TSEWG TP-13: UFC 3-501-03N LOAD DEMAND ANALYSES

Recent development of UFC 3-500-10, Design: Electrical Engineering, and UFC 3-520-01, Design: Interior Electrical Systems, will result in the cancellation of UFC 3-501-03N, Electrical Engineering Preliminary Considerations. UFC 3-501-03N contains in its entirety MIL-HDBK 1004/1, Electrical Engineering Preliminary Design Considerations. This Technical Paper has been developed to retain the load demand analysis information originally contained in MIL-HDBK 1004/1.

MIL-HDBK-1004/1
30 MAY 1988
SUPERSEDING
DM-4.1
MARCH 1983

MILITARY HANDBOOK

ELECTRICAL ENGINEERING

PRELIMINARY DESIGN CONSIDERATIONS

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Section 1: PRELIMINARY DATA

1.1 Scope. This handbook provides the criteria necessary for the proper selection of electric power sources and distribution systems. It covers preliminary load estimating factors, electrical power sources, and distribution systems.

1.2 Cancellation. This handbook cancels and supersedes DM-4.1, Electrical Engineering Preliminary Design Considerations, of December 1979, and change dated 1 March 1983.

1.3 Load Data. Before specific electric power sources and distribution systems can be considered, realistic preliminary load data must be compiled. The expected electric power demand on intermediate substations, and on the main electric power supply, shall be calculated from the connected load layout by applying appropriate factors. Determine these factors by load analysis and by combining loads progressively. To combine the loads, start at the ends of the smallest feeders and work back to the electric power source. Because all loads must be on a common kilowatt (kW) or kilovolt-ampere (kVA) basis, it is necessary to convert motor horsepower ratings to input kilowatts or kilovolt-amperes before combining them with other loads already expressed in those terms. Preliminary electric power load estimates can be made by using the approximate value of one kilovolt-ampere of input per horsepower (hp) at full load. Preliminary estimates of lighting loads may be made by assuming watts per ft^2 (m^2) of building area.

1.4 Load Analysis. To determine appropriate load estimating factors, using the tables and factors in this manual as guides analyze the characteristics of each load. Consider items such as environmental conditions of weather, geographical location, and working hours, as the situation dictates. Notice that when the load densities in w/ft^2 (m^2) are used only in preliminary estimates, the demand and load factors will be used in the final designs.

1.5 Terminology. Five terms are essential to the analysis of load characteristics: demand factor, coincidence factor, diversity factor, and maximum demand. These terms are defined in paras. 1.5.1 through 1.5.4.

1.5.1 Demand Factor. The demand factor is the ratio of the maximum demand on a system to the total connected load of the system or

$$\text{Demand factor} = \frac{\text{Maximum demand load}}{\text{Total load connected}} \quad (1)$$

1.5.2 Coincidence Factor. The coincidence factor is the ratio of the maximum demand of a system, or part under consideration, to the sum of the individual maximum demands of the subdivisions or

$$\text{Coincidence factor} = \frac{\text{Maximum system demand}}{\text{Sum of individual maximum demands}} \quad (2)$$

1.5.3 Diversity Factor. The diversity factor is the reciprocal of the coincidence factor or

$$\text{Diversity factor} = \frac{\text{Sum of individual maximum demands}}{\text{Maximum system demand}} \quad (3)$$

1.5.4 Load Factor. The load factor is the ratio of the average load over a designated period of time, usually 1 year, to the maximum load occurring in that period or

$$\text{Load factor} = \frac{\text{Average load}}{\text{Maximum load}} \quad (4)$$

1.5.5 Maximum Demand. The maximum demand is the integrated demand for a specified time interval, i.e., 5 minutes, 15 minutes, 30 minutes, or other appropriate time intervals, rather than the instantaneous or peak demand.

Section 2: ESTIMATION OF LOADS

2.1 Preparation of Load Data. Load data are generally computed in steps such as:

a) individual loads,

b) area loads, and

c) activity loads.

A particular design problem may be limited to step a), to steps a) and b), or may encompass steps a), b), and c). This section outlines each step as a separate entity, dependent only on previous steps for data. Paragraphs 2.2 through 2.4.4 describe the three loads.

2.2 Individual Loads. Individual loads are those with one incoming service supplying utilization voltage to the premises. In general, these loads would comprise single structures. Large structures could contain more than one function; for example, aircraft operations, aircraft fire and rescue stations, and photographic buildings. Under this condition, factors that have been developed and keyed to Navy category codes (refer to Table 1) would be used. In this case, the factors listed under Navy Category Code 141-40, 141-20, and 141-60, respectively, would be combined to obtain the total load.

2.2.1 Lighting. To eliminate lighting loads, divide a facility area into its significant components by function (for example, office, storage, mechanical, and corridor). Determine the average lighting level and type of light source for each area. Consider requirements for supplementary lighting (for example, floodlighting, security lighting, and special task lighting). Preliminary load estimates may be made based on the following load allowances:

a) 1 W/ft^2 (10.76W/m^2) for each 6 to 8 fc (60 to 80 dekalux) of incandescent illumination.

b) 1 W/ft^2 for each 15 to 20 fc (150 to 200 dekalux) of fluorescent illumination.

c) 1 W/ft^2 for each 12 to 18 fc (120 to 180 dekalux) of mercury vapor illumination.

d) 1 W/ft^2 for each 26 to 36 fc (260 to 360 dekalux) of metal halide illumination.

e) 1 W/ft^2 for each 33 to 54 fc (330 to 540 dekalux) of high pressure sodium illumination.

2.2.1.1 Small Appliance Loads. Small appliance loads shall include those served by general purpose receptacles. In general, the dividing of areas by function for estimating lighting loads will serve for estimating small appliance loads. The determination of loads requires not only a knowledge of the function of an area, but to what extent its occupants use small appliances. For example, an office area demand may average about 1 W/ft^2

Table 1
Factors for Individual Facilities by Navy Category Code (See Note 1)

NAVY CODE	DESCRIPTION	DEMAND FACTOR (%)	LOAD FACTOR (%)
100	Operational and Training Facilities:		
121	Aircraft fueling/dispensing facility	40-60	16-20
122	Marine fuel dispensing	40-60	16-20
123 10	Filling station	40-60	13-17
125 16	Miscellaneous POL pipeline facilities	100	13-17
126	Liquid fueling and dispensing-other	40-60	3- 7
131	Communications - buildings	60-65	70-75
131 40	Telephone exchange building	55-70	20-25
133 75	Air surveillance radar building	55-70	70-75
137 40	Port control office	55-70	20-25
141 11	Air passenger terminal building	65-80	28-32
141 20	Aircraft fire and rescue station	25-35	13-17
141 30	Aircraft line operations building	65-80	24-28
141 40	Aircraft operations building *EXC 141-70*	65-80	28-32
141 60	Photographic building	65-80	16-20
171 10	Academic instruction building	40-60	22-26
171 20	Applied instruction building	35-65	24-28
171 40	Drill Hall	75-85	3- 7
200	Maintenance and Production Facilities:		
211 05	Maintenance Hangar O/H space (high bay)	45-50	28-30
211 06	Maintenance Hangar - 01 space (crew equipment)	45-50	28-30
211 07	Maintenance Hangar - 02 space (administrative)	45-50	28-30
211 10	Aircraft overhaul and repair shop (NARF)	32-38	25-30
211 12	Paint/finishing hangar	65-75	25-27
211 20	Engine overhaul shop (NARF)	32-38	20-25
211 30	Aircraft/engine accessories overhaul shop (NAR)	32-38	25-30
211 75	Parachute/survival equipment	60-65	23-28
211 81	Engine test cell (Non-NARF)	42-48	25-30
211 96	Maintenance, aircraft spares storage (MISC)	58-63	23-28
212 20	Missile equipment maintenance ship	35-40	15-20
213 10	Drydock	5-10	0.5-1
214-10	Combat vehicle maintenance shop	55-65	20-25
214-20	Automobile vehicle maintenance - noncombat	55-65	20-25
215	Maintenance - weapons / spares	70-80	20-25
216 10	Ammunition rework and overhaul shop	35-40	18-22
216 20	Rocket rework and overhaul shop	35-40	18-22
216 30	Mines and depth charge rework shop	35-40	15-20
216 40	Torpedo shop	45-55	18-22
216 50	Special weapons shop	35-40	18-22
216 60	Quality evaluation laboratory	55-65	22-27

Note 1: Demand factors include allowance for system loss.

Table 1 (Continued)
Factors for Individual Facilities by Navy Category Code[1]

NAVY CODE	DESCRIPTION	DEMAND FACTOR (%)	LOAD FACTOR (%)
217 10	Electronics/communications maintenance shop	35-40	20-25
218 20	Construction/weight handling equipment shop	35-45	20-25
218 40	Railroad equipment shop	35-45	15-20
218 50	Battery shop	55-65	20-25
219 10	Public works shop	32-38	18-22
221 10	Aircraft engine assembly plant	32-38	20-25
222 10	Missile assembly buildings	35-40	15-20
222 20	Missile handling launch equipment	35-40	15-20
223 10	Fabrication/assembly building	22-27	24-29
225 10	Small arms plant	15-20	22-27
225 20	Light gun (20mm/51n) plant	15-20	22-27
225 30	Heavy gun (6/161n) plant	16-21	21-26
225 50	Launcher/projector plant	15-20	22-27
226 10	Bag charge filling plant	62-67	23-28
226 15	Case filling plant	35-40	23-28
226 20	Case overhaul tank repair facility	35-40	18-22
226 35	Major-caliber projectile loading plant	35-40	18-22
226 40	Medium-caliber projectile loading plant	35-40	18-22
226 55	Cast high explosives filling plant	35-40	18-22
226 65	Propellant and related chemical facility	30-40	32-38
227 10	Radio and radar equipment plant	50-55	23-28
227 10	Sonar equipment plant	50-55	23-28
228 10	Parachute/survival equipment plant	35-40	20-25
229 10	Asphalt plant	75-80	7-12
229 20	Concrete batching plant	75-80	15-20
229 30	Rock crusher plant	75-80	15-20
229 40	Sawmill	45-55	15-20
300	Research, Development, Test & Evaluation Facilities:		
310 13	Chemistry and Toxicology Laboratory	70-80	22-28
310 15	Materials Laboratory	30-35	27-32
310 19	Physics Laboratory	70-80	22-28
316 10	Ammunition, explosives, and toxics laboratory	28-32	20-25
317 20	Electrical and electronics systems laboratory	20-30	3-7
400	Supply Facilities:		
421	Ammunition storage installation	75-80	.....
423	Ammunition storage-liquid propellant	75-80	20-25
431 10	Cold storage warehouse	70-75	20-25
441 10	General warehouse Navy	75-80	23-28
441 20	Controlled humidity warehouse	60-65	33-38
441 30	Hazardous/flammable storehouse	75-80	20-25
441 40	Underground storage	65-70	23-28
441 70	Disposal, salvage, scrap building	35-40	25-20

[1] Demand factors include allowance for system loss.

Table 1 (Continued)
Factors for Individual Facilities by Navy Category Code[1]

NAVY CODE	DESCRIPTION	DEMAND FACTOR (%)	LOAD FACTOR (%)
500	Hospital-Medical Facilities:		
510 10	Hospital	38-42	45-50
530 20	Laboratory	32-37	20-25
540 10	Dental Clinic	35-40	18-23
550 10	Medical Clinic	45-50	20-23
600	Administrative Facilities:		
610 10	Administrative Office	50-65	20-35
620 10	Administrative facility, underground	50-65	35-40
700	Housing and Community Facilities:		
711	Family housing-dwellings	60-70	10-15
712	Substandard: Trailers-family housing	70-75	10-15
714 10	Detached garages	40-50	2-4
721 11	Bachelor enlisted quarters	35-40	38-42
721 12	Bachelor enlisted quarters E5/E6	35-40	38-42
721 13	Bachelor enlisted quarters E7/E9	35-40	38-42
721 30	Civilian barracks GS 01/6	35-40	38-42
721 40	Disciplinary barracks	35-40	38-42
722 10	Detached dining facilities, enlisted men	30-35	45-60
723 20	Latrine, detached	75-80	20-25
723 30	Laundry, detached	30-35	20-25
723 40	Garage, detached	40-50	2-4
724 11	UOPH, W-1/O-2	40-50	20-25
724 12	UOPH, O-3 and above	40-50	20-25
724 22	Civilian quarters, GS-7/PLS	40-50	20-25
724 30	Dining facility (attached) commissioned personnel	35-40	30-40
730 10	Fire station	25-35	13-17
730 15	Confinement facility	60-65	33-38
730 20	Police station	48-53	20-25
730 25	Gate/sentry house	70-75	28-33
730 30	Bakery	30-35	45-60
730 35	Enlisted personnel locker room	75-80	18-23
730 40	Laundry/dry cleaning plant	30-35	20-25
730 45	Dependent school - nursery school	75-80	10-15
730 50	Dependent school - kindergarten	75-80	10-15
730 55	Dependent school - grade school	75-80	10-15
730 60	Dependent school - high school	65-70	12-17
730 65	Fallout shelter	80-85	30-35
730 67	Bus station	80-85	30-35

[1] Demand factors include allowance for system loss.

Table 1 (Continued)
Factors for Individual Facilities by Navy Category Code[1]

NAVY CODE	DESCRIPTION	DEMAND FACTOR (%)	LOAD FACTOR (%)
730 70	Decontamination facility	75-80	15-2
730 83	Chapel	65-70	5-25
730 85	Post Office	75-80	20-25
740 01	Exchange retail store	65-70	25-32
740 18	Bank	75-80	20-25
740 23	Commissary including backup storage	55-60	25-30
740 26	Installation restaurant	45-75	15-25
740 30	Exchange auto repair station	40-60	15-20
740 36	Hobby shop, art/crafts	30-40	25-30
740 40	Bowling Alley	70-75	10-15
740 43	Gymnasium	70-75	20-45
740 46	Skating rink	70-75	10-15
740 50	Field house	75-80	7-12
740 53	Indoor swimming pool	55-60	25-50
740 56	Theater	45-55	8-13
740 60	Commissioned officers' mess, open	55-60	15-20
740 63	Enlisted personnel club	55-60	18-23
740 66	Petty officers' mess, open	55-60	18-23
740 70	Mess open, E-7 through E-9	55-60	15-20
740 76	Library	75-80	30-35
740 80	Golf club house	75-80	15-20
740 86	Exchange installation warehouse	58-63	23-28
740 88	Educational services office	70-75	30-35
760 10	Museum/memorial building	75-80	30-35
800	Utilities and Ground Improvements:		
811 10	Electric power plant-diesel	60-65	58-63
811 25	Electric power plant-steam	60-65	58-63
811 45	Electric power plant-gas turbine	60-65	58-63
811 60	Standby generator plant	75-80	5-10
812 20	Street lighting	95-..	46-..
812 40	Perimeter/security lighting	80-85	22-27
813 20	Substation, more than 499 KV	25-30	20-25
821 12	Fossil fuel heating plant - medium	55-60	30-60
821 22	Fossil fuel heating plant - large	55-60	30-60
821 50	Non-nuclear steam plant	50-55	30-40
826 20	Chilled water plant 25/100 tons	60-70	25-30
827 20	Air conditioning-chilled water transmission/ distribution system - medium (25/100 tons)	60-70	25-30
831 10	Combination sewage and industrial waste treatment plant	60-70	15-20
832 30	Sewage-industrial waste pumping station	55-60	30-35
833 22	Incinerator building and incinerator	55-60	15-20
841 10	Water treatment facilities	60-80	15-25
841 50	Wells-potable water	60-80	15-25

[1] Demand factors include allowance for system loss.

Table 1 (Continued)
Factors for individual Facilities By Navy Category Code[1]

NAVY CODE	DESCRIPTION	DEMAND FACTOR (%)	LOAD FACTOR (%)
843 20	Fire protection pumping station	Do not include -operate for test off peak.	
890 20	Compressed air plant	.45-50	25-30
890 42	Air-conditioning plant, ...	.60-70	25-30
	Miscellaneous Operational and Training Facilities:		
125 10	POL pipeline		
132 10	Antenna - communications	.95-..	46-..
	Miscellaneous Facilities for Ship Repair and Shipbuilding		
	Ship repair shops:		
213 41	Central tool shop - (06) (E).	.32-37	23-28
213 42	Shipfitting shop - (11) (A)	.22-27	24-29
213 43	Sheet metal shop - (17) (B)	.10-15	15-20
213 44	Forge and heat treatment space (23) (F)	.25-30	13-18
213 49	Inside machine shop - (31) (G).	.16-21	21-26
213 53	Boiler making shop - (41) (D)	.12-17	14-19
213 54	Electrical shop - (51) (M).	.33-38	20-25
213 55	Pipefitting shop - (56) (J)	.22-27	17-22
213 56	Woodworking shop - (64) (R)	.25-30	21-26
213 59	Abrasive blast facility	.30-35	10-15
213 60	Paint and blasting shop - (71) (S).	.50-55	23-28
213 61	Riggers shop - (72) (T)	.50-55	20-25
213 62	Sail loft	.35-40	20-25
213 63	Foundry - (81) (K)	.35-40	22-27
213 64	Patternmaking shop - (94) (X)	.28-33	12-17
213 67	Pumphouse, drydocks	75-80	0.1-0.2
	Miscellaneous Facilities for Naval Ordnance Manufacture:		
226	Ammunition components building	.15-20	20-25
226	Manufacturing	.30-45	17-32
226	Explosive loading	.65-70	25-30
226	Miscellaneous explosives storage and handling . . .	.65-70	5-10
226	Assembly building	.40-50	20-25
226	Detonator building	.65-70	20-25
226	Pelleting	.40-50	20-25
226	Plastic beading	.55-60	18-23
226	Sewing room	.35-40	25-30
226	Projective assembly breakdown	.55-60	18-23
226	Machine shop	.16-21	21-26
226	Phosphorous plant	.35-40	25-30
226	TNT detonator (military)	.35-40	15-20
226	Ammunition tank box assembly	.35-40	15-20
226	Box emptying	.35-40	15-20

[1] Demand factors include allowance for system loss.

Table 1 (Continued)
Factors for Individual Facilities by Navy Category Code[1]

NAVY CODE	Description	DEMAND FACTOR (%)	LOAD FACTOR (%)
226	Plating maintenance	35-40	18-23
226	Mixing	40-45	18-23
226	Segregation fleet return	35-40	15-20
226	Plaster load	35-40	15-20
	Fluoroscope building	45-50	18-23
	Tank building rocket	40-45	15-20
	Hydrostatic test	35-40	15-20
	Phosphorous loading	35-40	15-20
226	Vacuum and hydraulic pump building	35-40	12-17
226	Cable drive	35-40	12-17
226	Dryer building	75-80	3- 8
	Miscellaneous Production Facilities:		
229 50	Printing plant	45-55	25-30
	Miscellaneous Storage Facilities:		
750	Community Facilities - morale, welfare, and recreation - exterior	Determine by load count and time.	
750 30	Outdoor swimming pool installation	80-85	20-25
750 54	Band stand	75-80	15-25
	Miscellaneous Facilities for Utilities and Ground Improvements:		
821 09	Heating plant building (condensate)	55-60	25-40
821 09	Heating plant building (heating)	55-60	30-35
833 40	Garbage house	75-80	20-25
841	Potable water - supply/treatment/storage	Determine by load count and time.	
845 20	Pipeline nonpotable water	55-60	3- 8
852 30	Pedestrian bridge	80-85	20-25
872 20	Guard and watch towers	80-..	46-..
890 20	Compressed air plant	60-65	20-25

[1] Demand factors include allowance for system loss.

(10.76 W/m└2┘), but could vary from a low of 0.5 W/ft└2┘ (5.38 W/m└2┘) to a high of 1.5 W/ft└2┘ (16 W/m└2┘) depending on the specific tasks to be performed. A minimum of 0.1 W/ft└2┘ (1 W/m└2┘) for auditoriums to a maximum of 2.5 W/ft└2┘ (27 W/m└2┘) for machine shops is possible, although the upper limit would occur very rarely. Mechanical spaces in building storage areas and similar spaces in which outlets are provided but infrequently used are usually neglected in computing loads, except for special cases.

2.2.1.2 Electric Power Loads. Electric power loads shall include all loads other than lighting loads and those served by general purpose receptacles and comprise the environmental system electric power requirements and the facility occupancy equipment electric power requirements.

2.2.1.3 System Loss. A system loss of approximately 6 percent, based on calculated maximum demand, should be added to the building load.

2.2.2 Demand and Load Factors. The demand and load factors for a specific facility will vary with the division of load and hours of usage. Refer to Tables 2 and 3 for values that can be applied to determine demand and load factors. Table 4 is included as a guide and an aid in illustrating the method of determining loads, which are calculated for a particular type of building, such as an academic and general instruction building (Navy Code 171-10). The values given are empirical and will vary from activity to activity, and may vary from one facility to another within an activity. Annual hours use of demand must be determined for each case in accordance with methods of operation and characteristics of the installation. Demand factors and load factors for individual facilities by the Navy category code given in Table 1 are based on a survey of existing Navy facilities and past experience. Such factors should be used for quick estimating purposes and as a check when a more precise calculation is undertaken (refer to Table 4).

2.2.2.1 Guides for Demand Factors. For guides on the selection of demand factors, refer to Table 5.

2.2.2.2 Guides for Load Factors. Guides for the selection of load factors indicate the need for special considerations (refer to Table 6). Factors in the middle of the range are for the average facility at the peacetime shore establishment and should be used unless the guides in Table 6 indicate otherwise.

2.2.3 Load Growth. Determine the requirements for load growth for anticipated usage and life expectancy with particular attention to the possibility of adding heavy loads in the form of air conditioning, electric heating, electric data processing, and electronic communication equipment. Before determining the size of service and method of distribution to a facility, an economic analysis shall be made to determine the most feasible way of serving this future load. This analysis shall include the effect on the existing installation if future loads require reinforcing or rehabilitation of the service system.

Table 2
Demand Factors for Specific Loads (See Note 1)

TYPES OF LOADS	ESTIMATED RANGE OF DEMAND FACTOR (%)	QUICK ESTIMATING DEMAND FACTOR (%)
MOTORS: General purpose, machine tool, cranes, elevators, ventilation, compressors, pumps, etc.	20 - 100	30
MOTORS: Miscellaneous, fractional, and small appliances	10 - 50	25
Resistance ovens, heaters, and furnaces	80 - 100	80
Induction furnaces	80 - 100	80
Lighting	65 - 100	75
Arc welders	25 - 50	30
Resistance welders	5 - 40	20
Air-conditioning equipment	60 - 100	70
Refrigeration compressors	40 - 100	60

Note 1: Demand factors include allowance for system loss.

Table 3
Annual Hours of Demand Usage for Specific Loads

TYPES OF LOADS	QUICK ESIMATING HOURS USE		
	1-SHIFT OPERATION	2-SHIFT OPERATION	3-SHIFT OPERATION
MOTORS: General purpose	1,200	1,600	2,000
MOTORS: Miscellaneous, fractional, and small appliances	1,500	1,800	2,100
Resistance ovens, heaters, and furnaces	1,000	1,300	1,600
Induction furnaces	900	1,200	1,500
Lighting	2,200	2,800	3,500
Arc welders	500	700	900
Resistance welders	500	700	900
Air-conditioning equipment			
Less than 1,500 cooling degree days	1,200	1,400	1,600
1,500 to 1,500 cooling degree days	1,600	1,800	2,000
More than 2,500 cooling degree days	2,200	2,500	2,800

Table 4
Academic Building (Code 171-10) Demand and Load Factor Calculations
(See Note 1)

		MOTORS				
		GENERAL	MISCEL-LANEOUS FRAC-TIONAL & SMALL APPLI-ANCES	LIGHTING	AIR CONDI-TIONING	TOTAL
1.	Watts/square foot	1.0	1.0	2.7	4.5	9.2
	(Watts/square meter)	10	10	26.5	45	91.5
2.	Connected load	100 kw	100 kw	265 kw	450 kw	915 kw
3.	Specific load demand factor	30%	10%	75%	70%	
4.	Maximum demand load (line 2 X line 3)	30 kw	10 kw	200 kw	315 kw	555 kw
5.	Annual operating (1-shift) usage	1,200 hrs	1,500 hrs	2,200 hrs	1600 hrs	
6.	Annual usage in megawatt hours (line 4 X line 5)	36	15	440	504	995
7.	Demand factor Formula = $\frac{\text{line 4}}{\text{line 2}}$ (1)	—	—	—	—	60%
8.	Load factor Formula = $\frac{\text{line 6}}{\text{line 4 X 8760 hrs}}$ (4)	—	—	—	—	20%

Note 1: Calculated for a 100,000 square-foot (10,000 square meter) building. See tables 2 and 3 for data used for lines 3 and 5 respectively. Load growth is included in connected load. Maximum demand load includes allowance for system loss. For this illustration, the coincidence factor occurring when individual demand loads are added is considered to be 1.00 and has not been shown.

Table 5
Guides for Selection of Demand Factors

Selection of factors in upper half of range for conditions described below	Selection of factors in lower half of range for conditions described below
GENERAL GUIDES	
Facilities in active use and approaching maximum capacity.	Facilities of intermittent use or not being fully utilized.
Loads predominantly lighting.	Motor loads made up of a number of independently operated small motors.
Loads predominantly heating.	
Loads dominated by one or two large motors.	Motor loads controlled automatically unless control depends upon weather conditions.
OPERATIONAL AND TRAINING FACILITIES	
Instruction buildings with little or no electric equipment.	Large instruction buildings with electrical demonstration and training equipment.
Communications buildings with telephonic equipment only.	
MAINTENANCE AND PRODUCTION FACILITIES	
Shops and facilities when engaged in mass production of similar parts.	No special guides.
RESEARCH, DEVELOPMENT, AND TEST FACILITIES	
Facilities used for repetitive testing of material or equipment.	No special guides.
SUPPLY FACILITIES	
Refrigerated warehouses in South.	Warehouses with many items of electric materials handling equipment, including cranes and elevators.
Dehumidified warehouses in Mississippi Valley and along seacoasts.	
Warehouses for active storage.	
HOSPITAL AND MEDICAL FACILITIES	
No special guides.	No special guides.

Table 5 (Continued)
Guides for Selection of Demand Factors

ADMINISTRATIVE FACILITIES	
Large administrative buildings with mechanical ventilation and air conditioning. Note: Group large administrative buildings separately only when administration is a significant part of total activity load.	Casual offices, offices used infrequently by foremen and supervisors, or offices in which there is little prolonged desk work.
HOUSING AND COMMUNITY FACILITIES	
Enlisted barracks at training centers. Public quarters where less than 25 family units are involved. Restaurants, exchanges, cafeterias, and other food service facilities when gas or steam is primary fuel.	Food service facilities where load is primarily cooking and baking.
UTILITIES AND GROUND IMPROVEMENTS	
Central heating plants serving extended areas and buildings. Water pumping stations serving extended areas or carrying most of load of water systems. Central station compressed air plants.	No special guides.

Table 6
Guides for Selection of Loads Factors

Select factors in upper half of range conditions described below	Select factors in lower half of range for conditions described below
GENERAL GUIDES	
Facilities operated on two or more shifts.	Facilities used intermittently.
Loads that are primarily fluorescent or high intensity discharge lighting.	Inactive facilities.
Many small independently operated motors.	Large motor loads when the load consists of relatively small numbers of motors.
Electronic equipment continuously operated for immediate use.	Wholesale-type service facilities.
Cooling and dehumidification loads for year-round climate control in southern climates.	
Retail-type service loads and loads that are in active use.	
OPERATIONAL AND TRAINING FACILITIES	
Large, permanent instruction buildings in active use.	Special-purpose instruction and training facilities not regularly used.
MAINTENANCE AND PRODUCTION FACILITIES	
Shops with battery charging equipment operated after hours.	Welding loads or loads made up primarily of welding equipment.
Active shops at full employment.	Job-order workshops.
Mass production shops.	Shops with large, heavy special function machines.
	Large induction or dielectric heating loads.
RESEARCH, DEVELOPMENT, AND TEST FACILITIES	
No special guides.	No special guides.

Table 6 (Continued)
Guides for Selection of Loads Factors

SUPPLY FACILITIES	
Refrigerated and dehumidified warehouses in South or in humid climates. Warehouses for active storage and in continuous use.	Refrigerated warehouses in North. Warehouses with large materials handling equipment loads.
HOSPITAL AND MEDICAL FACILITIES	
Clinics and wards with daily operating hours and in active use.	No special guides.
ADMINISTRATIVE FACILITIES	
Large, active, well-lighted offices with ventilation and air-conditioning equipment.	No special guides.
HOUSING AND COMMUNITY FACILITIES	
Navy exchanges with food service facilities. Gymnasiums used in connection or with physical therapy. Barracks at schools and training centers.	Restaurants and exchanges serving only one meal a day. Restaurants and exchanges with gas steam food preparation equipment. Chapels used primarily on Sundays. Subsistence buildings serving less than four meals a day. Laundries with dry cleaning plants. Exchanges operated less than 8 hrs/day. Gatehouses operated less than 24 hrs/day.
UTILITIES AND GROUND IMPROVEMENTS	
Heating plants that supply both heating and process steam. Water plants with little power load. Air-conditioning plants for year-round control of environment in South. Compressed air plants consisting of many banked compressors operating automatically.	Heating plants in South.

2.2.4 Emergency Loads. The determination of emergency electric power requirements is based on three types of loads (refer to Section 3 for types of loads to be included in each category):

a) minimum essential load,

b) emergency load for vital operations, and

c) uninterruptible (no-break) load.

When the three categories of emergency electric power requirements have been ascertained, determine where local emergency facilities are required, where loads may be grouped for centralized emergency facilities, and what loads are satisfied by the reliability of the general system. Base the aforementioned determinations on safety, reliability, and economy, in that order.

2.3 Area Loads. Area loads consist of groups of individual facility loads served by a subdivision of the electric distribution system. The term "area" applies to the next larger subdivision of an overall distribution system. Demand loads for an area must be known for sizing the distribution wiring and switching, and in a large installation will be required for the design of substations serving the area. Table 7 gives an example of how the coincident peak demand is calculated.

2.3.1 General Loads. To obtain the general load, add roadway lighting, area lighting, obstruction lighting, and other loads not included in individual facility loads.

2.3.2 Coincidence Factor. Determine the maximum expected demands, taking into consideration whether loads within the area peak at the same or at different times.

2.3.2.1 Relationships. Figure 1 indicates the relationship that exists between the load factor of individual facility loads and the coincidence of their peak demands with the peak demand of the group. This relationship was developed by a study of the loads of selected naval shore activities and by the application of factors developed to the formulas published by the Institute of Electrical and Electronic Engineers (IEEE). For collateral reading on this subject, refer to IEEE Technical Paper 45-116 Coincidence-Factor Relationship of Electric Service Load Characteristics. Table 8 is Figure 1 in tabular form with values shown to the nearest whole dollar, except for low load factors.

2.3.2.2 Selection. Areas with relatively insignificant residential type loads, where the load curve indicates that most of the electric power consumed in the area is used during the 40 normal working hours of a week, have coincidence factors at the higher end of the range.

2.3.2.3 Electric Power Consumption. In general, areas where large amounts of electric power are consumed outside the usual 40 working hours a week have a coincidence factor at the lower end of the range (examples are hospitals, areas operated on two or more shifts, or large barracks type activities). The upper limit of the range is for a 40 hour per week operation; the lower limit is for a 60 hour per week operation.

Table 7
Method of Calculating Coincident Peak Demand
Parenthesized () numbers refer to Notes

NAVY CODE	DESCRIPTION	TOTAL CONNECTED LOAD (kW)	DEMND FACTOR (%)	MAXIMUM DEMAND (%)	LOAD FACTOR (%)	COINCIDENCE FACTOR (%)	COINCIDENCE PEAK (kW)
125 16	Fuel oil pump house.....						
125 16	Fuel oil pump house.....						
125 16	Total	0.3	100	0.3	52	52(1)	0.2
125 20	Filling station	3.0	60	1.8	18	57(1)	1.0
125 20	Filling station bldg .	0.3	80	0.2	20	61(1)	0.1
131 35	Receiver building	2.1	65	1.4	72	79	1.1
131 50	Transmitter building.....						
131 50	Transmitter building.....						
131 50	Total	37.2	65	24.2	72	79	19.1
133 25	Tacan building	0.7	65	0.5	72	79	0.4
133 75	Radar building	1.2	70	0.8	72	79	0.6
141 20	Aircraft fire and rescue station	8.0	30	2.4	15	52(1)	1.2
141 40	Aircraft operations building	80.2	80	64.2	28	68(1)	43.6
141 60	Photographic building	10.5	70	7.4	18	57(1)	4.2
171 10	Academic instruc. bldg.....						
171 10	Academic instruc. bldg.....						
171 10	Academic instruc. bldg.....						
171 10	Academic instruc. bldg.....						
171 10	Total	47	60	28.2	22	62(1)	17.5
171 35	Operational Trainer facility	0.1	80	0.1	15	52(1)	....
211 10	Aircraft overhaul and repair shop	7,600	38	2,890	25	95(2)	2,745
211 12	Paint/finishing hangar	127	70	89.0	26	66(1)	58.3
211 22	Engine preparation and storage shop.....						
211 21	Engine maint. shop.....						
211 21	Engine maint. shop.....						
211 21	Total	405	40	162	15	52(1)	84.2
211 83	Engine test cell	360	45	162	28	68(1)	110
212 20	Missile equipment maint. shop	3.0	40	1.2	22	62(1)	0.7
214 20	Auto veh. maint. facs.....						
214 20	Auto veh. maint. facs.....						
214 20	Auto veh. maint. facs.....						
214 20	Auto veh. maint. facs.....						
214 20	Total	370	60	222	25	65(1)	145

Table 7 (Continued)
Method of Calculating Coincident Peak Demand

730	10	Fire station	14.6	30		4.4	15	521		2.3
						Total				3,325
						System loss (6%)				194
						Grand total				3,429

(1) The coincidence factor has been increased to allow for low load factor and number of facilities in the area. Refer to para. 2.3.2.4, Influencing Factors, of this handbook.
(2) The coincidence factor has been increased because of the relative magnitude of the load. Refer to para. 2.3.2.5, Individual Loads, of this handbook.

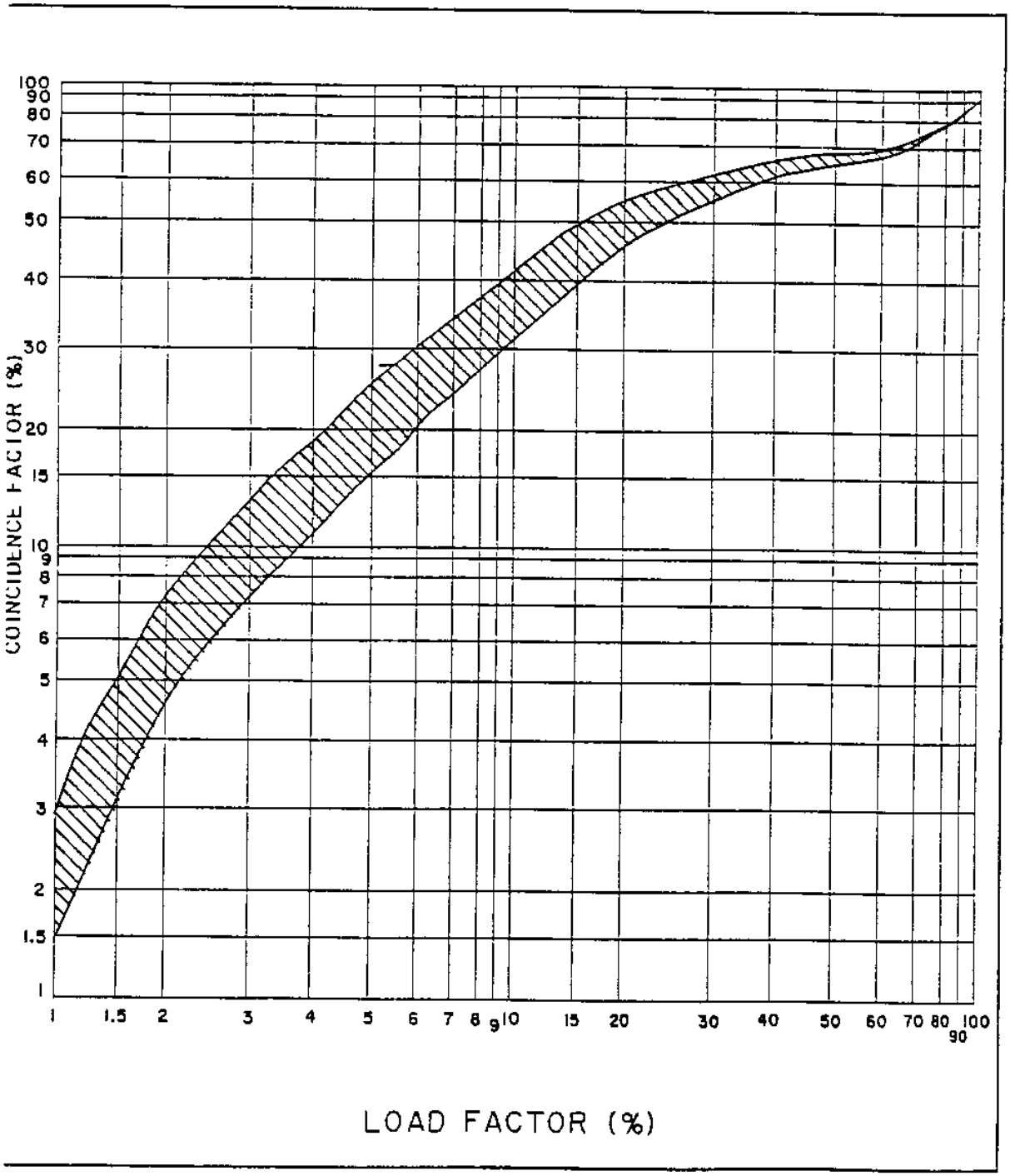

Figure 1
Theoretical Relationship Between Load Factor and Coincidence Factor at U.S. Naval Shore Establishments

Table 8
Relationship Between Load Factor and Coincidence Factor

LOAD FACTOR (%)	COINCIDENCE FACTOR (%) Loads (hr/wk) 40	60	LOAD FACTOR (%)	COINCIDENCE FACTOR (%) LOADS (hr/wk) 40	60
1	2.5	1.5	51	73	69
2	7.5	4.5	52	73	70
3	12	8	53	73	70
4	17	11	54	73	70
5	21	14	55	73	71
6	25	17	56	73	71
7	28	20	57	73	71
8	32	22	58	74	71
9	35	24	59	74	72
10	38	26	60	74	72
11	41	29	61	74	72
12	44	32	62	75	73
13	46	34	63	75	73
14	49	36	64	76	74
15	51	38	65	76	74
16	53	40	66	77	75
17	54	42	67	77	75
18	56	44	68	78	76
19	57	46	69	78	76
20	59	48	70	78	77
21	60	50	71	78	77
22	61	51	72	79	78
23	62	53	73	79	78
24	63	54	74	80	79
25	64	55	75	81	80
26	65	56	76	81	80
27	66	56	77	82	81
28	67	57	78	82	81
29	68	58	79	82	81
30	69	59	80	82	82
31	69	60	81	82	82
32	69	61	82	82	82
33	70	62	83	83	83
34	70	63	84	84	84
35	71	64	85	85	85
36	71	64	86	86	86
37	71	65	87	87	87
38	71	65	88	88	88
39	72	65	89	89	89
40	72	66	90	90	90
41	72	66	91	91	91
42	72	66	92	92	92
43	72	67	93	93	93

Table 8 (Continued)
Relationship Between Load Factor and Coincidence Factor

LOAD FACTOR (%)	COINCIDENCE FACTOR (%) Loads (hr/wk) 40	60	LOAD FACTOR (%)	COINCIDENCE FACTOR (%) LOADS (hr/wk) 40	60
44	73	67	94	94	94
45	73	67	95	95	95
46	73	67	96	96	96
47	73	68	97	97	97
48	73	68	98	98	98
49	73	69	99	99	99
50	73	69	100	100	100

2.3.2.4 Influencing Factors. The number of individual loads in a group and their load factors influence the individual load coincidence factor. The coincidence factors in Table 8 apply for groups of 100 or more individual loads. These coincidence factors can also be used for groups of as few as 30 to 50 individual loads if their load factor is 0.30 or greater. For areas of fewer individual loads, the mathematical relationship from IEEE Technical Paper 45-116 provides a basis for estimating the connected coincidence factor as shown by the following equation:

EQUATION: $E_n = E_t + (1-E_t)\ 1/n$ (5)

Where:

E_n = **The individual load coincidence factor applied with a given number of consumers**

E_t = **the coincidence factor as given in Table 8 in hundredths.**

n = **the number of individual loads in a group.**

2.3.2.5 Individual Loads. The coincidence factors in Table 8 are based on the individual loads in a group being substantially the same size. If a single load or small group of loads in an area represents a substantial percentage of overall load, the coincidence factors as given in Table 8 will no longer apply. With an individual load, increase the coincidence factor to a value commensurate with its effect on the overall area load. This is not in addition to, but in place of, the normal coincidence factor. Determine this value by considering intergroup coincidence factors given in paragraph

2.3.2.6. (An example of facility Navy code 211-70 is presented in Table 7.) For a small group, determine the coincidence peak load, and to this apply the appropriate intergroup coincidence factor to obtain the coincidence peak load for the area.

2.3.2.6 Groups of Loads or Areas. Where groups of loads within an area, or areas within a facility are combined, an additional intergroup coincidence factor will exist. For loads of a similar nature, the intergroup coincidence factor should be in the range 0.93 to 1.00. If loads of a varying nature (evening loads and daytime loads) are combined, the intergroup coincidence factor should be in the range of 0.70 to 1.00. The lower values will occur when the magnitudes of the loads are nearly balanced, and the higher ones when the combined load is predominantly one type.

2.3.3 Load growth. In addition to planned expansion, increased application of electric equipment will generate an increase in load. When sizing components, such as transformers or feeders for the area system, consider possible load growth in addition to that included in the determination of individual loads.

2.3.4 System Losses. Add distribution system losses to estimated area demands. For a good approximation, use 6 percent of the calculated maximum demand.

2.3.5 Emergency Loads. Review the overall emergency requirements for the area, based on criteria for the facility or as furnished by the using agency, to determine the following:

a) The emergency loads that may be combined in groups to take advantage of the coincidence factor.

b) The type of distribution system needed for reliability and to economically satisfy at least the less critical emergency load requirements. This reliability can be provided only if the source of electric power is not the determining factor.

c) Area loads that must be added to individual emergency loads; for example, security lighting and minimum roadway lighting.

2.3.6 Expansion. The planned development of the area, as shown on the activity general development map, shall be considered for requirements of future expansion.

2.4 Activity Loads. Activity loads are loads that consist of two or more area loads served from a single electric power source and an integrated distribution system.

2.4.1 General Loads. Follow the approach used in para. 2.3 for area loads. Area loads used for determining activity coincidence demand should be the area coincident demand exclusive of allowance for load growth.

2.4.2 Coincidence Factor. Refer to para. 2.3.2 for the necessary approach. Where dissimilar areas, whether residential, administrative, or industrial, are part of an activity, make a careful analysis of the coincidence factor used.

2.4.3 Load Growth. As for an area, components should be sized after due consideration has been given to load growth. Apply this increase to the coincident demand of the activity.

2.4.4 Expansion. The planned development of the activity, as shown on its general development map, shall be considered for requirements of future expansion.