Part 1
LOAD ESTIMATING

CHAPTER 1. BUILDING SURVEY AND LOAD ESTIMATE

The primary function of air conditioning is to maintain conditions that are (1) conducive to human comfort, or (2) required by a product, or process within a space. To perform this function, equipment of the proper capacity must be installed and controlled throughout the year. The equipment capacity is determined by the *actual* instantaneous peak load requirements; type of control is determined by the conditions to be maintained during peak and partial load. Generally, it is impossible to measure either the actual peak or the partial load in any given space; these loads must be estimated. It is for this purpose that the data contained in Part 1 has been compiled.

Before the load can be estimated, it is imperative that a comprehensive survey be made to assure accurate evaluation of the load components. If the building facilities and the actual instantaneous load within a given mass of the building are carefully studied, an economical equipment selection and system design can result, and smooth, trouble free performance is then possible.

The heat gain or loss is the amount of heat instantaneously coming into or going out of the space. *The actual load is defined as that amount of heat which is instantaneously added or removed by the equipment.* The instantaneous heat gain and the actual load on the equipment will rarely be equal, because of the thermal inertia or storage effect of the building structures surrounding a conditioned space.

Chapters 2, 4, 5, 6, and 7 contain the data from which the instantaneous heat gain or loss is estimated. *Chapter 3* provides the data and procedure for applying storage factors to the appropriate heat gains to result in the actual load. *Chapter 8* provides the bridge between the load estimate and the equipment selection. It furnishes the procedure for establishing the criteria to fulfill the conditions required by a given project.

The basis of the data and its use, with examples, are included in each chapter with the tables and charts; also an explanation of how each of the heat gains and the loads manifest themselves.

BUILDING SURVEY

SPACE CHARACTERISTICS AND HEAT LOAD SOURCES

An accurate survey of the load components of the space to be air conditioned is a basic requirement for a realistic estimate of cooling and heating loads. *The completeness and accuracy of this survey is the very foundation of the estimate, and its importance can not be overemphasized.* Mechanical and architectural drawings, complete field sketches and, in some cases, photographs of important aspects are part of a good survey. The following physical aspects must be considered:

1. *Orientation of building* — Location of the space to be air conditioned with respect to:
   a) Compass points — sun and wind effects.
   b) Nearby permanent structures — shading effects.
   c) Reflective surfaces — water, sand, parking lots, etc.
2. *Use of space(s)* — Office, hospital, department store, specialty shop, machine shop, factory, assembly plant, etc.
3. *Physical dimensions of space(s)* — Length width, and height.
4. *Ceiling height* — Floor to floor height, floor to ceiling, clearance between suspended ceiling and beams.
5. *Columns and beams* — Size, depth, also knee braces.
6. *Construction materials* — Materials and thick ness of walls, roof, ceiling, floors and parti tions, and their relative position in the struc ture.
7. *Surrounding conditions* — Exterior color of walls and roof, shaded by adjacent building or sunlit. Attic spaces — unvented or vented, gravity or forced ventilation. Surrounding spaces conditioned or unconditioned — temperature of non-conditioned adjacent spaces, such as furnace or boiler room, and kitchens. Floor on ground, crawl space, basement.
8. *Windows* — Size and location, wood or metal

sash, single or double hung. Type of glass — single or multipane. Type of shading device. Dimensions of reveals and overhangs.

9. *Doors* — Location, type, size, and frequency of use.
10. *Stairways, elevators, and escalators* — Location, temperature of space if open to unconditioned area. Horsepower of machinery, ventilated or not.
11. *People* — Number, duration of occupancy, nature of activity, any special concentration. At times, it is required to estimate the number of people on the basis of square feet per person, or on average traffic.
12. *Lighting* — Wattage at peak. Type — incandescent, fluorescent, recessed, exposed. If the lights are recessed, the type of air flow over the lights, exhaust, return or supply, should be anticipated. At times, it is required to estimate the wattage on a basis of watts per sq ft, due to lack of exact information.
13. *Motors* — Location, nameplate and brake horsepower, and usage. The latter is of great significance and should be carefully evaluated.

    The power input to electric motors is not necessarily equal to the rated horsepower divided by the motor efficiency. Frequently these motors may be operating under a continuous overload, or may be operating at less than rated capacity. It is always advisable to measure the power input wherever possible. This is especially important in estimates for industrial installations where the motor machine load is normally a major portion of the cooling load.
14. *Appliances, business machines, electronic equipment* — Location, rated wattage, steam or gas consumption, hooded or unhooded, exhaust air quantity installed or required, and usage.

    Greater accuracy may be obtained by measuring the power or gas input during times of peak loading. The regular service meters may often be used for this purpose, provided power or gas consumption not contributing to the room heat gain can be segregated.

    Avoid pyramiding the heat gains from various appliances and business machines. For example, a toaster or a waffle iron may not be used during the evening, or the fry kettle may not be used during morning, or not all business machines in a given space may be used at the same time.

    Electronic equipment often requires individual air conditioning. The manufacturer's recommendation for temperature and humidity variation must be followed, and these requirements are often quite stringent.
15. *Ventilation* — Cfm per person, cfm per sq ft, scheduled ventilation (agreement with purchaser), see *Chapter 6*. Excessive smoking or odors, code requirements. Exhaust fans — type, size, speed, cfm delivery.
16. *Thermal storage* — Includes system operating schedule (12, 16 or 24 hours per day) specifically during peak outdoor conditions, permissible temperature swing in space during a design day, rugs on floor, nature of surface materials enclosing the space (see *Chapter 3*).
17. *Continuous or intermittent operation* — Whether system be required to operate every business day during cooling season, or only occasionally, such as churches and ballrooms. If intermittent operation, determine duration of time available for precooling or pulldown.

LOCATION OF EQUIPMENT AND SERVICES

The building survey should also include information which enables the engineer to select equipment location, and plan the air and water distribution systems. The following is a guide to obtaining this information:

1. *Available spaces* — Location of all stairwells, elevator shafts, abandoned smokestacks, pipe shafts, dumbwaiter shafts, etc., and spaces for air handling apparatus, refrigeration machines, cooling towers, pumps, and services (also see *Item 5*).
2. *Possible obstructions* — Locations of all electrical conduits, piping lines, and other obstructions or interferences that may be in the way of the duct system.
3. *Location of all fire walls and partitions* — Requiring fire dampers (also see *Item 16*).
4. *Location of outdoor air intakes* — In reference to street, other buildings, wind direction, dirt, and short-circuiting of unwanted contaminants.
5. *Power service* — Location, capacity, current limitations, voltage, phases and cycle, 3 or 4 wire; how additional power (if required) may be brought in and where.
6. *Water service* — Location, size of lines, ca-

pacity, pressure, maximum temperature.

7. *Steam service* — Location, size, capacity, temperature, pressure, type of return system.
8. *Refrigeration, brine or chilled water* (if furnished by customer)—Type of system, capacity, temperature, gpm, pressure.
9. *Architectural characteristics of space* — For selection of outlets that will blend into the space design.
10. *Existing air conveying equipment and ducts* — For possible reuse.
11. *Drains* — Location and capacity sewage disposal.
12. *Control facilities* — Compressed air source and pressure, electrical.
13. *Foundation and support* — Requirements and facilities, strength of building.
14. *Sound and vibration control requirements* — Relation of refrigeration and air handling apparatus location to critical areas.
15. *Accessibility for moving equipment to the final location* — Elevators, stairways, doors, accessibility from street.
16. *Codes, local and national*—Governing wiring, drainage, water supply, venting of refrigeration, construction of refrigeration and air handling apparatus rooms, ductwork, fire dampers, and ventilation of buildings in general and apparatus rooms in particular.

AIR CONDITIONING LOAD ESTIMATE

The air conditioning load is estimated to provide the basis for selecting the conditioning equipment. It must take into account the heat coming into the space from outdoors on a design day, as well as the heat being generated within the space. A design day is defined as:

1. A day on which the dry- and wet-bulb temperatures are peaking simultaneously (*Chapter 2, "Design Conditions"*).
2. A day when there is little or no haze in the air to reduce the solar heat (*Chapter 4, "Solar Heat Gain Thru Glass"*).
3. All of the internal loads are normal (*Chapter 7, "Internal and System Heat Gain"*).

The time of peak load can usually be established by inspection, although, in some cases, estimates must be made for several different times of the day.

Actually, the situation of having all of the loads peaking at the same time will very rarely occur. To be realistic, various diversity factors must be applied to some of the load components; refer to *Chapter 3, "Heat Storage, Diversity, and Stratification."*

The infiltration and ventilation air quantities are estimated as described in *Chapter 6.*

Fig. 1 illustrates an air conditioning load estimate form and is designed to permit systematic load evaluation. This form contains the references identified to the particular chapters of data and tables required to estimate the various load components.

OUTDOOR LOADS

The loads from outdoors consist of:

1. *The sun rays entering windows — Table 15, pages 44-49,* and *Table 16, page 52,* provide data from which the solar heat gain through glass is estimated.

   The solar heat gain is usually reduced by means of shading devices on the inside or outside of the windows; factors are contained in *Table 16.* In addition to this reduction, all or part of the window may be shaded by reveals, overhangs, and by adjacent buildings. *Chart 1, page 57,* and *Table 18, page 58,* provide an easy means of determining how much the window is shaded at a given time.

   A large portion of the solar heat gain is radiant and will be partially stored as described in *Chapter 3. Tables 7 thru 11, pages 30-34,* provide the storage factors to be applied to solar heat gains in order to arrive at the actual cooling load imposed on the air conditioning equipment. These storage factors are applied to *peak solar heat gains* obtained from *Table 6, page 29,* with overall factors from *Table 16, page 52.*
2. *The sun rays striking the walls and roof* — These, in conjunction with the high outdoor air temperature, cause heat to flow into the space. *Tables 19 and 20, pages 62 and 63,* provide equivalent temperature differences for sunlit and shaded walls and roofs. *Tables 21, 22, 23, 24, 25, 27, and 28, pages 66-72,* provide the transmission coefficients or rates of heat flow for a variety of roof and wall constructions.
3. *The air temperature outside the conditioned space* — A higher ambient temperature causes heat to flow thru the windows, partitions, and floors. *Tables 25 and 26, pages 69 and 70,* and *Tables 29 and 30, pages 73 and 74,* provide the transmission coefficients. The temperature differences used to estimate the heat flow thru these structures are contained in the notes after each table.

CHAP REF	TABLE REFERENCES			
	ITEM	AREA OR QUANTITY	SUN GAIN OR TEMP. DIFF.	FACTOR
	SOLAR GAIN—GLASS			
3 & 4	GLASS WITH STORAGE	SQ FT ×	TBLS 6&7,8 9,10 OR 11 PP 29-34 ×	TBLS 16,17 PP 52-54
	GLASS WITHOUT STORAGE	SQ FT ×	TBL 15 PP 44-49 ×	TBL 15 CORR PP 44-49
	SKYLIGHT	SQ FT ×		
	SOLAR & TRANS. GAIN—WALLS & ROOF			
5	WALL	SQ FT ×	TBL 19 P 62 ×	TBLS 21,22, 23,24 OR 25 PP 66-69
	WALL	SQ FT ×		
	WALL	SQ FT ×		
	WALL	SQ FT ×		
	ROOF—SUN	SQ FT ×	TBL 20 P 63 ×	TBLS 27,28 71,72
	ROOF—SHADED	SQ FT ×		
	TRANS. GAIN—EXCEPT WALLS & ROOF			
	ALL GLASS	SQ FT ×	NOTE 1 ×	TBL 33 P 76
	PARTITION	SQ FT ×	NOTES, PP 69,70 ×	TBLS 25,26 PP 69,70
	CEILING	SQ FT ×	NOTES PP 73,74 ×	TBL 29 OR 30 PP 73,74
	FLOOR	SQ FT ×		
6	INFILTRATION NOTE 4	CFM ×	NOTE 1 ×	1.08
	INTERNAL HEAT			
3 & 7	PEOPLE	PEOPLE ×		TBLS 14,48 PP 38,100
	POWER	HP OR KW ×		TBL 53 P 105
	LIGHTS	WATTS × 3.4 ×		TBLS 12,14,49 PP 35,38,101
	APPLIANCES, ETC.	TBLS 50-52 PP 101-103 ×		CORR BELOW TBLS 50-52
	ADDITIONAL HEAT GAINS	TBLS 54-57 PP 107-109 ×		
				SUB TOTAL
2 & 3	STORAGE	SQ FT × (TEMP SWING) TBL 14 P 38 ×		(— TBL 13 P 37)
				SUB TOTAL
7	SAFETY FACTOR P 113	%		
				ROOM SENSIBLE HEAT ■
	SUPPLY DUCT HEAT GAIN CHART 3 P 110 % +	SUPPLY DUCT LEAK. LOSS P 110 % +	FAN H. P. TBL 59 P 111 %	
8	OUTDOOR AIR NOTE 3	CFM × NOTE 1 F ×		P 121 BF × 1.08
				EFFECTIVE ROOM SENSIBLE HEAT ■
	LATENT HEAT			
6	INFILTRATION NOTE 4	CFM × NOTE 2		GR/LB × 0.68
3 & 7	PEOPLE	PEOPLE ×		TBLS 14,48; PP 38,100
	STEAM P 107	LB/HR × 1050		
	APPLIANCES, ETC. TBLS 50-52 PP 101-103 ×			CORR BELOW TBLS
	ADDITIONAL HEAT GAINS			TBL 58 P 109
5	VAPOR TRANS.	SQ FT × 1/100 ×	NOTE 2 GR/LB ×	TBL 40 P 84
				SUB TOTAL
7	SAFETY FACTOR P 113	%		
				ROOM LATENT HEAT
	SUPPLY DUCT LEAKAGE LOSS P 110	%		
8	OUTDOOR AIR NOTE 3 CFM ×	NOTE 2 GR/LB ×		P 121 BF × 0.68
				EFFECTIVE ROOM LATENT HEAT
				EFFECTIVE ROOM TOTAL HEAT ■
	OUTDOOR AIR HEAT			
	SENSIBLE: NOTE 3 CFM × NOTE 1 F × (1 — P 121 BF) × 1.08			
	LATENT: NOTE 3 CFM × NOTE 2 GR/LB × (1 — P 121 BF) × 0.68			
7	RETURN DUCT HEAT GAIN CHART 3 P 110 % +	RETURN DUCT LEAK. GAIN P 112 % +	HP PUMP TBL 60 P 113 % +	SUB TOTAL DEHUM. & PIPE LOSS P 113 %
				GRAND TOTAL HEAT ■

CHAP REF	TABLE REFERENCES					
	ESTIMATE FOR	LOCAL TIME SUN TIME	PEAK LOAD	LOCAL TIME SUN TIME		
	HOURS OF OPERATION					
2	CONDITIONS	DB	WB	% RH	DP	GR/LB
	OUTDOOR (OA)	TBLS 1-3	PP 10-19			
	ROOM (RM)	TBLS 4.5	PP 20,22,23			
	DIFFERENCE		X X X	X X X	X X X	
	OUTDOOR AIR					
6	VENTILATION: PEOPLE × (TBL 45 P 97) CFM/PERSON =					
	SQ FT × CFM/SQ FT =					
	CFM VENTILATION ■					
	INFILTRATION: SWINGING, REVOLVING DOORS PEOPLE × (TBL 41 P 90) CFM/PERSON =					
	OPEN DOORS DOORS × CFM/DOOR =					
	EXHAUST FAN TBLS 46,47; P 98					
	CRACK FEET × TBL 44 P 95 CFM/FT =					
	CFM INFILTRATION ■ TBL 42 P 92					
	CFM OUTDOOR AIR THRU APPARATUS ■ NOTE 3					CFM$_{OA}$
	APPARATUS DEWPOINT					
8	ESHF: EFFECTIVE SENS HEAT FACTOR = EFFECTIVE ROOM SENS. HEAT / EFFECTIVE ROOM TOTAL HEAT =					
	TBL 65 P 145, OR PSYCH CHART, FIG 33 P 116					
	ADP: INDICATED ADP = F SELECTED ADP = F					
	DEHUMIDIFIED AIR QUANTITY					
	TEMP. RISE: $(1 - \frac{P\ 121}{\quad} BF) \times (T_{RM} __ F - T_{ADP} __ F) = __ F$					
	DEHUM. CFM: EFFECTIVE ROOM SENS. HEAT / (1.08 × F TEMP. RISE) = CFM$_{DA}$					
	OUTLET TEMP. DIFF.: ROOM SENS. HEAT / (1.08 × CFM$_{DA}$) = F (RM—OUTLET AIR)*					
	SUPPLY AIR QUANTITY					
	SUPPLY CFM: ROOM SENS. HEAT / (1.08 × F DESIRED DIFF) = CFM$_{SA}$					
	BYPASS CFM: CFM$_{SA}$ — CFM$_{DA}$ = CFM$_{BA}$					
	RESULTING ENT & LVG CONDITIONS AT APPARATUS					
	EDB: T_{RM} F + $\frac{CFM_{OA}}{P\ 125\ CFM\dagger}$ × (T_{OA} F — T_{RM} F) = T_{EDB} F					
	LDB: T_{ADP} F + $\frac{P\ 121}{\quad}$ BF × (T_{EDB} F — T_{ADP} F) = T_{LDB} F					
	FROM PSYCH. CHART: T_{EDB} F, T_{LWB} F					

NOTES

1. USE DRY-BULB (DB) TEMPERATURE DIFFERENCE FROM TOP OF ESTIMATE FORM.
2. USE MOISTURE CONTENT (GR/LB) DIFFERENCE FROM TOP OF ESTIMATE FORM.
3. NORMALLY, USE "CFM VENTILATION" FOR "CFM OUTDOOR AIR." HOWEVER, WHEN INFILTRATION IS TO BE OFFSET, REFER TO PAGE 92 TO DETERMINE "CFM OUTDOOR AIR."
4. WHEN INFILTRATION IS NOT TO BE OFFSET, AND "CFM VENTILATION" IS LESS THAN "CFM INFILTRATION," THEN THE EXCESS INFILTRATION IS ACCOUNTED FOR HERE.

*IF THIS ΔT IS TOO HIGH, DETERMINE SUPPLY CFM FOR DESIRED DIFFERENCE BY SUPPLY AIR QUANTITY FORMULA.

†WHEN BYPASSING A MIXTURE OF OUTDOOR AND RETURN AIR, USE SUPPLY CFM. WHEN BYPASSING RETURN AIR ONLY, USE DEHUMIDIFIED CFM.

With Carrier Masthead Form E20. Without Carrier Masthead Form E5024.

FIG. 1 — AIR CONDITIONING LOAD ESTIMATE

4. *The air vapor pressure* — A higher vapor pressure surrounding conditioned space causes water vapor to flow thru the building materials. This load is significant only in low dew-point applications. The data required to estimate this load is contained in *Table 40, page 84*. In comfort applications, this load is neglected.
5. *The wind blowing against a side of the building*—Wind causes the outdoor air that is higher in temperature and moisture content to infiltrate thru the cracks around the doors and windows, resulting in localized sensible and latent heat gains. All or part of this infiltration may be offset by air being introduced thru the apparatus for ventilation purposes. *Chapter 6* contains the estimating data.
6. *Outdoor air usually required for ventilation purposes* — Outdoor air is usually necessary to flush out the space and keep the odor level down. This ventilation air imposes a cooling and dehumidifying load on the apparatus because the heat and/or moisture must be removed. Most air conditioning equipment permits some outdoor air to bypass the cooling surface (see *Chapter 8*). This bypassed outdoor air becomes a load within the conditioned space, similar to infiltration; instead of coming thru a crack around the window, it enters the room thru the supply air duct. The amount of bypassed outdoor air depends on the type of equipment used as outlined in *Chapter 8*. *Table 45, page 97*, provides the data from which the ventilation requirements for most comfort applications can be estimated.

The foregoing is that portion of the load on the air conditioning equipment that originates outside the space and is common to all applications.

INTERNAL LOADS

Chapter 7 contains the data required to estimate the heat gain from most items that generate heat within the conditioned space. The internal load, or heat generated within the space, depends on the character of the application. Proper diversity and usage factor should be applied to all internal loads. As with the solar heat gain, some of the internal gains consist of radiant heat which is partially stored (as described in *Chapter 3*), thus reducing the load to be impressed on the air conditioning equipment.

Generally, *internal heat gains* consist of some or all of the following items:

1. *People* — The human body thru metabolism generates heat within itself and releases it by radiation, convection, and evaporation from the surface, and by convection and evaporation in the respiratory tract. The amount of heat generated and released depends on surrounding temperature and on the activity level of the person, as listed in *Table 48, page 100*.
2. *Lights* — Illuminants convert electrical power into light and heat (refer to *Chapter 7*). Some of the heat is radiant and is partially stored (see *Chapter 3*).
3. *Appliances* — Restaurants, hospitals, laboratories, and some specialty shops (beauty shops) have electrical, gas, or steam appliances which release heat into the space. *Tables 50 thru 52, pages 101-103*, list the recommended heat gain values for most appliances when not hooded. If a positive exhaust hood is used with the appliances, the heat gain is reduced.
4. *Electric calculating machines* — Refer to manufacturer's data to evaluate the heat gain from electric calculating machines. Normally, not all of the machines would be in use simultaneously, and, therefore, a usage or diversity factor should be applied to the full load heat gain. The machines may also be hooded, or partially cooled internally, to reduce the load on the air conditioning system.
5. *Electric motors* — Electric motors are a significant load in industrial applications and should be thoroughly analyzed with respect to operating time and capacity before estimating the load (see *Item 13* under *"Space Characteristics and Heat Load Sources"*). It is frequently possible to actually measure this load in existing applications, and should be so done where possible. *Table 53, page 105*, provides data for estimating the heat gain from electric motors.
6. *Hot pipes and tanks* — Steam or hot water pipes running thru the air conditioned space, or hot water tanks in the space, add heat. In many industrial applications, tanks are open to the air, causing water to evaporate into the space. *Tables 54 thru 58, pages 107-109* provide data for estimating the heat gain from these sources.
7. *Miscellaneous sources* — There may be other sources of heat and moisture gain within a space, such as escaping steam (industrial cleaning devices, pressing machines, etc.), absorption of water by hygroscopic materials (paper, textiles, etc.); see *Chapter 7*.

In addition to the heat gains from the indoor and outdoor sources, the air conditioning equipment and duct system gain or lose heat. The fans and pumps required to distribute the air or water thru the system add heat; heat is also added to supply and return air ducts running thru warmer or hot spaces; cold air may leak out of the supply duct and hot air may leak into the return duct. The procedure for estimating the heat gains from these sources in percentage of room sensible load, room latent load, and grand total heat load is contained in *Chart 3, page 110,* and *Tables 59 and 60, pages 111-113.*

HEATING LOAD ESTIMATE

The heating load evaluation is the foundation for selecting the heating equipment. Normally, the heating load is estimated for the winter design temperatures *(Chapter 2)* usually occurring at night; therefore, no credit is taken for the heat given off by internal sources (people, lights, etc.). This estimate must take into account the heat loss thru the building structure surrounding the spaces and the heat required to offset the outdoor air which may infiltrate and/or may be required for ventilation. *Chapter 5* contains the transmission coefficients and procedures for determining heat loss. *Chapter 6* contains the data for estimating the infiltration air quantities. *Fig. 2* illustrates a heating estimate form for calculating the heat loss in a building structure.

Another factor that may be considered in the evaluation of the heating load is temperature swing. Capacity requirements may be reduced when the temperature within the space is allowed to drop a few degrees during periods of design load. This, of course, applies to continuous operation only. *Table 4, page 20,* provides recommended inside design conditions for various applications, and *Table 13, page 37,* contains the data for estimating the possible capacity reduction when operating in this manner.

The practice of drastically lowering the temperature to 50 F db or 55 F db when the building is unoccupied precludes the selection of equipment based on such capacity reduction. Although this type of operation may be effective in realizing fuel economy, *additional* equipment capacity is required for pickup. In fact, it may be desirable to provide the additional capacity, even if continuous operation is contemplated, because of pickup required after forced shutdown. It is, therefore, evident that the use of storage in reducing the heating load for the purpose of equipment selection should be applied with care.

HIGH ALTITUDE LOAD CALCULATIONS

Since air conditioning load calculations are based on pounds of air necessary to handle a load, a decrease in density means an increase in cfm required to satisfy the given sensible load. The weight of air required to meet the latent load is decreased because of the higher latent load capacity of the air at higher altitudes (greater gr per lb per degree difference in dewpoint temperature). For the same dry-bulb and percent relative humidity, the wet-bulb temperature decreases (except at saturation) as the elevation above sea level increases.

The following adjustments are required for high altitude load calculations (see *Chapter 8, Table 66, page 148):*

1. Design room air moisture content must be adjusted to the required elevation.
2. Standard load estimating methods and forms are used for load calculations, except that the factors affecting the calculations of volume and sensible and latent heat of air must be multiplied by the relative density at the particular elevation.
3. Because of the increased moisture content of the air, the effective sensible heat factor must be corrected.

EQUIPMENT SELECTION

After the load is evaluated, the equipment must be selected with capacity sufficient to offset this load. The air supplied to the space must be of the proper conditions to satisfy both the sensible and latent loads estimated. *Chapter 8, "Applied Psychrometrics,"* provides procedures and examples for determining the criteria from which the air conditioning equipment is selected (air quantity, apparatus dewpoint, etc.).

HEATING CONDITIONS

ROOM (TBL 4 P 20) D.B. ____ W.B. ____ % R.H. ____ GR/LB

OUTSIDE (TBL 1 PP 10-17) D.B. ____ W.B. ____ % R.H. ____ GR/LB

DIFF. ____ °F DIFF. ____ GR/LB

TEMPERATURE OF AIR ENTERING UNIT

____ % OUTSIDE AIR × ____ °F = ____ °F

____ % RECIRCULATED AIR × ____ °F* = ____ °F

TOTAL (AVERAGE ENTERING AIR TEMP.) = ____ °F

*ROOM TEMP. PLUS TEMP. CORRECTION FOR HT. OF UNIT

SURFACE	SQ FT	TRANS. FACT.	BTU PER HR PER °F DIFF.	TOTAL BTU PER HR °F DIFF.	TEMP. DIFF.	TOTAL BTU PER HOUR
		(CHAPTER 5, TBLS 21-34 PP 66-80)				

INFILTRATION

	CRACK METHOD	AREA METHOD	CFM
WINDOW	LIN. FT × (CHAPTER 6, TBL 44 P 95)	SQ FT × 0.8	
SKYLIGHT	LIN. FT × (CHAPTER 6, TBL 44 P 95)	SQ FT × 0.8	
DOOR	LIN. FT × (CHAPTER 6, TBL 44 P 95)	SQ FT × (TBL 43 P 94)	
DOOR USAGE	SQ. FT × (CHAPTER 6, TBL 44 P 95)	SQ FT × (TBL 43 P 94)	
		TOTAL	

TOTAL TRANSMISSION LOSS

× TEMP. GRADIENT FACTOR ____

OUTSIDE AIR (TBL 45 P 97) CFM × ____ °F × 1.08

INFILTRATION ____ CFM × ____ °F × 1.08

SUBTOTAL

SAFETY FACTOR ____ %

GRAND TOTAL HEAT LOSS

AIR CHANGE METHOD

____ CU FT / 60 × { ____ MAX. / ____ MIN. } CHANGES/HR

CFM MAX. ____

CFM MIN. ____

HUMIDIFICATION

(CFM INFIL. + CFM OA) (GR/LB DIFF.)

1560

WATER EVAPORATED

____ LB/H

EQUIPMENT CHOICE

QUAN.	UNIT SIZE	RPM	CFM	FIN. TEMP. F.	BASIC RATING	BTU CONSTANT	INSTALLED CAPACITY	STEAM COND'S. LB/HR	HOT WATER G P M	CU FT GAS/HR

FORM E10

FIG. 2 — HEATING LOAD ESTIMATE