	10551
	Calgary . . . . A	–	109	186	402	719	1110	1389	1575	1379	1268	798	477	291	9703
	Edmonton . . . . A	–	74	180	411	738	1215	1603	1810	1520	1330	765	400	222	10268
	Lethbridge . . . . A	–	56	112	318	611	1011	1277	1497	1291	1159	696	403	213	8644
B.C.	Kamloops . . . . A	–	22	40	189	546	894	1138	1314	1057	818	462	217	102	6799
	Prince George* . . . . A	–	236	251	444	747	1110	1420	1612	1319	1122	747	468	279	9755
	Prince Rupert C	–	273	248	339	539	708	868	936	808	812	648	493	357	7029
	Vancouver* . . . . A	–	81	87	219	456	657	787	862	723	676	501	310	156	5515
	Victoria* . . . . A	–	136	140	225	462	663	775	840	718	691	504	341	204	5699
	Victoria C	–	172	184	243	426	607	723	805	668	660	487	354	250	5579
Man.	Brandon* . . . . A	–	47	90	357	747	1290	1792	2034	1737	1476	837	431	198	11036
	Churchill . . . . A	–	360	375	681	1082	1620	2248	2558	2277	2130	1569	1153	675	16728
	The Pas C	–	59	127	429	831	1440	1981	2232	1853	1624	969	508	228	12281
	Winnipeg . . . . A	–	38	71	322	683	1251	1757	2008	1719	1465	813	405	147	10679
N.B.	Fredericton* . . . . A	–	78	68	234	592	915	1392	1541	1379	1172	753	406	141	8671
	Monoton C	–	62	105	276	611	891	1342	1482	1336	1194	789	468	171	8727
	St. John C	–	109	102	246	527	807	1194	1370	1229	1097	756	490	249	8219
Nfld.	Argentia . . . . A	–	260	167	294	546	750	1001	1159	1085	1091	879	707	483	8440
	Corner Brook C	–	102	133	324	642	873	1194	1358	1283	1212	885	639	333	8978
	Gander . . . . A	–	121	152	330	670	909	1231	1370	1266	1243	939	657	366	9254
	Goose* . . . . A	–	130	205	444	843	1227	1745	1947	1689	1494	1074	741	348	11887
	St. John's* . . . . A	–	186	180	342	651	831	1113	1262	1170	1187	927	710	432	8991
N.W.T.	Aklavik C	–	273	459	807	1414	2064	2530	2632	2336	2282	1674	1063	483	18017
	Fort Norman C	–	164	341	666	1234	1959	2474	2592	2209	2058	1386	732	294	16109
	Resolution Island C	–	843	831	900	1113	1311	1724	2021	1850	1817	1488	1181	942	16021

*The data for these normals were from the full ten-year period 1951-1960, adjusted to the standard normal period 1931-1960.

PROV.	STATION	AVG. WINTER TEMP.	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	YEARLY TOTAL
N.S.	Halifax C	–	58	51	180	457	710	1074	1213	1122	1030	742	487	237	7361
	Sydney . . . . A	–	62	71	219	518	765	1113	1262	1206	1150	840	567	276	8049
	Yarmouth . . . . A	–	102	115	225	471	696	1029	1156	1065	1004	726	493	258	7340
Ont.	Cochrane C	–	96	180	405	760	1233	1776	1978	1701	1528	963	570	222	11412
	Fort William . . . . A	–	90	133	366	694	1140	1597	1792	1557	1380	876	543	237	10405
	Kapuskasing C	–	74	171	405	756	1245	1807	2037	1735	1562	978	580	222	11572
	Kitchener C	–	16	59	177	505	855	1234	1342	1226	1101	663	322	66	7566
	London . . . . A	–	12	43	159	477	837	1206	1305	1198	1066	648	332	66	7349
	North Bay C	–	37	90	267	608	990	1507	1680	1463	1277	780	400	120	9219
	Ottawa C	–	25	81	222	567	936	1469	1624	1441	1231	708	341	90	8735
	Toronto C	–	7	18	151	439	760	1111	1233	1119	1013	616	298	62	6827
P.E.I.	Charlottetown C	–	40	53	198	518	804	1215	1380	1274	1169	813	496	204	8164
	Summerside C	–	47	84	216	546	840	1246	1438	1291	1206	841	518	216	8488
Que.	Arvida C	–	102	136	327	682	1074	1659	1879	1619	1407	891	521	231	10528
	Montreal* . . . . A	–	9	43	165	521	882	1392	1566	1381	1175	684	316	69	8203
	Montreal C	–	16	28	165	496	864	1355	1510	1328	1138	657	288	54	7899
	Quebec* . . . . A	–	56	84	273	636	996	1516	1665	1477	1296	819	428	126	9372
	Quebec C	–	40	68	243	592	972	1473	1612	1418	1228	780	400	111	8937
Sask.	Prince Albert . . . . A	–	81	136	414	797	1368	1872	2108	1763	1569	867	446	219	11630
	Regina . . . . A	–	78	93	360	741	1284	1711	1966	1687	1473	804	409	201	10808
	Saskatoon C	–	66	87	372	750	1302	1758	2006	1689	1463	798	403	186	10870
Y.T.	Dawson C	–	164	326	645	1197	1875	2415	2561	2150	1838	1068	570	258	15067
	Mayo Landing C	–	208	366	648	1135	1794	2325	2427	1992	1665	1020	580	294	14454

*The data for these normals were from the full ten-year period 1951-1960, adjusted to the standard normal period 1931-1960.

TABLE B-4
FUEL EFFICIENCY CHART

TYPE OF FUEL	TYPICAL HEATER OR FURNACE EFFICIENCY*	BTU's PER UNIT OF FUEL	COST PER UNIT OF FUEL*
Heating Oil	60%	144,000 BTU's/gal	$1.20/gallon
Natural Gas	65%	100,000 BTU's/therm	46¢/therm
Electric	95%	3,412 BTU's/kw hr	6¢/kw hr
Propane	65%	91,500 BTU's/gal	67¢/gallon

*Typical or average heating system efficiencies and fuel cost. Use available local or current values.

APPENDIX C DETERMINING COOLING COSTS USING THE OS-652 ENERGY METER

In warm climates and during the summer months in temperature climates, cooling costs are a significant percentage of total energy costs. The OS-652 can be used to determine these costs. The effects of the sun, outdoor air temperature and air conditioner efficiency have been taken into account to provide the user with a procedure for estimating cooling costs. To use this procedure, it is necessary to specify the latitude, wall orientation, and month. For example, to estimate the cooling costs associated with a west wall in Yuma, Arizona during July, proceed as follows:

LATITUDE:

Locate the nearest latitude (24°, 32°, 40°, or 48°) to yours. A map of the U.S. is provided.

Example: Yuma, Arizona is closest to the 32° latitude.

ORIENTATION:

(N, E, S, W, HOR). The orientation of the wall has a significant effect on the heat gain through that wall. Therefore, each wall must be calculated separately. The HOR (horizontal) values can be used for determining the heat gain through flat roofs.

Example: A west-facing wall will be used.

SELECTED MONTH:

Since the earth's orientation in relation to the sun changes, different values for each month are provided in the charts.

Example: The month of July is used in Table C-3 and Table C-4.

C.1 INSTRUCTIONS FOR COOLING COST ESTIMATION

LINES 1 THROUGH 4:

The procedure for measuring Net Heat Flow and Reading Difference is explained fully in Section 2. It is assumed that outdoor temperature will be greater than indoor temperature during the summer months. If the U-Value of the structure has been determined during a previous audit, this figure may be used on Line 4 of the Estimator Form.

Example: Using the second trigger position, a Net Heat Flow reading of 7.0 BTU/sq. ft-hr is determined using the OS-652 and is entered on Line 1.

Using the first trigger position, the reading of the outside wall is 168 BTU/sq. ft-hr and is entered on Line 2a.

Similarly, the reading of the inside wall is 135 BTU/sq. ft-hr and is entered on Line 2b.

The reading difference across the wall is 168 minus 135, or 33 BTU/sq. ft-hr, and is entered on Line 2c.

Using the R-Value Estimator Chart, the R-Value for this wall is estimated to be 5.0 and is entered on Line 3.

Compute the U-Value of the wall from:

$$U = \frac{1}{R + 0.85} \quad \frac{1}{5.85} = 0.17 \text{ BTU/(sq. ft.-hr °F)}$$

and enter on Line 4.

Line 5: Table C-3 provides the data for this line.

Example: Using Table C-3 (Cooling Degree Days), a value of 890 is found for Yuma, Arizona in July.

Line 6: Table C-4 accounts for a number of solar parameters to assign an Effective Solar Heat Gain Factor.

Example: Using Table C-4, we find that for a west-facing wall at a latitude of 32°N in July, the Effective Solar Heat Gain Factor is 249.

Line 7: Example: Add Line 5 (890) and Line 6 (249) to obtain the total effective Sol-Air Degree Days of 1139.

Line 8: Example: The wall under consideration has an area of 480 sq. ft.

Line 9: This takes the U-Value, Sol-Air Degree Days and area of wall into account to provide a value for Heat Gain in BTU's.

Example: Multiply Line 4 (0.17) x Line 7 (1139) x Line 8 (480) x 24 to obtain a total heat gain of 2,230,618 BTU's for the month.

Line 10: The Energy Efficiency Ratio (EER) is currently required by law to be on the label of all air-conditioners sold in the United States. An EER can be determined by dividing the BTU/hr capacity of the air conditioner by number of watts input to the device.

Example: The air-conditioner in this example has an EER of 8.5 as obtained from its label.

Line 11: Example: Line 9 (2,230,618 BTU's) is divided by Line 10 (8.5) and divided again by 1000 to obtain a value of 262 Kw-hrs.

Line 12: A typical value for electric energy is 6¢/Kw-hr. Local utility companies can provide accurate costs for your area.

Example: The utility rate of Yuma, Arizona is 6¢/Kw-hr (Spring 1981).

Line 13: Example: Line 11 (262) is multiplied by Line 12 (6¢) and then divided by 100 to obtain a dollar value of $15.72 for July.

This value is for one wall. Following the above procedure for the remaining three walls and a flat ceiling of a 3000 square foot house, the additional cooling cost for July is $156.41. The total cooling costs for July then is $172.13.

TABLE C-1
COOLING COST ESTIMATOR EXAMPLE FOR HEAT GAIN THROUGH WALLS

NAME: J. T. Manufacturing Co
ADDRESS: 1234 Easy St.
CITY: Yuma, STATE: Arizona
PHONE:

DATE: July 20, 1981
LATITUDE* 32° N
ORIENTATION OF WALL West
SELECTED MONTH

Net Heat Flow (using OS-652)	1. 70	BTU/(sq.ft.-hr)
Reading of outdoor surface of outer wall	2a. 168	
Reading of indoor surface of outer wall	2b. 135	
Reading Difference: 2a — 2b = 2c	2c. 33	
R-Value from Estimator Chart	3. 5	
U-Value: $\left[\frac{1}{R\ (Value)+0.85}\right]$	4. 0.17	BTU/(sq.ft.-hr°F)
Cooling Degree Days for selected month (See Table C-3)	5. 890	
Solar Heat Gain Factor, SHGF, for latitude, orientation of wall, and month (See Table C-4)	6. 249	
Total effective sol-air Degree Days (Line 5 + Line 6)	7. 1130	
Area of Wall	8. 480	sq. ft.
Heat Gain due to air & sun for selected month Line 4 x Line 7 x Line 8 x 24 =	9. 2,230,618	BTUs
Energy Efficiency Ratio of cooling unit (EER)	10. 8.5	$\frac{\text{BTU/hr capacity}}{\text{watts input}}$
Required Electrical Energy $\left[\frac{\text{Line 9}}{1000 \times \text{Line 10}}\right]$	11. 262	Kw-hrs
Energy cost ¢/(Kw-hr)	12. 6	¢
Cooling Cost $\left[\frac{\text{Line 11} \times \text{Line 12}}{100}\right]$	13. $15.72	per month

*See map and Table C-4 for nearest appropriate latitude.

TABLE C-2
COOLING COST ESTIMATOR FOR HEAT GAIN THROUGH WALLS

NAME: ______________________

ADDRESS: ______________________

CITY: ______________ STATE: ______________

PHONE: ______________________

DATE: ______________________

LATITUDE* ______________________

ORIENTATION OF WALL ______________________

SELECTED MONTH ______________________

Net Heat Flow (using OS-652)	1.	________ BTU/(sq.ft.-hr)
Reading of outdoor surface of outer wall	2a.	________
Reading of indoor surface of outer wall	2b.	________
Reading Difference: 2a — 2b = 2c	2c.	________
R-Value from Estimator Chart	3.	________
U-Value: $\left[\frac{1}{\text{R (Value)}+0.85}\right]$	4.	________ BTU/(sq.ft.-hr°F)
Cooling Degree Days for selected month (See Table C-3)	5.	________
Solar Heat Gain Factor, SHGF, for latitude, orientation of wall, and month (See Table C-4)	6.	________
Total effective sol-air Degree Days (Line 5 + Line 6)	7.	________
Area of Wall	8.	________ sq. ft.
Heat Gain due to air & sun for selected month Line 4 x Line 7 x Line 8 x 24 =	9.	________ BTUs
Energy Efficiency Ratio of cooling unit (EER)	10.	________ $\frac{\text{BTU/hr capacity}}{\text{watts input}}$
Required Electrical Energy $\left[\frac{\text{Line 9}}{\text{1000 x Line 10}}\right]$	11.	________ Kw-hrs
Energy cost ¢/(Kw-hr)	12.	________ ¢
Cooling Cost $\left[\frac{\text{Line 11 x Line 12}}{100}\right]$	13.	________ per month

*See map and Table C-4 for nearest appropriate latitude.

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
BIRMINGHAM, ALABAMA	30	12	14	35	83	227	414	499	487	324	117	7	0	2219
BIRMINGHAM, ALABAMA	30	9	10	26	62	190	372	462	440	273	84	0	0	1928
HUNTSVILLE, ALABAMA	30	0	6	21	46	174	357	450	434	248	72	0	0	1808
MOBILE, ALABAMA	30	23	29	47	127	304	459	515	512	375	160	16	10	2577
MONTGOMERY, ALABAMA	30	14	16	35	82	237	417	496	487	330	118	6	0	2238
ANCHORAGE, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
ANNETTE, ALASKA	30	0	0	0	0	0	6	8	0	0	0	0	0	14
BARROW, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
BARTER ISLAND, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
BETHEL, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
BETTLES, ALASKA	30	0	0	0	0	0	6	11	0	0	0	0	0	17
BIG DELTA, ALASKA	30	0	0	0	0	0	20	8	6	0	0	0	0	34
COLD BAY, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
FAIRBANKS, ALASKA	30	0	0	0	0	0	31	15	6	0	0	0	0	52
GULKANA, ALASKA	30	0	0	0	0	0	9	0	0	0	0	0	0	9
HOMER, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
JUNEAU, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
KING SALMON, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
KODIAK, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
KOTZEBUE, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
MC GRATH, ALASKA	30	0	0	0	0	0	6	8	0	0	0	0	0	14
NOME, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
ST. PAUL ISLAND, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
TALKEETNA, ALASKA	30	0	0	0	0	0	6	0	0	0	0	0	0	6
UNALAKLEET, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
VALDEZ, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
YAKUTAT, ALASKA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
FLAGSTAFF, ARIZONA	30	0	0	0	0	0	15	70	49	6	0	0	0	140
PHOENIX, ARIZONA	30	0	14	21	141	355	588	812	747	564	240	26	0	3508
TUCSON, ARIZONA	30	0	11	13	96	272	513	660	583	453	187	26	0	2814
WINSLOW, ARIZONA	30	0	0	0	9	52	218	412	344	154	14	0	0	1203
YUMA, ARIZONA	30	10	36	63	210	425	624	890	862	663	343	63	6	4195
FORT SMITH, ARKANSAS	30	0	0	15	48	175	390	533	508	274	79	0	0	2022
LITTLE ROCK, ARKANSAS	30	0	0	14	40	169	393	508	484	254	63	0	0	1925
NO. LITTLE ROCK, AR	30	0	0	18	54	177	381	508	481	257	75	0	0	1951
BAKERSFIELD, CALIFORNIA	30	0	0	6	71	171	362	586	515	348	114	6	0	2179
BISHOP, CALIFORNIA	30	0	0	0	19	58	179	360	287	119	15	0	0	1037
BLUE CANYON, CALIFORNIA	30	0	0	0	0	0	20	123	114	45	0	0	0	302
EUREKA, CALIFORNIA	30	0	0	0	0	0	0	0	0	0	0	0	0	0
FRESNO, CALIFORNIA	30	0	0	0	41	125	276	484	412	267	66	0	0	1671
LONG BEACH, CALIFORNIA	30	0	7	0	16	43	92	226	260	211	107	23	0	985
LOS ANGELES, CA - INTL AP	30	5	7	0	9	17	56	127	154	134	83	23	0	615
LOS ANGELES, CA - CITY	30	10	14	10	25	51	115	258	282	236	140	44	0	1185
MOUNT SHASTA, CALIFORNIA	30	0	0	0	0	8	28	124	95	31	0	0	0	286
OAKLAND, CALIFORNIA	30	0	0	0	0	0	21	21	28	44	14	0	0	128
RED BLUFF, CALIFORNIA	30	0	0	0	53	139	323	536	462	309	82	0	0	1904
SACRAMENTO, CALIFORNIA	30	0	0	0	26	98	185	316	286	200	48	0	0	1159
SANDBERG, CALIFORNIA	30	0	0	0	0	0	86	286	258	150	20	0	0	800
SAN DIEGO, CALIFORNIA	30	10	0	0	15	26	67	149	201	163	77	14	0	722
SAN FRANCISCO, CA - INTL AP	30	0	0	0	0	0	18	16	22	39	13	0	0	108

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SAN FRANCISCO, CA - CITY	30	0	0	0	0	0	5	0	0	18	16	0	0	39
SANTA MARIA, CALIFORNIA	30	0	0	0	0	0	5	22	18	22	17	0	0	84
STOCKTON, CALIFORNIA	30	0	0	0	22	73	219	363	323	217	42	0	0	1259
ALAMOSA, COLORADO	30	0	0	0	0	0	9	55	24	0	0	0	0	88
COLORADO SPRINGS, COLORADO	30	0	0	0	0	6	91	186	140	32	6	0	0	461
DENVER, COLORADO	30	0	0	0	0	0	110	248	208	54	5	0	0	625
GRAND JUNCTION, COLORADO	30	0	0	0	0	47	209	425	322	126	11	0	0	1140
PUEBLO, COLORADO	30	0	0	0	6	27	199	353	295	91	10	0	0	981
BRIDGEPORT, CONNECTICUT	30	0	0	0	0	17	111	273	241	87	6	0	0	735
HARTFORD, CONNECTICUT	30	0	0	0	0	18	108	239	179	40	0	0	0	584
WILMINGTON, DELAWARE	30	0	0	0	0	48	196	335	282	119	12	0	0	992
WASHINGTON, DC - DULLES AP	30	0	0	0	0	57	188	319	267	100	9	0	0	940
WASHINGTON, DC - NATIONAL AP	30	0	0	0	7	109	288	425	375	182	29	0	0	1415
APALACHICOLA, FLORIDA	30	18	32	42	129	307	450	508	512	408	202	41	14	2663
DAYTONA BEACH, FLORIDA	30	37	59	86	158	310	432	496	499	435	262	100	45	2919
FORT MYERS, FLORIDA	30	81	116	156	253	394	483	543	552	498	353	176	106	3711
JACKSONVILLE, FLORIDA	30	25	38	58	117	288	426	496	496	396	190	47	19	2596
KEY WEST, FLORIDA	30	193	210	303	393	493	555	608	611	546	453	303	220	4888
LAKELAND, FLORIDA	30	58	89	123	219	372	465	515	524	456	288	126	63	3298
MIAMI, FLORIDA	30	121	145	212	300	403	480	536	555	501	397	229	159	4038
ORLANDO, FLORIDA	30	52	86	122	202	353	456	508	521	453	288	123	62	3226
PENSACOLA, FLORIDA	30	27	37	53	130	316	468	521	521	399	187	24	12	2695
TALLAHASSEE, FLORIDA	30	23	38	41	121	304	450	499	499	393	164	21	10	2563
TAMPA, FLORIDA	30	60	87	121	219	378	480	524	533	474	301	125	64	3366
WEST PALM BEACH, FLORIDA	30	98	122	174	270	388	465	524	536	495	378	202	134	3786
ATHENS, GEORGIA	30	0	0	14	35	175	354	437	415	234	58	0	0	1722
ATLANTA, GEORGIA	30	0	0	12	27	154	321	403	388	227	57	0	0	1589
AUGUSTA GEORGIA	30	6	8	23	54	218	396	477	453	279	76	5	0	1995
COLUMBUS, GEORGIA	30	10	12	25	77	236	411	484	474	315	93	6	0	2143
MACON, GEORGIA	30	10	14	35	90	269	438	508	493	324	103	10	0	2294
ROME, GEORGIA	30	0	0	13	25	145	324	425	406	227	50	0	0	1615
SAVANNAH, GEORGIA	30	15	18	39	96	260	423	499	484	336	125	16	6	2317
HILO, HAWAII	30	192	170	191	216	264	288	319	338	318	310	255	205	3066
HONOLULU, HAWAII	30	226	204	248	294	369	417	468	487	462	431	345	270	4221
KAHULUI, HAWAII	30	208	187	223	264	322	363	409	428	402	381	309	236	3732
LIHUE, HAWAII	30	196	176	211	249	326	375	415	437	414	381	306	233	3719
BOISE, IDAHO	30	0	0	0	0	17	91	295	235	70	6	0	0	714
LEWISTON, IDAHO	30	0	0	0	0	18	84	264	218	73	0	0	0	657
POCATELLO, IDAHO	30	0	0	0	0	7	42	205	159	24	0	0	0	437
CAIRO, ILLINOIS	30	0	0	16	35	171	381	487	440	221	55	0	0	1806
CHICAGO, IL - O HARE AP	30	0	0	0	0	35	138	221	207	51	12	0	0	664
CHICAGO, IL - MIDWAY AP	30	0	0	0	0	53	191	301	277	84	19	0	0	925
MOLINE, ILLINOIS	30	0	0	0	0	63	194	298	255	67	16	0	0	893
PEORIA, ILLINOIS	30	0	0	0	5	71	206	313	271	85	17	0	0	968
ROCKFORD, ILLINOIS	30	0	0	0	0	41	149	247	218	48	11	0	0	714
SPRINGFIELD, ILLINOIS	30	0	0	0	6	82	249	344	300	114	21	0	0	1116
EVANSVILLE, INDIANA	30	0	0	11	14	117	296	397	347	157	25	0	0	1364
FORT WAYNE, INDIANA	30	0	0	0	0	48	158	251	207	75	9	0	0	748
INDIANAPOLIS, INDIANA	30	0	0	0	6	72	212	310	259	102	13	0	0	974
SOUTH BEND, INDIANA	30	0	0	0	0	40	143	232	210	62	8	0	0	695

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
BURLINGTON, IOWA	30	0	0	0	5	73	208	322	284	82	20	0	0	994
DES MOINES, IOWA	30	0	0	0	0	59	191	317	270	73	18	0	0	928
DUBUQUE, IOWA	30	0	0	0	0	30	124	219	191	32	10	0	0	606
SIOUX CITY, IOWA	30	0	0	0	6	62	192	324	274	65	9	0	0	932
WATERLOO, IOWA	30	0	0	0	0	37	144	243	206	35	10	0	0	675
CONCORDIA, KANSAS	30	0	0	0	10	84	250	405	383	143	27	0	0	1302
DODGE CITY, KANSAS	30	0	0	0	14	84	282	440	406	158	27	0	0	1411
GOODLAND, KANSAS	30	0	0	0	0	27	178	338	286	87	9	0	0	925
TOPEKA, KANSAS	30	0	0	8	14	103	268	409	378	151	30	0	0	1361
WICHITA, KANSAS	30	0	0	8	23	124	331	487	456	200	44	0	0	1673
CINCINNATI AP-COVINGTON, KY	30	0	0	0	8	82	222	329	294	128	17	0	0	1080
LEXINGTON, KENTUCKY	30	0	0	10	11	97	248	347	313	148	23	0	0	1197
LOUISVILLE, KENTUCKY	30	0	0	10	13	99	254	369	338	158	27	0	0	1268
BATON ROUGE, LOUISIANA	30	17	24	44	135	304	459	527	515	375	163	16	6	2585
LAKE CHARLES, LOUISIANA	30	21	29	54	143	316	471	539	533	402	191	33	7	2739
NEW ORLEANS, LOUISIANA	30	28	35	55	137	313	462	524	524	396	189	32	11	2706
SHREVEPORT, LOUISIANA	30	0	10	37	107	266	456	564	564	372	148	14	0	2538
CARIBOU, MAINE	30	0	0	0	0	0	8	81	39	0	0	0	0	128
PORTLAND, MAINE	30	0	0	0	0	0	22	120	99	11	0	0	0	252
BALTIMORE, MARYLAND	30	0	0	0	0	70	225	360	307	132	14	0	0	1108
BLUE HILL OBSERVATORY - MA	30	0	0	0	0	10	69	195	150	33	0	0	0	457
BOSTON, MASSACHUSETTS	30	0	0	0	0	20	117	260	203	61	0	0	0	661
WORCESTER, MASSACHUSETTS	30	0	0	0	0	10	64	168	121	24	0	0	0	387
ALPENA, MICHIGAN	30	0	0	0	0	6	27	90	85	0	0	0	0	208
DETROIT, MI - CITY AP	30	0	0	0	0	33	149	261	225	65	10	0	0	743
DETROIT, MI - METRO AP	30	0	0	0	0	30	135	232	196	53	8	0	0	654
FLINT, MICHIGAN	30	0	0	0	0	21	89	160	135	27	6	0	0	438
GRAND RAPIDS, MICHIGAN	30	0	0	0	0	25	116	210	182	36	6	0	0	575
HOUGHTON LAKE, MICHIGAN	30	0	0	0	0	11	48	96	87	8	0	0	0	250
LANSING, MICHIGAN	30	0	0	0	0	26	111	192	166	34	6	0	0	535
MARQUETTE, MICHIGAN	30	0	0	0	0	0	15	97	97	7	0	0	0	216
MARQUETTE, MI	30	0	0	0	0	0	15	64	50	0	0	0	0	129
MUSKEGON, MICHIGAN	30	0	0	0	0	18	82	170	161	32	6	0	0	469
SAULT STE. MARIE, MICHIGAN	30	0	0	0	0	0	11	59	69	0	0	0	0	139
DULUTH, MINNESOTA	30	0	0	0	0	0	14	86	76	0	0	0	0	176
INTERNATIONAL FALLS, MINNESOTA	30	0	0	0	0	0	30	90	56	0	0	0	0	176
MINNEAPOLIS-ST.PAUL, MINNESOTA	30	0	0	0	0	26	122	225	182	23	7	0	0	585
ROCHESTER, MINNESOTA	30	0	0	0	0	19	108	179	147	14	7	0	0	474
SAINT CLOUD, MINNESOTA	30	0	0	0	0	14	79	179	142	12	0	0	0	426
JACKSON, MISSISSIPPI	30	14	17	37	95	245	432	518	502	330	116	10	5	2321
MERIDIAN, MISSISSIPPI	30	14	17	37	91	236	426	502	487	309	105	7	0	2231
COLUMBIA, MISSOURI	30	0	0	8	14	98	251	381	346	141	30	0	0	1269
KANSAS CITY, MISSOURI	30	0	0	0	12	99	255	388	361	140	30	0	0	1285
KANSAS CITY, MO	30	0	0	9	16	135	312	459	431	192	55	0	0	1609
SAINT JOSEPH, MISSOURI	30	0	0	0	0	116	278	409	362	133	36	0	0	1334
ST. LOUIS, MISSOURI	30	0	0	9	17	128	307	422	378	173	41	0	0	1475
SPRINGFIELD, MISSOURI	30	0	0	9	20	98	268	401	381	164	41	0	0	1382
BILLINGS, MONTANA	30	0	0	0	0	8	59	220	173	38	0	0	0	498
GLASGOW, MONTANA	30	0	0	0	0	9	61	185	154	29	0	0	0	438
GREAT FALLS, MONTANA	30	0	0	0	0	0	36	151	116	29	7	0	0	339

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
HAVRE, MONTANA	30	0	0	0	0	6	59	170	133	27	0	0	0	395
HELENA, MONTANA	30	0	0	0	0	0	20	123	94	19	0	0	0	256
KALISPELL, MONTANA	30	0	0	0	0	0	9	51	48	9	0	0	0	117
MILES CITY, MONTANA	30	0	0	0	0	19	114	301	248	64	6	0	0	752
MISSOULA, MONTANA	30	0	0	0	0	0	18	89	71	10	0	0	0	188
GRAND ISLAND, NEBRASKA	30	0	0	0	8	51	206	356	315	89	11	0	0	1036
LINCOLN, NEBRASKA	30	0	0	0	8	73	232	386	333	101	15	0	0	1148
NORFOLK, NEBRASKA	30	0	0	0	0	48	184	331	283	69	10	0	0	925
NORTH PLATTE, NEBRASKA	30	0	0	0	6	30	155	295	256	60	0	0	0	802
OMAHA, NEBRASKA	30	0	0	0	10	86	236	378	334	110	19	0	0	1173
OMAHA (NORTH), NEBRASKA	30	0	0	0	6	59	189	320	280	81	14	0	0	949
SCOTTSBLUFF, NEBRASKA	30	0	0	0	0	16	118	273	213	46	0	0	0	666
VALENTINE, NEBRASKA	30	0	0	0	0	22	130	291	242	46	5	0	0	736
ELKO, NEVADA	30	0	0	0	0	0	28	166	122	26	0	0	0	342
ELY, NEVADA	30	0	0	0	0	0	22	92	77	16	0	0	0	207
LAS VEGAS, NEVADA	30	0	6	8	90	268	519	763	694	453	139	6	0	2946
RENO, NEVADA	30	0	0	0	0	6	40	150	109	24	0	0	0	329
WINNEMUCCA, NEVADA	30	0	0	0	0	11	50	192	129	25	0	0	0	407
CONCORD, NEW HAMPSHIRE	30	0	0	0	0	8	49	162	113	17	0	0	0	349
MT. WASHINGTON, NH	30	0	0	0	0	0	0	0	0	0	0	0	0	0
ATLANTIC CITY, NEW JERSEY	30	0	0	0	0	25	168	313	260	98	0	0	0	864
NEWARK, NEW JERSEY	30	0	0	0	0	47	197	353	298	118	11	0	0	1024
TRENTON, NEW JERSEY	30	0	0	0	0	45	194	338	276	105	10	0	0	968
ALBUQUERQUE, NEW MEXICO	30	0	0	0	6	67	291	425	360	160	7	0	0	1316
CLAYTON, NEW MEXICO	30	0	0	0	0	17	164	271	234	73	8	0	0	767
ROSWELL, NEW MEXICO	30	0	0	0	26	128	360	440	400	179	27	0	0	1560
ALBANY, NEW YORK	30	0	0	0	0	27	114	226	165	42	0	0	0	574
BINGHAMTON, NEW YORK	30	0	0	0	0	13	69	148	111	28	0	0	0	369
BUFFALO, NEW YORK	30	0	0	0	0	14	79	170	138	36	0	0	0	437
NEW YORK, NY - CENTRAL PARK	30	0	0	0	0	54	202	360	307	131	14	0	0	1068
NEW YORK, NY - JFK AP	30	0	0	0	0	27	144	313	267	102	8	0	0	861
NEW YORK, NY - LA GUARDIA AP	30	0	0	0	0	46	199	363	307	123	10	0	0	1048
ROCHESTER, NEW YORK	30	0	0	0	0	22	103	202	159	45	0	0	0	531
SYRACUSE, NEW YORK	30	0	0	0	0	18	103	212	164	54	0	0	0	551
ASHEVILLE, NORTH CAROLINA	30	0	0	0	6	60	182	264	244	101	15	0	0	872
CAPE HATTERAS, NORTH CAROLINA	30	0	0	12	5	109	283	403	388	261	82	7	0	1550
CHARLOTTE, NORTH CAROLINA	30	0	0	15	19	152	327	419	394	220	50	0	0	1596
GREENSBORO, NORTH CAROLINA	30	0	0	11	11	124	282	378	341	165	29	0	0	1341
RALEIGH, NORTH CAROLINA	30	0	0	12	15	123	282	388	357	180	37	0	0	1394
WILMINGTON, NORTH CAROLINA	30	9	0	22	46	199	375	477	450	291	89	6	0	1964
BISMARCK, NORTH DAKOTA	30	0	0	0	0	11	86	198	165	27	0	0	0	487
FARGO, NORTH DAKOTA	30	0	0	0	0	11	88	190	163	21	0	0	0	473
WILLISTON, NORTH DAKOTA	30	0	0	0	0	7	66	180	144	25	0	0	0	422
AKRON, OHIO	30	0	0	0	0	36	132	217	181	62	6	0	0	634
CINCINNATI, OHIO	30	0	0	7	10	100	250	347	313	139	22	0	0	1188
CLEVELAND, OHIO	30	0	0	0	0	37	127	208	172	62	7	0	0	613
COLUMBUS, OHIO	30	0	0	0	0	55	175	267	222	82	8	0	0	809
DAYTON, OHIO	30	0	0	0	5	61	202	298	255	102	13	0	0	936
MANSFIELD, OHIO	30	0	0	0	0	52	168	267	230	91	10	0	0	818
TOLEDO, OHIO	30	0	0	0	0	37	149	231	198	63	7	0	0	685

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
YOUNGSTOWN, OHIO	30	0	0	0	0	29	102	185	153	49	0	0	0	518
OKLAHOMA CITY, OKLAHOMA	30	0	0	11	42	138	354	512	499	252	68	0	0	1876
TULSA, OKLAHOMA	30	0	0	10	50	145	369	530	508	259	78	0	0	1949
ASTORIA, OREGON	30	0	0	0	0	0	0	8	5	0	0	0	0	13
BURNS, OREGON	30	0	0	0	0	5	25	135	102	22	0	0	0	289
EUGENE, OREGON	30	0	0	0	0	0	25	100	85	29	0	0	0	239
MEDFORD, OREGON	30	0	0	0	0	11	73	218	189	71	0	0	0	562
PENDLETON, OREGON	30	0	0	0	0	18	88	269	214	67	0	0	0	656
PORTLAND, OREGON	30	0	0	0	0	7	38	114	106	35	0	0	0	300
SALEM, OREGON	30	0	0	0	0	7	19	92	87	27	0	0	0	232
SEXTON SUMMIT, OREGON	30	0	0	0	0	0	7	53	57	20	0	0	0	137
GUAM, PACIFIC	30	381	344	394	420	446	444	446	437	423	431	426	419	5011
JOHNSTON ISLAND, PACIFIC	30	366	322	360	378	431	456	490	502	477	484	429	391	5086
KOROR ISLAND, PACIFIC	30	502	440	499	507	527	498	499	502	498	524	507	505	6008
KWAJALEIN ISLAND, PACIFIC	30	502	459	518	504	521	507	530	543	525	539	501	515	6164
MAJURO, MARSHALL IS. PACIFIC	30	490	454	502	483	505	480	496	512	492	505	486	499	5904
PAGO PAGO, AMERICAN SAMOA	30	474	434	477	468	450	423	412	409	420	446	447	465	5325
PONAPE ISLAND, PACIFIC	30	484	440	490	471	487	465	465	468	468	471	459	484	5652
TRUK, CAROLINE IS. PACIFIC	30	496	451	505	489	505	489	487	493	480	499	489	505	5888
WAKE ISLAND, PACIFIC	30	372	336	394	399	459	495	527	546	528	515	462	422	5455
YAP ISLAND, PACIFIC	30	477	434	496	501	521	501	502	496	489	508	495	496	5916
ALLENTOWN, PENNSYLVANIA	30	0	0	0	0	38	156	282	214	76	6	0	0	772
ERIE, PENNSYLVANIA	30	0	0	0	0	13	68	139	120	33	0	0	0	373
HARRISBURG, PENNSYLVANIA	30	0	0	0	0	69	214	344	279	111	8	0	0	1025
PHILADELPHIA, PENNSYLVANIA	30	0	0	0	0	67	223	366	304	131	13	0	0	1104
PITTSBURGH, PA - INTL AP	30	0	0	0	0	46	134	221	177	62	7	0	0	647
PITTSBURGH, PA - CITY	30	0	0	0	7	74	199	298	254	103	13	0	0	948
AVOCA, PENNSYLVANIA	30	0	0	0	0	30	115	230	173	53	7	0	0	608
WILLIAMSPORT, PENNSYLVANIA	30	0	0	0	0	43	137	249	197	66	6	0	0	698
SAN JUAN, PUERTO RICO	30	322	288	350	375	440	465	493	505	483	484	411	366	4982
BLOCK ISLAND, RHODE ISLAND	30	0	0	0	0	0	25	149	142	43	0	0	0	359
PROVIDENCE, RHODE ISLAND	30	0	0	0	0	8	78	224	177	45	0	0	0	532
CHARLESTON, SOUTH CAROLINA	30	12	13	36	57	225	387	471	453	306	108	10	0	2078
COLUMBIA, SOUTH CAROLINA	30	0	5	25	56	233	414	502	471	289	87	5	0	2087
GREENVILLE-SPARTANBURG, SC	30	0	0	13	24	156	327	412	388	210	43	0	0	1573
ABERDEEN, SOUTH DAKOTA	30	0	0	0	0	15	105	223	195	28	0	0	0	566
HURON, SOUTH DAKOTA	30	0	0	0	0	25	135	278	233	40	0	0	0	711
RAPID CITY, SOUTH DAKOTA	30	0	0	0	0	15	110	249	222	56	9	0	0	661
SIOUX FALLS, SOUTH DAKOTA	30	0	0	0	0	32	143	267	229	42	6	0	0	719
BRISTOL-JOHNSON CITY, TN	30	0	0	9	9	87	230	316	285	142	29	0	0	1107
CHATTANOOGA, TENNESSEE	30	0	6	12	30	159	330	428	403	216	52	0	0	1636
KNOXVILLE, TENNESSEE	30	0	8	16	32	152	315	409	381	208	48	0	0	1569
MEMPHIS, TENNESSEE	30	0	0	23	56	205	408	515	477	265	80	0	0	2029
NASHVILLE, TENNESSEE	30	0	0	19	29	153	348	453	419	220	53	0	0	1694
OAK RIDGE, TENNESSEE	30	0	0	12	22	129	281	372	344	173	34	0	0	1367
ABILENE, TEXAS	30	0	0	29	110	240	459	586	577	333	123	9	0	2466
AMARILLO, TEXAS	30	0	0	0	20	99	298	425	391	164	36	0	0	1433
AUSTIN, TEXAS	30	8	16	52	152	316	498	608	611	417	197	28	5	2908
BROWNSVILLE, TEXAS	30	79	106	173	297	443	534	601	601	498	337	128	77	3874
CORPUS CHRISTI, TEXAS	30	34	48	117	238	400	522	614	623	480	283	78	37	3474

TABLE C-3
NORMAL COOLING DEGREE DAYS (JAN. - DEC.)

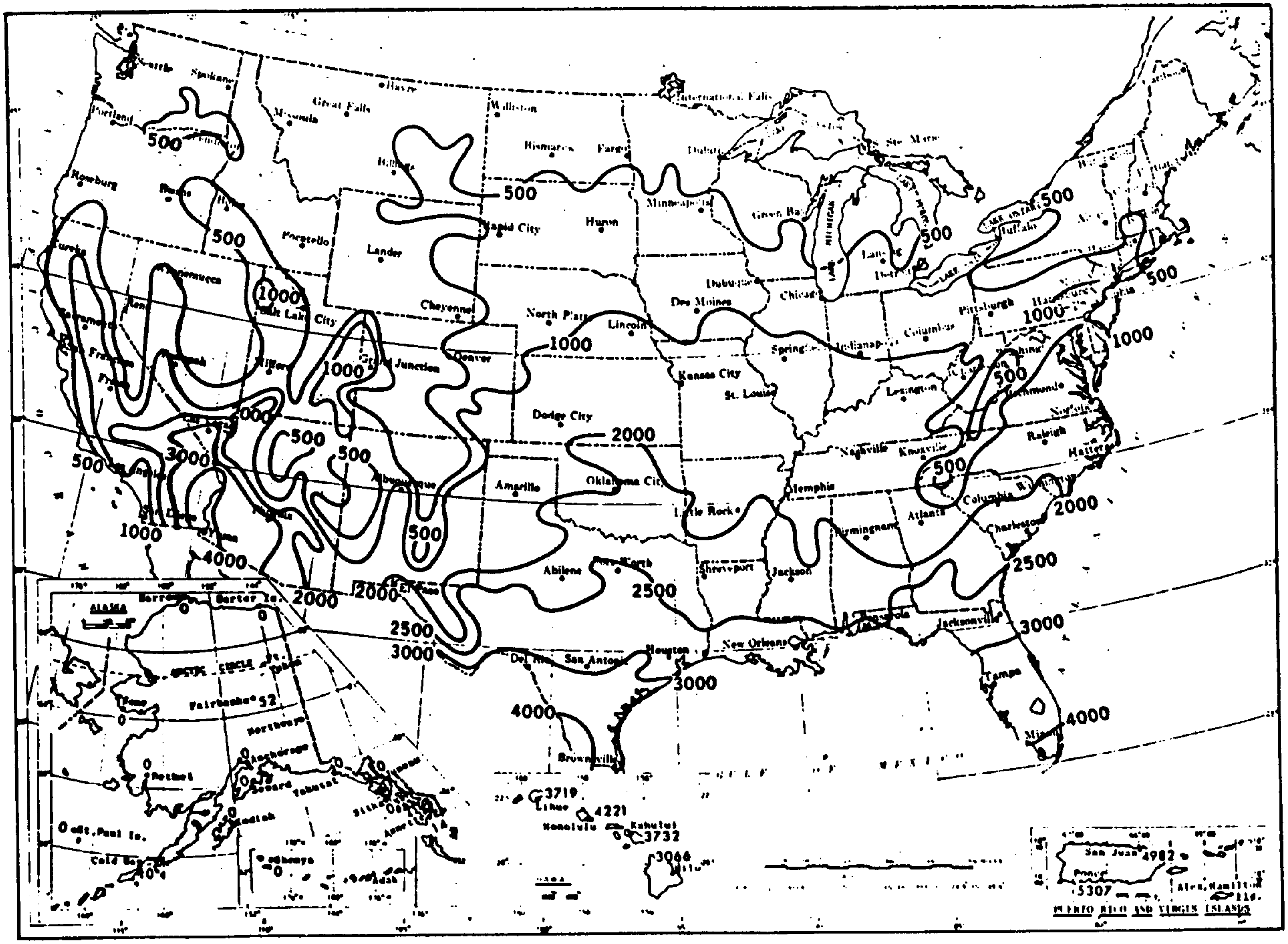
NORMALS 1941-70	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
DALLAS-FORT WORTH, TEXAS	30	0	0	25	94	236	468	614	617	381	141	11	0	2587
DEL RIO, TEXAS	30	8	22	88	226	409	579	673	654	456	226	22	0	3363
EL PASO, TEXAS	30	0	0	6	56	223	459	536	481	276	61	0	0	2098
GALVESTON, TEXAS	30	20	27	63	146	338	489	564	567	450	263	60	17	3004
HOUSTON, TEXAS	30	16	22	59	155	335	483	567	570	426	207	38	11	2889
LUBBOCK, TEXAS	30	0	0	9	40	138	363	456	415	188	38	0	0	1647
MIDLAND-ODESSA, TEXAS	30	0	0	17	77	230	447	536	521	312	105	5	0	2250
PORT ARTHUR, TEXAS	30	17	25	51	150	310	474	558	561	417	187	40	8	2798
SAN ANGELO, TEXAS	30	0	0	42	140	298	498	611	605	354	141	13	0	2702
SAN ANTONIO, TEXAS	30	8	16	64	169	341	516	611	611	429	202	20	7	2994
VICTORIA, TEXAS	30	16	28	76	186	360	510	601	605	453	239	51	15	3140
WACO, TEXAS	30	0	6	38	125	295	507	639	642	417	178	16	0	2863
WICHITA FALLS, TEXAS	30	0	0	22	91	239	489	645	636	360	123	6	0	2611
MILFORD, UTAH	30	0	0	0	0	10	88	288	242	60	0	0	0	688
SALT LAKE CITY, UTAH	30	0	0	0	0	30	124	363	300	99	11	0	0	927
BURLINGTON, VERMONT	30	0	0	0	0	15	69	169	123	20	0	0	0	396
LYNCHBURG, VIRGINIA	30	0	0	0	8	91	232	335	291	126	17	0	0	1100
NORFOLK, VIRGINIA	30	0	0	8	10	106	285	412	369	213	38	0	0	1441
RICHMOND, VIRGINIA	30	0	0	8	10	111	276	400	350	171	27	0	0	1353
ROANOKE, VIRGINIA	30	0	0	0	10	83	205	316	282	122	12	0	0	1030
OLYMPIA, WASHINGTON	30	0	0	0	0	0	14	46	35	6	0	0	0	101
QUILLAYUTE, WASHINGTON	30	0	0	0	0	0	0	8	0	0	0	0	0	8
SEATTLE, WA - URBAN SITE	30	0	0	0	0	6	22	83	55	17	0	0	0	183
SEATTLE, WA - INTL AP	30	0	0	0	0	0	11	65	45	8	0	0	0	129
SPOKANE, WASHINGTON	30	0	0	0	0	8	39	167	140	34	0	0	0	388
STAMPEDE PASS, WASHINGTON	30	0	0	0	0	0	0	8	8	0	0	0	0	16
WALLA WALLA, WASHINGTON	30	10	0	0	0	29	115	334	279	89	6	0	0	862
YAKIMA, WASHINGTON	30	0	0	0	0	19	79	197	148	36	0	0	0	479
BECKLEY, WEST VIRGINIA	30	0	0	0	0	24	108	166	135	51	6	0	0	490
CHARLESTON, WEST VIRGINIA	30	0	0	7	14	97	220	310	267	121	19	0	0	1055
ELKINS, WEST VIRGINIA	30	0	0	0	0	25	84	135	111	34	0	0	0	389
HUNTINGTON, WEST VIRGINIA	30	0	0	7	14	99	233	319	279	127	20	0	0	1098
PARKERSBURG, WEST VIRGINIA	30	0	0	0	8	86	221	316	276	118	20	0	0	1045
GREEN BAY, WISCONSIN	30	0	0	0	0	12	76	152	138	8	0	0	0	386
LA CROSSE, WISCONSIN	30	0	0	0	0	38	144	252	215	34	12	0	0	695
MADISON, WISCONSIN	30	0	0	0	0	18	96	172	154	14	6	0	0	460
MILWAUKEE, WISCONSIN	30	0	0	0	0	13	75	167	166	23	6	0	0	450
CASPER, WYOMING	30	0	0	0	0	6	54	199	159	40	0	0	0	458
CHEYENNE, WYOMING	30	0	0	0	0	0	45	149	112	21	0	0	0	327
LANDER, WYOMING	30	0	0	0	0	0	36	182	138	27	0	0	0	383
SHERIDAN, WYOMING	30	0	0	0	0	7	51	195	161	32	0	0	0	446

TABLE C-4
EFFECTIVE SOLAR HEAT GAIN FACTOR (SHGF)

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
24° N Latitude	N	41	49	58	73	103	123	107	78	60	50	42	38
	E	167	200	226	238	242	242	240	233	218	195	165	152
ORIENTATION	S	365	304	199	78	81	81	83	106	196	293	359	377
	W	167	200	226	238	242	242	240	233	218	195	165	152
	HOR	289	357	418	456	473	477	468	447	404	350	287	260
32° N Latitude	N	34	43	54	70	97	113	100	74	57	45	35	31
	E	141	182	217	240	252	254	249	236	209	177	140	124
ORIENTATION	S	371	339	256	157	109	98	108	153	250	327	364	370
	W	141	182	217	240	252	254	249	236	209	177	140	124
	HOR	223	300	380	441	477	488	473	434	367	295	221	191
40° N Latitude	N	27	37	50	67	93	110	97	71	52	38	27	23
	E	112	159	206	240	261	267	258	236	197	155	110	93
ORIENTATION	S	353	357	302	212	156	137	153	206	292	344	347	337
	W	112	159	206	240	261	267	258	236	197	155	110	93
	HOR	154	238	332	416	471	490	468	411	321	235	154	123
48° N Latitude	N	19	30	43	64	93	112	97	68	46	31	19	14
	E	78	132	190	239	269	279	268	235	182	128	77	58
ORIENTATION	S	305	353	333	263	210	190	206	255	320	339	298	268
	W	78	132	190	239	269	279	268	235	182	128	77	58
	HOR	88	172	[illegible]	380	454	482	453	378	267	17[illegible]	89	61

TABLE C-5

MEAN ANNUAL TOTAL COOLING DEGREE DAYS (BASE 65°F.)



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