SCOPE

This standard establishes the criteria for estimating commercial & industrial customer loads based upon Square Foot Demand and Load Schedule Demand.

PURPOSE

This criteria provides a standard method for estimating new commercial customer demands for sizing distribution transformers and secondary/service cables.

DEFINITIONS

Square Foot Demand – the estimated demand in kilowatts/square foot based upon building area and customer type.

Load Schedule Demand – the estimated demand based on the sum of the diversified loads, identified individually.

Future Load – connected load that is not installed by the building/project in–service date.

Estimated Demand Selection – the chosen demand estimate based upon Square Foot Demand or Load Schedule Demand.

Commercial Diversity Factor – the factor that is applied to the sum of the individual (customer) service point demands connected to any three–phase equipment or system.

Minimum Transformer Size – The smallest size transformer that will serve the initial peak load.

Ultimate Transformer Size – The size transformer that is needed to serve the ultimate (future) load of a building/project.

DEMAND ESTIMATING WORKSHEET APPLICATION

The following example demonstrates the proper use of the Demand Estimating Worksheet shown on page 5311.6.

EXAMPLE

The following equipment data has been provided from the Energy Load Information Agreement Form:

Given: A 22,400 square foot bank having a 120/208V service with a 1,000A service panel.

The transformer pad is 100 feet from the service panel. Total Air Conditioning load is 110.6 kW; the sum of two units.

STEP 1

Indicate the following on Demand Estimating Worksheet:
- Work Order Number
- DPSS Number
- Job Location
- Job Name

STEP 2

Building/Service Information:
- Transfer building/service information from the Energy Load Information Agreement Form to the Demand Estimating Worksheet:

- Building/service point number	1
- Building area	22,400 sq.ft.
- Serving voltage	120/208 Volts
- Service panel size	1,000 Amps
- Transformer to service panel distance	100 Ft.
- Largest motor size	25 HP (A/C Compressor)

Note:
It is necessary to identify the service point for each building by a number designation because larger buildings may be granted multiple service points.

STEP 3

Square Foot Demand Calculation: (Method one)
- Check box on Demand Estimating Worksheet by appropriate customer class to be calculated. (Refer to Table 1 on Page 5311.4).
- Multiply building area from Building/Service Information by the customer class (kW/sq.ft.) factor.
  - Customer Class — Bank
  - Building Unit Demand — 22,400 x 0.006 kW/sq.ft. = 134.4 kW

STEP 4

Load Schedule Demand Calculation: (Method two)

The following load schedule: (Work in kW using conversion factors from page 5311.7).

Lighting	28 kW
Air Conditioning	110.6 kW (Total of two units)
Receptacles	28 kW
Spare	17 kW

- Load Schedule Demand (kW = Sum of Load x D.Factor) for each type of load

Lighting	28 kW x 0.9 = 25.2 kW
Air Conditioning	55.3 kW x 1.0 = 55.3 kW (1st unit)
	55.3 kW x 0.8 = 44.2 kW (2nd unit)
Receptacle	28 kW x 0.1 = 2.8 kW
	Total Demand = 127.5 kW

STEP 5

– Estimated Demand Selection:
If the Square Foot Demand (SFD) divided by the Load Schedule Demand (LSD) is between .8 and 1.2, inclusive, choose the Square Foot Demand as the Estimated Demand Selection. If SFD/LSD is outside the .8 to 1.2 range, choose the lesser of the two as the Estimated Demand. However, if the LSD exceeds the change–out value of the selected transformer, the LSD should be checked for accuracy of information. Once a more accurate value is determined, the choice of transformer size should be made. If the load is for a chain store, an effort should be made to find out if there is an existing store in our service territory that is the same square footage and load profile. The Commercial Customer Demand Listing (Superdata Book) can be used to make a comparison between the SFD and LSD.

Peak KVA of similar accounts in Superdata Book (Customer #1 & Customer #2)

Customer #1 = 129 kW
Customer #2 = 133 kW

Estimated Peak demand = Average Demand = $\frac{129 + 133}{2}$ = 131 kW

STEP 6

Equipment Selection:
– Permanent Facilities
– Conduit, substructures and transformer pads to be sized in accordance with UG Construction Standard 3942.

Transformer:

– For Transformer Loading refer to Design Standard 5621.
– Select transformer size based on the estimated demand selection value obtained in Step 4.

For this example:

Estimate result in 150 kVA per 5621.1

Secondary & Service:

– Use PMWORKS to determine size.

BREAK EVEN ANALYSIS

When there is a clear understanding of the end use of the customer's building, use the results obtained with the Demand Estimating Worksheet. If, however, it is not clear what the building's initial use is or the load is not well defined, then a "Break Even Analysis" can be used. This will compare installing less capacity initially vs. full capacity.

A Break Even Year Matrix is shown on page 5311.8. Inputs to the matrix are the initial and ultimate transformer sizes. The output of the matrix is the number of years the installation of the ultimate transformer must be delayed to justify installing the smaller unit initially. At the end of the break even year, the total present value cost of installing and replacing the the smaller transformer will equal the total cost of initially installing the ultimate transformer.

Good judgment must be used forecasting the ultimate building use and demand. Consider similar buildings in the area with comparable floor space and similar customers in the service territory.

REFERENCES:

1. Design Standard 5621, Initial Transformer Design Loading for Balanced Loads
2. Design Standard 5411, Voltage Drop and Flicker Nomographs Application Guide
3. Design Standard 5431, Underground Cable Voltage Drop and Flicker Nomograph
4. Design Standard 5432, Overhead Conductor Voltage Drop and Flicker Nomograph.
5. Service Planning Practices 392, Load Studies, Gas and Electric
6. Service Planning Practice 930, Energy Load Information Agreement

TABLE 1 – CUSTOMER CLASS SELECTION

BUSINESS TYPE	
OFFICES	Lending institutions, insurance brokers, real estate legal services, etc. (4 stories or less)
DEPARTMENT STORES	Sears, Mervyns, Woolworths or large shops
RETAIL STORES	Variety stores, general merchandise, or small shops
BANKS	Local, state and federal banking
MEDICAL OFFICES	Dentists, physicians and laboratories
MEDICAL HOSPITALS	Hospital complexes, 3 stories or less
RESTAURANTS (fast fd.)	McDonalds, Burger King, Wendy's
RESTAURANTS (dining)	Denny's, Black Angus, El Toritos
CONVENIENCE STORES	Stop and Go, 7–11, U–Totem, corner delis
GROCERY STORES, CLUB STORES	Major chains, i.e. Vons, Safeway, Lucky, Costco
HOTEL/MOTEL	Hotels or motels, i.e. Hilton, Holiday Inn, Motel 8
LIGHT COMMERCIAL/ INDUSTRIAL	Fabrication, light manufacturing, non–assembly line, product distributing, machine shops, auto repair shops, bakeries
MANUFACTURING	Heavy manufacturing, assembly line
WAREHOUSING	Storage, distribution

Contact Distribution Standards for customers not identified in Table 1.

TABLE 2 – MISC LOADING/CONVERSION

WELDERS:

Convert input amps of welder to kW using the following equation;

$$\text{single-phase input kW} = \frac{\text{serving voltage x input amps x .9(PF)}}{1000}$$

$$\text{three-phase input kW} = \frac{\text{serving voltage x input amps(*) x .85(PF)xI.73}}{1000}$$

(*) input amps per phase
1 or 2 welders apply demand factor of .80 to the sum
3 to 5 welders apply demand factor of .60 to the sum
6 or more welders apply demand factor of .40 to the sum

Note: Use the same criteria for both transformer arc and motor generator welders.

X-RAY MACHINES:

Convert the rated kVA of x-ray equipment to kW by multiplying by a .9 p.f.

1 x-ray machine, apply demand factor of .80
2 x-ray machines, apply a demand factor of .60
3 or more x-ray machines, apply a demand factor of .32

MOTORS:

Convert the rated horsepower (hp) into kW using the following equation assuming 85% efficiency
1hp = .9kW
Convert the rated horse power (hp) into kVA using the following equation assuming .9pf.
– 1hp = 1kVA

TABLE 3 – COMMERCIAL DIVERSITY FACTORS

The following commercial diversity factors apply:

1 customer	1.00
2 customers	.90
3 customers	.80
4 customers	.70

THREE-PHASE KW CONVERSION FACTORS

KW 3Ø = AMPS. X 0.306 for 120/208
0.353 for 120/240
0.707 for 277/480

THREE-PHASE KW CONVERSION CALCULATION

$$\text{KW} = \frac{\text{Amps (Voltage line to line)(0.85pf)(1.732)}}{1000}$$

DEMAND ESTIMATING WORKSHEET

WORK ORDER NO.	DPSS NO.
JOB LOCATION	JOB NAME

This worksheet provides values of kW demand for new customers that may be used for sizing distribution transformers and services.

TRANSFORMER NO:	PANEL SIZE: Amps	SERVICE VOLTAGE: / Volts	PHASE:	WIRE:	SELECTED TRANSFORMER SIZE: kVA

Building or Serv. Pt.	SQUARE FOOT DEMAND					Type of Load	LOAD SCHEDULE DEMAND				
	Bldg.sq.ft.	x	kW/sq.ft.	=	Demand in kW		Total Load	x	D.Factor	=	Demand in kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
	Total				kW		Total				kW

TRANSFORMER NO:	PANEL SIZE: Amps	SERVICE VOLTAGE: / Volts	PHASE:	WIRE:	SELECTED TRANSFORMER SIZE: kVA

Building or Serv. Pt.	SQUARE FOOT DEMAND					Type of Load	LOAD SCHEDULE DEMAND				
	Bldg.sq.ft.	x	kW/sq.ft.	=	Demand in kW		Total Load	x	D.Factor	=	Demand in kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
		x		=	kW			x		=	kW
	Total				kW		Total				kW

LOAD DENSITY

Type of Building:	kW/sq.ft. *Climate Zone 1	kW/sq.ft. *Climate Zone 2
☐ Office small (<40k sq. ft.)	0.006	0.007
☐ Office large (>40k sq. ft.)	0.004	0.005
☐ Retail Store	0.005	0.006
☐ Department Store	0.004	0.005
☐ Bank	0.006	0.007
☐ Medical Office	0.008	0.009
☐ Hospital	0.007	0.008
☐ Restaurant (fast food)	0.022	0.024
☐ Restaurant (dining)	0.014	0.016
☐ Bio–Medical	0.016	0.018
☐ Grocery/Conv. Store (<40k sq. ft.)	0.011	0.012
☐ Grocery/Conv. Store (>40k sq. ft.)	0.009	0.010
☐ Hotel/Motel	0.004	0.005
☐ Light Commercial	0.007	0.008
☐ Manufacturing	0.009	0.010
☐ Warehousing	0.005	0.006
☐ School	0.005	0.006
☐ Church	0.007	0.008

DEMAND FACTORS BY TYPE OF LOAD

Type of Load	D.FACTOR
☐ Lighting	0.9
☐ Air Conditioning	
1st unit	1.0
2nd through 5th unit	0.8
6th and up unit	0.7
☐ Motors	
Continuous Use	0.9
Elevator/Process	0.8
Equipment Machine Shop	0.5
Machine Tools	0.3
☐ Heating (Induction/ Resistance) Largest unit	1.0
Balance	0.5
☐ Computers	0.8
☐ Receptacles	0.1
☐ Commercial Cooking	0.4
☐ Resistance Welders	0.6 to 1.2
☐ Arc Welders	
Largest unit	1.0
Balance	0.5

SQUARE FOOT DEMAND (SFD) / LOAD SCHEDULE DEMAND (LSD) = COMPARISON RATIO (CR)

If 0.8 ≤ CR ≤ 1.2, choose SFD as Estimated Demand.
If CR < 0.8 or CR> 1.2, choose the lesser (SFD or LSD) as the Estimated Demand.

NOTE: CONTACT DISTRIBUTION STANDARDS TO MODIFY DEMAND FACTOR FOR SPECIAL SITUATIONS. FURTHER ANALYSIS SHOULD BE DONE IF THE COMPARISON RATIO IS GREATER THAN 1.2.

Submitted by:_____ Approved by:_____
Project Management Supervisor

* Climate zones are same as contamination zones. See Overhead Standards page 287. Page _____of _____

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CONVERSION FACTORS

277/480 VOLT
THREE PHASE, FOUR WIRE *
(PF = .85, MOTOR EFFICIENCY = 85%)
LOADS ARE ASSUMED BALANCED

To Get ===>	Amps	kW	kVA	Tons A/C	Motor HP
Multiply Amps by	1.00	.71	.83	.55	.83
" kW by	1.42	1.00	1.18	.78	1.18
" kVA by	1.20	.85	1.00	.67	1.00
" Tons A/C by	1.80	1.28	1.50	1.00	1.50
" Motor HP by	1.20	.85	1.00	.67	1.00

120/208 VOLT
THREE PHASE, FOUR WIRE *
(PF = .85, MOTOR EFFICIENCY = 85%)
LOADS ARE ASSUMED BALANCED

To Get ===>	Amps	kW	kVA	Tons A/C	Motor HP
Multiply Amps by	1.00	.31	.36	.24	.36
" kW by	3.27	1.00	1.18	.78	1.18
" kVA by	2.78	.85	1.00	.67	1.00
" Tons A/C by	4.16	1.28	1.50	1.00	1.50
" Motor HP by	2.78	.85	1.00	.67	1.00

120/240 VOLT
SINGLE PHASE, THREE WIRE *
(PF = .90, MOTOR EFFICIENCY = 85%)
LOADS ARE ASSUMED BALANCED

To Get ===>	Amps	kW	kVA	Tons A/C	Motor HP
Multiply Amps by	1.00	.22	.24	.16	.24
" kW by	4.63	1.00	1.11	.74	1.11
" kVA by	4.17	.90	1.00	.67	1.00
" Tons A/C by	6.25	1.35	1.50	1.00	1.50
" Motor HP by	4.17	.90	1.00	.67	1.00

* Factors for 208 volt, 240 volt, or 480 volt three phase, three wire systems can be converted by using the corresponding table for 120/208 volt, 120/240 volt, 277/480 volt three phase, four wire systems.

120/240 VOLT
THREE PHASE, FOUR WIRE *
(PF = .85, MOTOR EFFICIENCY = 85%)
LOADS ARE ASSUMED BALANCED

To Get ===>	Amps	kW	kVA	Tons A/C	Motor HP
Multiply Amps by	1.00	.35	.42	.28	.42
" kW by	2.83	1.00	1.18	.78	1.18
" kVA by	2.41	.85	1.00	.67	1.00
" Tons A/C by	3.61	1.28	1.50	1.00	1.50
" Motor HP by	2.41	.85	1.00	.67	1.00

* Factors for 208 volt, 240 volt or 480 volt three phase, three wire systems can be converted by using the corresponding table for 120/208 volt, 120/240 volt or 277/480 volt three phase, four wire systems.

NOTE: CONTACT DISTRIBUTION STANDARDS FOR CONVERSION FACTORS NOT IDENTIFIED.

BREAK EVEN YEAR MATRIX
INITIAL VS. ULTIMATE TRANSFORMER REQUIREMENT

277/480 Secondary Voltage (Minimum Change–Out Delay Required to Justify Initial Installation Of Smaller Unit (In Years)

Ultimate Transformer (KVA) \ Initial Transformer Size (KVA)	300	500	750	1000	1500
2000	2	1	4	2	4
1500	2	2	6	5	
1000	3	3	>10		
750	3	6			
500	9				

120/208 Secondary Voltage (Minimum Change–Out Delay Required To Justify Initial Installation Of Smaller Unit (In Years)

Ultimate Transformer (KVA) \ Initial Transformer Size (KVA)	225	300	500	750	1000
1500	2	3	2	2	4
1000	3	4	2	4	
750	5	7	6		
500	7	>10			
300	7				

NOTES:

1. Install the smaller size transformer unless the ultimate size transformers will be required prior to the breakeven year shown in the table above. For example, in the case of installing a 120/208 volt, 500 KVA unit initially where a 750 KVA unit initially where a 750 KVA unit will be rquired ultimately, the 500 KVA should be used if it will meet customer load requirements for at least 6 years.
2. Table values assume service cable will be sized to match transformer.

TONS OF AIR CONDITIONING AND BTU's OF COOLING

Tons of air conditioning refers to the amount of heat an air conditioner can remove in a one hour period. One full ton of air conditioning is equivalent to the removal of 12,000 BTU/HR of heat and will normally cool an area from 200 to 600 square feet of floor space.

A one ton air conditioner would be rated at 12,000 BTU/HR; a three ton at 36,000 BTU/HR; a five ton at 60,000 BTU/HR.

AIR CONDITIONING – HORSEPOWER

When used in reference to an air conditioner, HORSEPOWER (hp) generally refers to the rating of the compressor of the equipment only. The relationship of compressor HORSEPOWER to TONS OF COOLING varies.

The HORSEPOWER to TONS ratio is generally 1.5 hp to 1 ton. This does not include the hp rating of auxiliary fans, pumps, motors, etc.

The HORSEPOWER to kVA ratio is generally 1 hp to 1 kVA. This assumes an 85% efficiency and 90% power factor.

KW RATING OF AIR CONDITIONERS

The ratio of KW to TONS OF COOLING will be found to be about 1.35 to 1.

Discretion should be exercised when using the average relationships and ratios above to positively rate individual equipment without seeing it. Within the two general types described above, there is much individual variation from one make and model to another. The most reliable means of rating individual equipment is to take its total nameplate amperage and work out the KW or hp rating using the above relationships as a general guide.

When 240 volt, single–phase service is provided to loads which include air conditioners, the following starting currents should be used as a guide for voltage flicker calculations: (the actual amperage may be found on the equipment nameplate as locked rotor amps or L–R)

TABLE 3

STARTING CURRENT FOR 240V 1Ø AIR CONDITIONERS	
Air Conditioner Size	Starting Current *
Up to 30,000 BTU/hr. (2–1/2 ton)	85A
31,000 – 42,000 BTU/hr. (2–1/2 to 3–1/2 ton)	85 – 120A or 110A Average
43,000 – 60,000 BTU/hr. (3–1/2 to 5 ton)	120 – 170A or 150A Average

* assumes 5.5 times motor running current

SCOPE

This design standard provides criteria for the proper selection of residential kW demand and multiple dwelling diversified demand based on dwelling type, dwelling size and major appliance usage.

PURPOSE

The Residential Demand Estimating Criteria was established to provide a uniform demand estimate for various residential dwelling types.

DEFINITIONS

Base load – refers to those dwellings whose electrical load consists of lights, refrigerator, electric range, dishwasher and receptacle load such as television, stereo, microwave, etc.

Major appliances – refers to central or through–the–wall air conditioning, electric heating, and electric water heating.

Dwelling type – refers to the classification of a residential dwelling as either single–family detached (no common walls with another dwelling, i.e., subdivision), single–family attached (one common wall or condominium/townhouse), multi–family (two or more common walls such as apartments) and mobilehome (regardless of length and width).

Residential Diversity Factor – refers to a multiplier applied to the sum of the individual service point (customer) demands connected to any single–phase or three–phase electric distribution system.

CRITERIA

A. Residential Demand Selection

The residential kW demand per unit selection is dependent on the dwelling type, dwelling square footage and major appliance usage or connected appliances.

1. Table 1 provides the kW demand per unit selection for dwellings in a project that are less than 3000 square feet. Select a square footage category based on the majority of dwellings. If s square footage is not obtainable, select a square footage category that is typical for that dwelling type, i.e., single–family detached (1300–1999), single–family attached and multi–family (0–1299).

2. Table 2 provides the kW demand selection for a dwelling that is 3000 square feet or greater, i.e., custom dwelling. To determine the kW demand from Table 2, add the connected appliance loads for each demand category and multiply this sum by the appropriate demand factor. The sum of these factors will provide the kW demand requirement.

3. When both air conditioning and electric heating are installed in a dwelling, the higher of the two demand estimates shall be used.

4. Section B provides diversity factor(s) for serving three or more dwellings.

B. Residential Diversity Selection

The residential diversity factors are applied based on the number of customers being served, diversity factor category and dwelling type. The following guidelines shall apply when determining the diversified demand from Table 3:

1. Determine diversified demand based on the sum of the individual service point (customer) demands multiplied by the appropriate diversity factor.

2. When applying an air conditioning diversity factor, pay particular attention to the two subcategories (single–family detached and single–family attached or multi–family).

TABLE 1 Residential Dwelling kW Demand Per Unit (Less Than 3000 sq. ft.)

Dwelling Type	Square Footage	KW DEMAND CATEGORIES ⓐ					
		Base Load	Air Cond.	Elec. Water Heating	Elec. Heating	Elec. Heating & Water Heating	A/C & Elec. Water Heating
single–family detached	0–1299 1300–1999 2000–2999	3.0 4.0 4.5	5.0 6.0 7.0	5.0 6.0 7.0	4.0 5.0 6.0	6.5 7.5 8.0	6.0 7.0 8.0
single–family attached (condo/ townhouse)	0–1299 1300–1999 2000–2999	3.0 4.0 4.5	4.0 5.0 5.5	5.0 6.0 6.5	4.0 5.0 5.5	6.5 7.5 8.0	5.0 6.0 6.5
multi–family (apartments)	0–1299 1300–1999	1.5 2.0	3.5 4.0	3.5 4.0	4.0 4.5	6.5 7.0	4.5 5.0
mobile–homes	0–1299 1300–1999	2.5 3.0	5.0 6.0	ⓑ	5.0 6.0	ⓑ	ⓑ

TABLE 2 Custom Residential Dwelling kW Demand (3000 sq. ft. or greater)

Demand Categories	Demand Factor	Connected Appliances	Connected kW Demand per Unit Estimate ⓒ
LIGHTS	.50	internal lighting	4–6
HVAC (heat pump)	.50	3 to 7–1/2 ton single or multiple units	1.35kW/ton
MAJOR APPLIANCES	.50	range water heater water heater (quick recovery) clothes dryer dishwasher heat strip	8–12 ea. 4.5 ea. 9 ea. 5.5 ea. 1.2 ea. 5–15 ea.
EXTERIOR LOADS	.50	tennis court lighting swimming pool equipment exterior lighting	varies varies varies
OTHER LOADS	.40	convenience outlets wine cellar sauna small motor load	varies

TABLE 3 Residential Diversity Factors

Number Of Customers	Diversity factor categories		
	Base load electric heating electric water heating	Air conditioning	
		SF detached	MF, SF attached
1–2	1.00	1.00	1.00
3–4	.75	0.85	0.70
5–7	.65	0.80	0.65
8–14	.55	0.75	0.65
15 and above	.50	0.70	0.60

SF = single–family MF = multi–family

Notes:

ⓐ The kW demand provided in Table 1 represents the total demand requirement in each category.

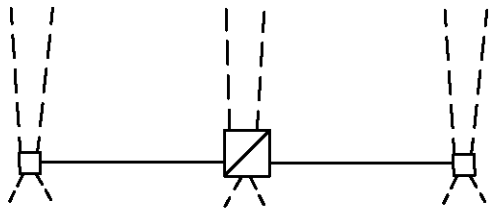
i.e., base load category = strictly base load
air conditioning category = base load plus air conditioning load

ⓑ If kW demand is required for these categories, consult Design Planning.

ⓒ Use the kW demand per unit estimate in Table 2 as a check for submitted connected loads. These estimates can also be used if connected loads are not known.

Example 1:

Determine the diversified demand estimates for a 12 lot subdivision with single–family detached dwellings ranging from 1800–2400 square feet with 4 ton air conditioning. Assume the following distribution configuration:



Use Table 1 and 3 to determine diversified demand for this transformer and secondary/service system.

- dwelling type = single–family detached
- square footage range = 2000–2999 (1)
- demand per unit from Table 1 = 7kW
- total demand (transformer) = 12x 7kW = 84kW
- total demand (either secondary) = 4 x 7kW = 28kW
- diversified demand from Table 3 (transformer) = .75 x 84kW = 63kW
- diversified demand from Table 3 (secondary) = .80 x 28kW = 22kW

The diversified demand of 63kW and 22kW would be used to size the transformer and secondaries respectively.

Example 2:

Determine the kW demand estimate for a custom home that is 4500 square feet with the following appliances being served:

Connected Appliance Load Breakdown (2)

air conditioning (2 units)	–	1–3 ton, 1–5 ton
electric range	–	demand not known (use estimate at 8kW)
water heating	–	4.5kW
clothes dryer	–	5.5kW
heat strips	–	2 at 5kW each
tennis courts	–	4kW
swimming pool	–	1–7 1/2 hp, 1–1 1/2 hp
sauna	–	8kW
internal lighting	–	5kW

The diversified kW demand for a custom home is obtained from Table 2 as follows:

- add the connected appliance loads in each demand category (2)
- multiply by the appropriate demand factor
- the sum of these will produce total diversified kW demand

Demand Category (2)		Sum of Connected Load	x	Demand Factor	=	Diversified Demand
Lights	=	5kW	x	.50	=	2.5kW
HVAC	=	11kW	x	.50	=	5.5kW
Major Appliances	=	28kW	x	.50	=	14kW
Exterior Loads	=	12kW	x	.50	=	6kW
Other Loads	=	8kW	x	.40	=	3.2kW
		total diversified kW demand				31.2kW

The total diversified kW demand of 31kW would be used to size transformer and secondary/service system.

Notes:

(1) The square footage range of 2000–2999 was selected because 7 of the 12 dwellings occupied this range.

(2) Consult Table 2 for the connected appliance load to demand category relationship.

References:

1. Design Standard 5222, Secondary and Service Guidelines, Secondary Conductors
2. Design Standard 5411, Voltage Drop, Secondary Conductors
3. Design Standard 5413, Voltage Fluctuation (flicker), Secondary Conductors
4. Design Standard 5431, Underground Voltage Drop and Flicker Nomograph
5. Design Standard 5432, Overhead Voltage Drop and Flicker Nomograph
6. Design Standard 5621, Initial Transformer Design Loading For Balanced Loads

SCOPE: THIS STANDARD PROVIDES TABLES TO DETERMINE THE DIVERSIFIED DEMAND IN KW FOR MULTIPLE RESIDENTIAL CUSTOMERS WITH UNIFORM LOADS.

PURPOSE: THESE TABLES WERE ESTABLISHED TO PROVIDE EASY APPLICATION OF THE RESIDENTIAL DEMAND ESTIMATING DIVERSITY FACTORS.

CRITERIA:

TABLE 1 – BASE LOAD, ELECTRIC WATER HEATING, ELECTRIC HEATING – ALL DWELLING TYPES

DIVERSIFIED KW DEMAND (1)

KW DEMAND/UNIT		1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8
NO. OF CUSTOMERS	DIVERSITY FACTOR (REFERENCE)														
3	0.75	3.4	4.5	5.6	6.8	7.9	9	10.1	11.3	12.4	13.5	14.6	15.8	16.9	18
4	0.75	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24
5	0.65	4.9	6.5	8.1	9.8	11.4	13	14.6	16.3	17.9	19.5	21.1	22.8	24.4	26
6	0.65	5.9	7.8	9.8	11.7	13.7	15.6	17.6	19.5	21.5	23.4	25.4	27.3	29.3	31.2
7	0.65	6.8	9.1	11.4	13.7	15.9	18.2	20.5	22.8	25	27.3	29.6	31.9	34.1	36.4
8	0.55	6.6	8.8	11	13.2	15.4	17.6	19.8	22	24.2	26.4	28.6	30.8	33	35.2
9	0.55	7.4	9.9	12.4	14.9	17.3	19.8	22.3	24.8	27.2	29.7	32.2	34.7	37.1	39.6
10	0.55	8.3	11	13.8	16.5	19.3	22	24.8	27.5	30.3	33	35.8	38.5	41.3	44
11	0.55	9.1	12.1	15.1	18.2	21.2	24.2	27.2	30.3	33.3	36.3	39.3	42.4	45.4	48.4
12	0.55	9.9	13.2	16.5	19.8	23.1	26.4	29.7	33	36.3	39.6	42.9	46.2	49.5	52.8
13	0.55	10.7	14.3	17.9	21.5	25	28.6	32.2	35.8	39.3	42.9	46.5	50.1	53.6	57.2
14	0.55	11.6	15.4	19.3	23.1	27	30.8	34.7	38.5	42.4	46.2	50.1	53.9	57.8	61.6
15	0.5	11.3	15	18.8	22.5	26.3	30	33.8	37.5	41.3	45	48.8	52.5	56.3	60
16	0.5	12	16	20	24	28	32	36	40	44	48	52	56	60	64
17	0.5	12.8	17	21.3	25.5	29.8	34	30.3	42.5	46.8	51	55.3	59.5	63.8	68
18	0.5	13.5	18	22.5	27	31.5	36	40.5	45	49.5	54	58.5	63	67.5	72
19	0.5	14.3	19	23.8	28.5	33.3	38	42.8	47.5	52.3	57	61.8	66.5	71.3	76
20	0.5	15	20	25	30	35	40	45	50	55	60	65	70	75	80
21	0.5	15.8	21	26.3	31.5	36.8	42	47.3	52.5	57.8	63	68.3	73.5	78.8	84
22	0.5	16.5	22	27.5	33	38.5	44	49.5	55	60.5	66	71.5	77	82.5	88
23	0.5	17.3	23	28.8	34.5	40.3	46	51.8	57.5	63.3	69	74.8	80.5	86.3	92
24	0.5	18	24	30	36	42	48	54	60	66	72	78	84	90	96
25	0.5	18.8	25	31.3	37.5	43.8	50	56.3	62.5	68.8	75	81.3	87.5	93.8	100
26	0.5	19.5	26	32.5	39	45.5	52	58.5	65	71.5	78	84.5	91	97.5	104
27	0.5	20.3	27	33.8	40.5	47.3	54	60.8	67.5	74.3	81	87.8	94.5	101.3	108
28	0.5	21	28	35	42	49	56	63	70	77	84	91	98	105	112
29	0.5	21.8	29	36.3	43.5	50.8	58	65.3	72.5	79.8	87	94.3	101.5	108.8	116
30	0.5	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90	97.5	105	112.5	120

TABLE 2 – AIR CONDITIONING – SINGLE FAMILY DETACHED

DIVERSIFIED KW DEMAND ①

KW DEMAND/UNIT		2.5	3	4	4.5	5	6	7	8
NO. OF CUSTOMERS	DIVERSITY FACTOR (REFERENCE)								
3	0.85	6.4	7.6	10.2	11.5	12.8	15.3	17.9	20.4
4	0.85	8.5	10.2	13.6	15.3	17	20.4	23.8	27.2
5	0.80	10	12	16	18	20	24	28	32
6	0.80	12	15.8	19.2	21.6	24	28.8	33.6	38.4
7	0.80	14	16	22.4	25.2	28	33.6	39.2	44.8
8	0.75	15	18	24	27	30	36	42	48
9	0.75	16.9	20.3	27	30.4	33.8	40.5	47.3	54
10	0.75	18.8	22.5	30	33.8	37.5	45	52.5	60
11	0.75	20.6	24.8	33	37.1	41.3	49.5	57.8	66
12	0.75	22.5	27	36	40.5	45	54	63	72
13	0.75	24.4	29.3	39	43.9	48.8	58.5	68.3	78
14	0.75	26.3	31.5	42	47.3	52.5	63	73.5	84
15	0.70	26.3	31.5	42	47.3	52.5	63	73.5	84
16	0.70	28	33.6	44.8	50.4	56	67.2	78.4	89.6
17	0.70	29.8	35.7	47.6	53.6	59.5	71.4	83.3	95.2
18	0.70	31.5	37.8	50.4	56.7	63	75.6	88.2	100.8
19	0.70	33.3	39.9	53.2	59.9	66.5	79.8	93.1	106.4
20	0.70	35	42	56	63	70	84	98	112
21	0.70	36.8	44.1	58.8	66.2	73.5	88.2	102.9	117.6
22	0.70	38.5	46.2	61.6	69.3	77	92.4	107.8	123.2
23	0.70	40.3	48.3	64.4	72.5	80.5	96.6	112.7	128.8
24	0.70	42	50.4	67.2	75.6	84	100.8	117.6	134.4
25	0.70	43.8	52.5	70	78.8	87.5	105	122.5	140
26	0.70	45.5	54.6	72.8	81.9	91	109.2	127.4	145.6
27	0.70	47.3	56.7	75.6	85.1	94.5	113.4	132.3	151.2
28	0.70	49	58.8	78.4	88.2	98	117.6	137.2	156.8
29	0.70	50.8	60.9	81.2	91.4	101.5	121.8	142.1	162.4
30	0.70	52.5	63	84	94.5	105	126	147	168

TABLE 3 – AIR CONDITIONING – MULTI–FAMILY AND SINGLE FAMILY ATTACHED

DIVERSIFIED KW DEMAND (1)

KW DEMAND/UNIT		1.5	2	3	3.5	4	4.5	5	5.5	6	6.5
NO. OF CUSTOMERS	DIVERSITY FACTOR (REFERENCE)										
3	0.70	3.2	4.2	6.3	7.4	8.4	9.5	10.5	11.6	12.6	13.7
4	0.70	4.2	5.6	8.4	9.8	11.2	12.6	14	15.4	16.8	18.2
5	0.65	4.9	6.5	9.8	11.4	13	14.6	16.3	17.9	19.5	21.1
6	0.65	5.9	7.8	11.7	13.7	15.6	17.6	19.5	21.5	23.4	25.4
7	0.65	6.8	9.1	13.7	15.9	18.2	20.5	22.8	25	27.3	29.6
8	0.65	7.8	10.4	15.6	18.2	20.8	23.4	26	28.6	31.2	33.8
9	0.65	8.8	11.7	17.6	20.5	23.4	26.3	29.3	32.2	35.1	38
10	0.65	9.8	13	19.5	22.8	26	29.3	32.5	35.8	39	42.3
11	0.65	10.7	14.3	21.5	25	28.6	32.2	35.8	39.3	42.9	46.5
12	0.65	11.7	15.6	23.4	27.3	31.2	35.1	39	42.9	46.8	50.7
13	0.65	12.7	16.9	25.4	29.6	33.8	38	42.3	46.5	50.7	54.9
14	0.65	13.7	18.2	27.3	31.9	36.4	41	45.5	50.1	54.6	59.2
15	0.60	13.5	18	27	31.5	36	40.5	45	49.5	54	58.5
16	0.60	14.4	19.2	28.8	33.6	38.4	43.2	48	52.8	57.6	62.4
17	0.60	15.3	20.4	30.6	35.7	40.8	45.9	51	56.1	61.2	66.3
18	0.60	16.2	21.6	32.4	37.8	43.2	48.6	54	59.4	64.8	70.2
19	0.60	17.1	22.8	34.2	39.9	45.6	51.3	57	62.7	68.4	74.1
20	0.60	18	24	36	42	48	54	60	66	72	78
21	0.60	18.9	25.2	37.8	44.1	50.4	56.7	63	69.3	75.6	81.9
22	0.60	19.8	26.4	39.6	46.2	52.8	59.4	66	72.6	79.2	85.8
23	0.60	20.7	27.6	41.4	48.3	55.2	62.1	69	75.9	82.8	89.7
24	0.60	21.6	28.8	43.2	50.4	57.6	64.8	72	79.2	86.4	93.6
25	0.60	22.5	30	45	52.5	60	67.5	75	82.5	90	97.5
26	0.60	23.4	31.2	46.8	54.6	62.4	70.2	78	85.8	93.6	101.4
27	0.60	24.3	32.4	48.6	56.7	64.8	72.9	81	89.1	97.2	105.3
28	0.60	25.2	33.6	50.4	58.8	67.2	75.6	84	92.4	100.8	109.2
29	0.60	26.1	34.8	52.2	60.9	69.6	78.3	87	95.7	104.4	113.1
30	0.60	27	36	54	63	72	81	90	99	108	117

NOTES: (1) THE DIVERSITY FACTOR COLUMN IS PROVIDED FOR REFERENCE ONLY.