

IIEE WEBINAR PRESENTATION
ROADMAP ON HOW TO BECOME A
PEE Module 2

May 14, 2020 2:00 PM



TRAINING AND CONTINUING
PROFESSIONAL
DEVELOPMENT COMMITTEE
CENTRAL LAGUNA CHAPTER

LOAD SCHEDULE & VOLTAGE DROP

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President, POWERBUILD CONSTRUCTION
& DEVELOPMENT CORP.



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PRESENTER BACKGROUND





ENGR. FRANCIS DENNY J. DELMENDO, PEE
President/GM Powerbuild Construction & Dev't. Corp., PCAB 35465
Former Manager Fuji-Haya International Corp.
Former Manager Fuji-Haya Electric Corp.
Electrical Construction Manager
Power System Analysis Practitioner, ETAP
Power Quality Practitioner
SLR Deputy Gov. 2018,2019
President, IIEE Central Laguna 2016, 2017
VP-Technical CLC Chapter 2015
IIEE Senior Member
IIEE Life Member
PEE 3787, 2015
REE 10358, 1991
1990 BSEE Graduate, Bicol University



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OUTLINE



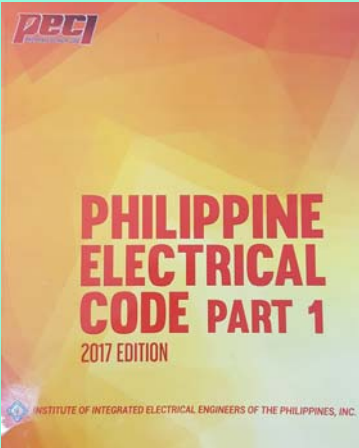
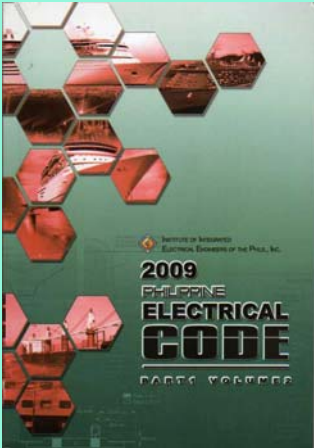
- Introduction to PEC 2017
- Electrical Plan Requirements
- Schedule of Load
 - Cable Selection & Derating Factors
 - Grounding Cable Selection
 - Lighting System Calculation
 - Motor Load Calculation
 - Demand and Diversity Factor
- Voltage Drop Calculation



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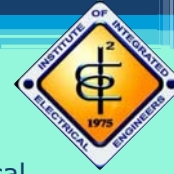
PEC 2017

Philippine Electrical Code 2017



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PEC 2017



PEC 2017 is the 9th Edition of the Philippines Electrical Code was officially endorsed by the Board of Electrical Engineering last November 10, 2017.

PEC 2017 took effect 15 days after full and complete publication, publication was done on November 17, 2017.

PEC 2017 took effect last December 2, 2017

PEC 2017 Supersedes all previous editions of the Philippines Electrical Code.

PEC 2017 was based on 2017 National Electrical Code and Relevant IEC and Other Standards



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PEC 2017



(A) Practical Safeguarding. The purpose of this *Code* is the practical safeguarding of persons and property from hazards arising from the use of electricity.

(B) Adequacy. This *Code* contains provisions that are considered minimum requirements necessary for safety. Compliance therewith and proper maintenance will result in an installation that is essentially free from hazard but not necessarily efficient, convenient, or adequate for good service or future expansion of electrical use.


(C) Intention. This *Code* is intended as a design specification or an instruction manual to qualified persons.

(D) Relation to Other International Standards. The requirements in this *Code* address the fundamental principles of protection for safety contained in Section 131 of International Electrotechnical Commission Standard 60364-1, *Electrical Installations of Buildings*.



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PEC 2017



CHAPTER 1 - General

CHAPTER 2 – Wiring and Protection

CHAPTER 3 – Wiring Methods and Materials

CHAPTER 4 – Equipment for General Use


Applies generally to all Electrical installation

Supplements or modifies Chapter 1 through Chapter 4

CHAPTER 5 – Special Occupancies


CHAPTER 6 – Special Equipment

CHAPTER 7 – Special Conditions



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PEC 2017



CHAPTER 8 – Communication System

CHAPTER 9 – Water Craft

CHAPTER 10 – Tables

Appendix

Chapter 8 and Chapter 9 are not subject to the requirements of Chapter 1 through 7 except where the requirements are specifically referenced

CAPS

CHAPTER.....1


ARTICLE.....1.2

PART.....1.2.3

SECTION.....1.2.3.4
1.2.3.4(a)

PEC 2017 Article 1.0 Introduction

PEC 2017 Section 1.0.1.1(A) – Practical Safeguard....



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PEC 2017 Chapters and Article



CHAPTER 1 – General

- 1.0 - Introduction
- 1.1 – Definition of Terms
- 1.3 – Electrical Plans and Specification
- 1.10 – Requirements for Electrical Installation

CHAPTER 2 – Wiring Protection

- 2.1 – Branch Circuit
- 2.15 – Feeders
- 2.20 – Branch Circuit, Feeders and Service Load Calculation
- 2.40 – Over-Current Protection
- 2.50 – Grounding and Bonding



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PEC 2017 Chapters and Article



CHAPTER 3 - Wiring Methods and Materials

- 3.10 – Conductor for General Wiring
- 3.42 – Intermediate Metal Conduit (IMC)
- 3.44 – Rigid Metal Conduit (RMC)
- 3.58 – Electrical Metallic Tubing (EMT)
- 3.52 – Rigid Polyvinyl Chloride Conduit (PVC)
- 3.92 – Cable Trays

CHAPTER 4 – Equipment for General Use

- 4.30 – Motors, Motor Circuits, and Controller
- 4.40 – Air-Conditioning and Refrigeration Equipment
- 4.45 – Generators
- 4.50 – Transformers and Transformer Vaults



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PEC 2017 Chapters and Article



CHAPTER 5 – Special Occupancies

- 5.0 – Hazardous Locations
- 5.17 – Health Care Facilities

CHAPTER 6 - Special Equipment

- 6.20 – Elevators, Dumbwaiters, Escalators Moving Walks
- 6.80 – Swimming Pools, Fountains and Similar Installation
- 6.90 – Solar Photovoltaic (PV) Electric Power Production Facilities
- 6.91 – Large Scale Photovoltaic
- 6.95 – Fire Pumps

CHAPTER 7 - Special Conditions

- 7.0 – Emergency System
- 7.60 – Fire Alarm System
- 7.70 – Optical Fiber Cables



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PEC 2017 Chapters and Article



CHAPTER 8 – Communication System

- 8.0 – Communication Circuits
- 8.10 – Radio and Television Equipment
- 8.30 – Network Powered Broadband Communication System

CHAPTER 9 – Water Craft

CHAPTER 10 – Tables

- 10.1.1.5 – Dimensions of Insulated Conductors
- 10.1.1.9 – Resistance and Reactance Table

Appendix

- A – Electrical Symbols
- C – Conduit and Tubing
- D – Wiring Design Example



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Electrical Plans

PEC 2017 Part 1.3.2 Plans and Specification

- A. Location and Site Location
- B. Legend and Symbols
- C. General Notes and/or Specifications
- D. Electrical Layout
 - (1) Plans for Power
 - (2) Plans for Lighting and Receptacle Outlets
- E. Schedule of Loads**
 - (1) Motor Loads
 - (2) Lighting and Receptacle Loads
 - (3) Other Loads



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Electrical Plans

PEC 2017 Part 1.3.2 Plans and Specification

F. Design Analysis

- (1) Branch Circuit, sub-feeders, busways and service entrance
- (2) Type, Ratings and Trip setting of overload devices
- (3) Calculation of Voltage Drop**
- (4) Calculation of Short Circuit Currents**
- (5) Protection and Coordination
- (6) Arc-Flash Hazard Analysis



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Electrical Plans

PEC 2017 Part 1.3.2 Plans and Specification

G. One Line Diagram

1.11	Circuit Breaker	
1.12	Fuse	

3.0 TRANSFORMERS AND REACTORS		
3.1	Transformer with Two Separate Windings	
3.2	Transformer with Three Separate Windings	
3.3	Auto-Transformer	
3.4	Reactor	
3.5	Current Transformer	

ANSI/IEEE

T2
750 kVA
13.2/0.24 kV
5.75 %Z

CB2
225 A
85 kA

Fuse2
38 kV
17.5 kA

IEC

T1
750 kVA
13.2/0.24 kV
5.75 %Z

CB1
2500 A
85 kA

Fuse1
36 kV
20 kA

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Electrical Plans

Philippine Economic Zone Authority
PEZA

MEMORANDUM CIRCULAR No. 2016-120

TO : ALL ECOZONE DEVELOPERS/OPERATORS
ALL LOCATOR COMPANIES

FROM : JUSTO MENDOZA LL. YUSINCO
Officer-in-Charge and Deputy Director General
for Finance and Administration

DATE : 23 AUGUST 2016

SUBJECT : ELECTRICAL DESIGN ANALYSIS
Re: Philippine Electrical Code Compliance

Section 1301 of PD 1096, otherwise known as the "National Building Code of the Philippines," states that "All electrical systems, equipment, and installations mentioned in this Code shall conform to the provisions of the "Philippine Electrical Code" (PEC), as adopted by the Board of Electrical Engineering pursuant to RA 184 (amended by RA 7920), the "Electrical Engineering Law".

Article 1.3.2.1 (f) of PEC specifically provides the inclusion of a design analysis on the drawings or submission of the same on separate sheets, showing the calculation of short circuit currents and voltage drop, among others, to wit:

- (1) Branch circuits, sub-feeders, busways, and service entrance;
- (2) Types, ratings, and trip setting of overload devices;
- (3) Calculation of short circuits current for determining the interrupting capacity of overcurrent protection device for residential, commercial and industrial establishment; and
- (4) Calculation of voltage drops.

In view of the foregoing, all concerned entities in the PEZA Economic Zones are hereby advised to immediately comply with all pertinent requirements, more particularly the above-quoted provisions. Strict compliance shall be monitored by the respective PEZA Building Official assigned to each Ecozone. A copy of the full text of PEC's Article 1.3.2.1 (f) may be downloaded from the PEZA website (www.peza.gov.ph).

Please feel free to call your respective PEZA Building Official for any clarification or assistance.

For compliance.

Building & SPP/PEZA/Compliance, Energy Division, 5th Floor
Bldg. 1000000 City, Alabang City, Muntinlupa City
Telephone: (02) 8511-0000 / 8511-0001 / 8511-0002
Fax: (02) 8511-0000

49713-01-PAN
12-19-18-AN
LMD - BBAF

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

DEC 15 2015

NBC MEMORANDUM
CIRCULAR No. 02
Series of 2015

SUBJECT: ELECTRICAL DESIGN ANALYSIS
PHILIPPINE ELECTRICAL CODE
COMPLIANCE

TO : All Building Officials
City / Municipal Engineers and Others concerned

In order to attain an electrically safe environment and pursuant to Section 1301 of the National Building Code (PD 1096) and Article 1.3.2 of the Philippine Electrical Code, all Building Officials are hereby engaged to be stricter in approving Building Permits by requiring the submission of electrical plans that include design analysis showing all the calculations of short circuits, voltage drop and other essential data as requisite for the issuance of Electrical Permit. Likewise, existing buildings, factories and infrastructures with substantial electrical load shall be subjected to inspections and that an updated design analysis and calculations is required to ensure that fire and life safety requirements are being complied.


For strict and immediate compliance of all concerned.

RODELICAL SINDSON
Secretary

7511000/NO/GOV

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LOAD SCHEDULE



Panel Name: LP-1-1		LOAD SCHEDULE										Main Feeder			Main BREAKER	
Panel Location: Optical Glass Material Storage		LP-1-1										50mm2 THHN R,Y,Bk AT 100 A			125 A	
Enclosure: Nema-1												22 mm2 THHN GREEN AF			3 P	
System: 220 V, 3-ph, 3-wire, 60 Hz												1 SET IN CABLE TRAY				
Ckt. No.	Load Description	Min. RMS Sym. Current	KAIC	Load in kW	Load in kVA	DF (%)	Demand kVA	Volts	Connected Load Current, Amperes		Breaker	Conductor (mm ²)	Conduit (mm dia.)			
									3-ph	AB						
1	3-Phase			1.32	100%	1.32	220					3.5	EMT, 15			
2	3-Phase			1.10	100%	1.10	220					3.5	EMT, 15			
3	3-Phase			1.10	100%	1.10	220					3.5	EMT, 15			
4	13-HF32Wx2			1.79	100%	1.79	220					X3.5+G3.5	EMT, 15			
5	4-EML + 6-EXL + 2-HF32Wx2			0.58	100%	0.58	220		2.64	20	63	X3.5+G3.5	EMT, 15			
6	4-EML + 5-EXL			0.36	100%	0.36	220		1.64	20	63	X3.5	EMT, 15			
7	5-DCO			0.90	60%	0.54	220			20	63	X3.5+G3.5	PVC, 20			
8	5-DCO			0.90	60%	0.54	220			20	63	X3.5+G3.5	PVC, 20			
9	2-DCO			0.36	60%	0.22	220			20	63	X3.5+G3.5	PVC, 20			
10	3-DCO			0.54	60%	0.32	220			20	63	X3.5+G3.5	PVC, 20			
11	1-Hand Dryer			1.50	60%	0.90	220			20	63	X3.5+G3.5	PVC, 20			
12	1-Hand Dryer			1.50	60%	0.90	220		6.82	20	63	X3.5+G3.5	PVC, 20			
13	FACP (Office Room)			1.00	60%	0.60	220		4.55	20	63	X3.5+G3.5	EMT, 15			
14	Spare				60%		220			20	63					
15	Spare				60%		220			20	63					
16	Spare				60%		220			20	63					
17	Spare				60%		220			20	63					
18	Spare				60%		220			20	63					
Total						10.27			23.75	17.92	17.24					

For Feeder Current :


- 3Ph + 1Ph Load = 41.14 A
- 25% Continuous load = 10.29 A
- Total Current = 51.43 A

For Overcurrent Device

- Total Current = 51.43 A


Note :

- Duplex C.O. @ 0.18 kVA per PEC 1, 2017, 2, 20.2.5(i)
- HF32Wx2 Fixture @ 0.11kVA per Supplier Data
- Emergency Light @ 0.06kVA per Supplier Data
- Exit Light @ 0.03kVA per Supplier Data
- Hand Dryer @ 1.5kVA per Supplier Data
- CFL26W @ .06kVA per Supplier Data



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LOAD SCHEDULE



Panel Name: LP-1-1		LOAD SCHEDULE										Main Feeder			Main BREAKER	
Panel Location: Optical Glass Material Storage		LP-1-1										50mm2 THHN R,Y,Bk AT 100 A			125 A	
Enclosure: Nema-1												22 mm2 THHN GREEN AF			3 P	
System: 220 V, 3-ph, 3-wire, 60 Hz												1 SET IN CABLE TRAY				
Ckt. No.	Load Description	Min. RMS Sym. Current	KAIC	Load in kW	Load in kVA	DF (%)	Demand kVA	Volts	Connected Load Current, Amperes		Breaker	Conductor (mm ²)	Conduit (mm dia.)			
									3-ph	AB						
1	3-Phase			1.32	100%	1.32	220					3.5	EMT, 15			
2	3-Phase			1.10	100%	1.10	220					3.5	EMT, 15			
3	3-Phase			1.10	100%	1.10	220					3.5	EMT, 15			
4	13-HF32Wx2			1.79	100%	1.79	220			8.14	20	63	X3.5+G3.5	EMT, 15		
5	4-EML + 6-EXL + 2-HF32Wx2			0.58	100%	0.58	220		2.64	20	63	X3.5+G3.5	EMT, 15			
6	4-EML + 5-EXL			0.36	100%	0.36	220		1.64	20	63	X3.5+G3.5	EMT, 15			
7	5-DCO			0.90	60%	0.54	220		4.10	20	63	X3.5+G3.5	PVC, 20			
8	5-DCO			0.90	60%	0.54	220		4.10	20	63	X3.5+G3.5	PVC, 20			
9	2-DCO			0.36	60%	0.22	220		1.64	20	63	X3.5+G3.5	PVC, 20			
10	3-DCO			0.54	60%	0.32	220		2.46	20	63	X3.5+G3.5	PVC, 20			
11	1-Hand Dryer			1.50	60%	0.90	220		6.82	20	63	X3.5+G3.5	PVC, 20			
12	1-Hand Dryer			1.50	60%	0.90	220		6.82	20	63	X3.5+G3.5	PVC, 20			
13	FACP (Office Room)			1.00	60%	0.60	220		4.55	20	63	X3.5+G3.5	EMT, 15			
14	Spare				60%		220			20	63					
15	Spare				60%		220			20	63					
16	Spare				60%		220			20	63					
17	Spare				60%		220			20	63					
18	Spare				60%		220			20	63					
Total						10.27			23.75	17.92	17.24					

For Feeder Current :


- 3Ph + 1Ph Load = 41.14 A
- 25% Continuous load = 10.29 A
- Total Current = 51.43 A

For Overcurrent Device

- Total Current = 51.43 A

Note :

- Duplex C.O. @ 0.18 kVA per PEC 1, 2017, 2, 20.2.5(i)
- HF32Wx2 Fixture @ 0.11kVA per Supplier Data
- Emergency Light @ 0.06kVA per Supplier Data
- Exit Light @ 0.03kVA per Supplier Data
- Hand Dryer @ 1.5kVA per Supplier Data
- CFL26W @ .06kVA per Supplier Data



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LOAD SCHEDULE



TYPICAL LOADS FOR INDUSTRIAL PLANTS & COMMERCIAL ESTABLISHMENTS

1. Lighting Loads
2. Power and Outlet
3. Air-Conditioning and Ventilation System
4. Kitchen Equipment
5. Production Equipment
6. Fire Pumps



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Cable Selection Guide



Proper Selection of Cable


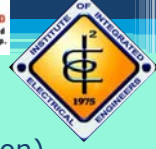
The ampacity of the cable is affected by the following :

1. Temperature Limitation of the Cable (Type of Insulation)
2. Ambient Temperature
3. Cable Arrangement Adjustment Factor
4. Application Raceway or Cable Ladder



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Cable Selection Guide

The ampacity of the cable is affected by the following :



- Temperature Limitation of the Cable (Type of Insulation)
 TW – 60 °C, THWN - 75 °C, THWN-2/THHN - 90 °C

Table 3.10.2.6(B)(16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C, Not More Than Three Current-Carrying Conductors in Raceways, Cable, or Earth (Directly Buried), Base on Ambient Temperature of 30°C

Conductor Size mm ²	Temperature Rating of Conductor [See Table 3.10.3.1(A)]					
	60°C	75°C	90°C	60°C	75°C	90°C
	Types TW, UF	Types RHW, THHW, THW, THWN , XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN , THHW, THW-2, THWN-2 , USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM		
2.0(1.6)*	15	20	25	—	—	—
3.5(2.0)*	20	25	30	15	20	25

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Cable Selection Guide

Type of Insulation

TW – 60 °C	Moisture – Resistant Thermoplastic, used for Dry and Wet Location	
THWN - 75 °C	Moisture and Heat Resistant Thermoplastic, used for Dry and Wet Location	★
THWN-2 - 90 °C	Moisture and Heat Resistant Thermoplastic, used for Dry and Wet Location	★
THHN - 90 °C	Heat Resistant Thermoplastic, used for Dry and Damp Location	


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Cable Selection Guide

Table 3.10.2.6(B)(16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C, Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C*

Conductor Size mm ²	Temperature Rating of Conductor [See Table 3.10.3.1(A)]					
	60°C	75°C	90°C	60°C	75°C	90°C
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
2.0(1.6)*	15	20	25	—	—	—
3.5(2.0)*	20	25	30	15	20	25
5.5(2.6)*	30	35	40	25	30	35
8.0(3.2)	40	50	55	30	40	45
14	55	65	75	40	50	65
22	70	85	95	55	65	80
30	85	100	115	65	80	90
38	100	115	130	75	90	105
50	115	140	150	90	110	125
60	130	155	170	100	120	135
80	155	190	205	120	145	165
100	185	220	240	140	170	190
125	210	255	285	165	200	225
150	240	285	320	190	230	255
175	260	305	345	205	245	275
200	275	325	360	220	265	300
250	315	375	425	255	305	345
325	370	435	490	300	355	405
375	395	470	530	315	380	430
400	400	480	535	320	385	440
500	445	530	595	365	435	485

Use TABLE 3.10.2.6(B)16 for Raceway
"Table 16"




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Cable Selection Guide

Table 3.10.2.6(B)(17) Allowable Ampacities of Single-Insulated Conductors Rated Up to and Including 2000 Volts in Free Air, Based on Ambient Temperature of 30°C*

Conductor Size mm ²	Temperature Rating of Conductor [See Table 3.10.3.1(A)]					
	60°C	75°C	90°C	60°C	75°C	90°C
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2
COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
2.0(1.6)*	25	30	35	—	—	—
3.5(2.0)*	30	35	40	25	30	35
5.5(2.6)*	40	50	55	35	40	40
8.0(3.2)	55	65	75	45	50	55
14	80	100	110	65	80	85
22	105	130	145	85	105	115
30	125	150	165	95	115	130
38	145	175	195	115	135	155
50	180	210	235	135	165	185
60	200	235	265	155	185	210
80	245	290	325	185	225	255
100	285	340	380	220	265	295
125	335	400	445	260	310	350
150	375	445	505	295	355	400
175	410	495	560	325	390	440
200	440	530	590	345	410	465
250	510	620	685	405	485	545
325	600	720	800	475	560	640
375	645	775	875	510	615	690
400	660	795	890	520	630	705
500	755	905	1020	605	730	820

Use TABLE 3.10.2.6(B)17 for Cable Tray
Refer to Article 3.92 Cable Ladder
"Table 17"



*Refer to 3.10.2.6(B)(2)(a) for the ampacity correction factors where the ambient temperature is other than 30°C.
**Refer to 2.40.1.4(D) for conductor overcurrent protection limitations.

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Cable Selection Guide





Table 3.10.2.6(B)(20) Ampacities of Not More Than Three Single Insulated Conductors, Rated Up to and Including 2000 Volts, Supported on a Messenger, Based on Ambient Air Temperature of 40°C*

Conductor Size mm ²	Temperature Rating of Conductor [See Table 3.10.3.1(A)]			
	75°C	90°C	75°C	90°C
	Type RH, RHW, THHW, THW, THWN, XHHW, ZW	Types TTHN, TTHW, THW-2, THWN-2, RHH, RWH- 2, USE-2, XHHW-2, ZW-2	Types RH, RHW, TTHW, THW, THWN, ZHHW	Type TTHN, TTHW, RHH, XHHW, RHW- 2, XHHW-2, THW-2, THWN-2, USE- 2, ZW-2
	COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM	
8.0(3.2)	53	62	41	48
14	80	94	62	73
22	105	121	81	94
30	116	136	91	106
38	138	162	107	126
50	165	193	129	150
60	187	218	146	170
80	227	266	178	208
100	270	315	210	246
125	316	369	248	288
150	363	423	285	331
175	390	460	310	360
200	416	486	327	382
250	496	581	392	458
325	576	674	458	535
375	630	740	505	590
400	659	771	529	617
500	741	870	606	709


*Refer to 3.10.2.6(B)(2)(b) for the ampacity correction factors where the ambient temperature is other than 40°C. Refer to 3.10.2.6(B)(3)(a) for more than three current-carrying conductors.



Use TABLE 3.10.2.6(B)20 for Messenger
"Table 20"

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Cable Selection Guide




2. Ambient Temperature Correction Factor

Table 3.10.2.6(B)(2)(a) Ambient Temperature Correction Factors Based on 30°C

For ambient temperatures other than 30°C, multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.

Ambient Temperature (°C)	Temperature Rating of Conductor		
	60°C	75°C	90°C
10 or less	1.29	1.2	1.15
11 - 15	1.22	1.15	1.12
16 - 20	1.15	1.11	1.08
21 - 25	1.08	1.05	1.04
26 - 30	1	1	1
31 - 35	0.91	0.94	0.96
36 - 40	0.82	0.88	0.91
41 - 45	0.71	0.82	0.87



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Cable Selection Guide

2. Ambient Temperature Correction Factor






Table 3.10.2.6(B)(2)(b) Ambient Temperature Correction Factors Based on 40°C



For ambient temperatures other than 40°C, multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.

Ambient Temperature (°C)	Temperature Rating of Conductor					
	60°C	75°C	90°C	150°C	200°C	250°C
10 or less	1.58	1.36	1.26	1.13	1.09	1.07
11 - 15	1.5	1.31	1.22	1.11	1.08	1.06
16 - 20	1.41	1.25	1.18	1.09	1.06	1.05
21 - 25	1.32	1.2	1.14	1.07	1.05	1.04
26 - 30	1.22	1.13	1.1	1.04	1.03	1.02
31 - 35	1.12	1.07	1.05	1.02	1.02	1.01
36 - 40	1	1	1	1	1	1
41 - 45	0.87	0.93	0.95	0.98	0.98	0.99
46 - 50	0.71	0.85	0.89	0.95	0.97	0.98

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Cable Selection Guide

3. Adjustment Factors

(3) Adjustment Factors.

(a) *More than Three Current-Carrying Conductors.*
 Where the number of current-carrying conductors in a raceway or cable exceeds three, or where single conductors or multiconductor cables are installed without maintaining spacing for a continuous length longer than 600 mm and are not installed in raceways, the allowable ampacity of each conductor shall be reduced as shown in Table 3.10.2.6(B)(3)(a). Each current-carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

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Cable Selection Guide

3. Adjustment Factors








Table 3.10.2.6(B)(3)(a) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors ¹	Percent of Values in Table 3.10.2.6(B)(16) Through Table 3.10.2.6(B)(19) as Adjusted for Ambient Temperature if Necessary
4 - 6	80
7 - 9	70
10 - 20	50
21 - 30	45
31 - 40	40
41 and above	35

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Cable Selection Guide

3. Adjustment Factors

- (1) Where conductors are installed in cable trays, the provisions of 3.92.2.71 shall apply.
- (2) Adjustment factors shall not apply to conductors in raceways having a length not exceeding 600 mm.
- (3) Adjustment factors shall not apply to underground conductors entering or leaving an outdoor trench if those conductors have physical protection in the form of rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride conduit (PVC), or reinforced thermosetting resin conduit (RTRC) having a length not exceeding 3 000 mm, and if the number of conductors does not exceed four.

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Cable Selection Guide

4. Application


Cable Tray Article 3.92

3.92.2.1 Single conductor cable shall be 50mm² or larger

Single conductor use as grounding shall be 22mm² or larger



3.92.2.71(A)(2) Single-Conductor Cable allowable ampacity use Table 3.10.2.6(B)(17) (Free Air)

Note : 50mm² to 250mm²
 If installed triplex uncovered – 65%
 If installed triplex 1800mm covered – 60%
 If installed one cable uncovered – 100%



3.92.2.71(A)(1a) Multi Conductor Cable allowable ampacity use Table 3.10.2.6(B)(16) (commonly called royal cord, RC, use TW column)

Note :
 If 3 current carrying conductor – 100%
 If 1800mm covered – 95%

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Cable Selection Guide

4. Application

3.92.2.13 Number of Conductors or Cables.

(a) Where all of the cables are 100 mm² or larger, the sum of the diameters of all cables shall not exceed the cable tray width, and the cables shall be installed in a single layer. Where the cable ampacity is determined according to 3.92.2.71(A)(1)(c), the cable tray width shall not be less than the sum of the diameters of the cables and the sum of the required spacing widths between the cables.

(b) Where all of the cables are smaller than 100 mm², the sum of the cross-sectional areas of all cables shall not exceed the maximum allowable cable fill area in Column 1 of Table 3.92.2.13(A) for the appropriate cable tray width.

(c) Where 100 mm² or larger cables are installed in the same cable tray with cables smaller than 100 mm², the sum of the cross-sectional areas of all cables smaller than 100 mm² shall not exceed the maximum allowable fill area resulting from the calculation in Column 2 of Table 3.92.2.13(A) for the appropriate cable tray width. The 100 mm² and larger cables shall be installed in a single layer, and no other cables shall be placed on them.






Table 3.92.2.13(A) Allowable Cable Fill Area for Multiconductor Cables in Ladder, Ventilated Trough, or Solid Bottom Cable Trays for Cables Rated 2000 Volts or Less

Inside Width of Cable Tray (mm)	Maximum Allowable Fill Area for Multiconductor Cables			
	Column 1 Applicable for 3.92.2.13(A)(1)(b) Only (mm ²)	Column 2 Applicable for 3.92.2.13(A)(1)(c) Only (mm ²)	Column 3 Applicable for 3.92.2.13(A)(3)(b) Only (mm ²)	Column 4 Applicable for 3.92.2.13(A)(3)(c) Only (mm ²)
50	1500	1500 - (30 Sd) ²	1200	1200 - (25 Sd) ²
100	3000	3000 - (30 Sd) ²	2300	2300 - (25 Sd) ²
150	4500	4500 - (30 Sd) ²	3500	3500 - (25 Sd) ²
200	6000	6000 - (30 Sd) ²	4500	4500 - (25 Sd) ²
225	6800	6800 - (30 Sd)	5100	5100 - (25 Sd)
300	9000	9000 - (30 Sd)	7100	7100 - (25 Sd)
400	12000	12000 - (30 Sd)	9400	9400 - (25 Sd)
450	13500	13500 - (30 Sd)	10600	10600 - (25 Sd)
500	15000	15000 - (30 Sd)	11800	11800 - (25 Sd)
600	18000	18000 - (30 Sd)	14200	14200 - (25 Sd)
750	22500	22500 - (30 Sd)	17700	17700 - (25 Sd)
900	27000	27000 - (30 Sd)	21300	21300 - (25 Sd)

*The maximum allowable fill area in Columns 2 and 4 shall be calculated. For example, the maximum allowable fill in mm² for a 150-mm wide cable tray in Column 2 shall be 4500 minus (30 multiplied by Sd)
 *The term Sd in Columns 2 and 4 is equal to the sum of the diameters, in mm, of all cables 107.2 mm and larger multiconductor cables in the same cable tray with smaller cables.

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PEC 2017 Provisions



Cable Selection Guide

4. Others Provisions

Table 3.10.3.3(A) Minimum Size of Conductors

Conductor Voltage Rating (Volts)	Minimum Conductor Size mm ² (mm dia.)	
	Copper	Aluminum or Copper-Clad Aluminum
0-2 000	2.0(1.6)	3.5(2.0)
2 001-8 000	8.0(3.2)	8.0(3.2)
8 001-15 000	30	30
15 001-28 000	38	38
28 001-35 000	50	50

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Cable Selection Guide

4. Other Provisions

Section 2.10.1.5(C)(a)

(a) Means of Identification. The means of identification shall be permitted to be by separate color coding, marking tape, tagging, or other approved means.

Section 3.10.1.2(H)(1)

(H) Conductors in Parallel.

(1) General. Aluminum, copper-clad aluminum, or copper conductors, for each phase, polarity, neutral, or grounded circuit shall be permitted to be connected in parallel (electrically joined at both ends) only in sizes 50 mm² and larger where installed in accordance with 3.10.2.1(H)(2) through (H)(6).

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Cable Selection Guide

4. Other Provisions

Section 2.15.1.2(A)(1a)

Continuous Load. A load where the maximum current is expected to continue for 3 hours or more.

2.15.1.2 Minimum Rating and Size.

(A) Feeders Not More Than 600 Volts.

- (1) **General.** Feeder conductors shall have an ampacity not less than required to supply the load as calculated in Parts 2.20.3, 2.20.4, and 2.20.5. Conductors shall be sized to carry not less than the larger of 2.15.1.2(A)(1)(a) or (b).
- (a) Where a feeder supplies continuous loads or any combination of continuous and noncontinuous loads, the minimum feeder conductor size shall have an allowable ampacity not less than the **noncontinuous load plus 125 percent of the continuous load.**

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Other PEC 2017 Provisions

Section 2.10.2.3(A)

2.10.2.3 Overcurrent Protection. Branch-circuit conductors and equipment shall be protected by overcurrent protective devices that have a rating or setting that complies with 2.10.2.3(A) through (D).

(A) Continuous and Noncontinuous Loads. Where a branch circuit supplies continuous loads or any combination of continuous and noncontinuous loads, the rating of the **overcurrent device shall not be less than the noncontinuous load plus 125 percent of the continuous load.**

Section 2.15.1.3

2.15.1.3 Overcurrent Protection. Feeders shall be protected against overcurrent in accordance with the provisions of Part 2.40.1. Where a feeder supplies continuous loads or any combination of continuous and noncontinuous loads, **the rating of the overcurrent device shall not be less than the noncontinuous load plus 125 percent of the continuous load.**

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Other PEC 2017 Provisions

Table 2.10.2.7 Summary of Branch-Circuit Requirements

Circuit Rating	15 A	20 A	30 A	40 A	50 A
Conductors (min. size):					
Circuit Wires ¹	2.0 (1.6)	3.5 (2.0)	5.5 (2.6)	8.0 (3.2)	14
Taps ¹	2.0 (1.6)	2.0 (1.6)	2.0 (1.6)	3.5 (2.0)	3.5 (2.0)
Fixture wires and cords - see 2.40.1.5					
Overcurrent Protection	15 A	20 A	30 A	40 A	50 A
Outlet devices:					
Lampholders permitted	Any type	Any type	Heavy duty	Heavy duty	Heavy duty
Receptacle rating ²	15 max. A	15 or 20 A	30 A	40 or 50 A	50 A
Maximum Load	15 A	20 A	30 A	40 A	50 A
Permissible load	See 2.10.2.6(A)	See 2.10.2.6(A)	See 2.10.2.6(B)	See 2.10.2.6(C)	See 2.10.2.6(C)

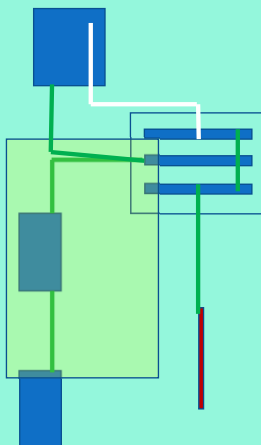
¹These wires sizes are for 60 °C insulated copper conductors - mm² (mm dia).
²For receptacle rating of cord-connected electric-discharge luminaires, see 4.10.6.15

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Equipment Grounding



2.50.6.10 Identification of Equipment Grounding Conductors. Unless required elsewhere in this Code, equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

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Equipment Grounding

2.50.6.13 Size of Equipment Grounding Conductors.

(A) **General.** Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in **Table 2.50.6.13**, but in no case shall they be required to be larger than the circuit conductors supplying the equipment. Where a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 2.50.6.9 and 2.50.7.5(A), it shall comply with 2.50.1.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined cross-sectional area complies with **Table 2.50.6.13**.

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Equipment Grounding

Table 2.50.6.13 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size mm ² (mm dia.)	
	Copper	Copper Aluminum or Copper-Clad Aluminum*
15	2.0(1.6)	3.5(2.0)
20	3.5(2.0)	5.5(2.6)
30	5.5(2.6)	8.0(3.2)
40	5.5(2.6)	8.0(3.2)
60	5.5(2.6)	8.0(3.2)
100	8.0(3.2)	14
200	14	22
300	22	30
400	30	38

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Bonding Jumper

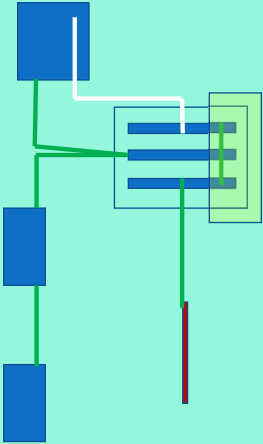




Table 2.50.5.13(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors ^a mm ²		Size of Grounding Conductor or Bonding Jumper* mm ²	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum ^b
30 or smaller	50 or smaller	8.0(3.2)	14
38 or 50	60 or 80	14	22
60 or 80	100 or 125	22	30
Over 80 through 175	Over 125 through 250	30	50
Over 175 through 325	Over 250 through 400	50	80
Over 325 through 500	Over 400 through 850	60	100
Over 500	Over 850	See Notes 1 and 2.	

Note:

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Grounding Electrode

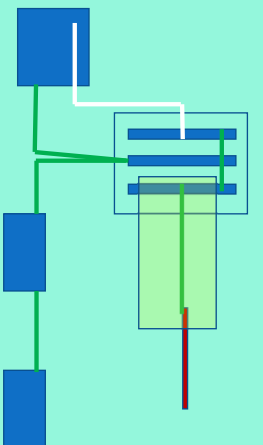


Table 2.50.3.17 Grounding Electrode Conductor for Alternating-Current Systems

Size of Largest Ungrounded Service-Entrance Conductor or Equivalent Area for Parallel Conductors ^a mm ²		Size of Grounding Electrode Conductor mm ²	
Copper	Aluminum or Copper-Clad Aluminum	Copper	Aluminum or Copper-Clad Aluminum ^b
30 or smaller	50 or smaller	8.0(3.2)	14
38 or 50	60 or 80	14	22
60 or 80	100 or 125	22	30
Over 80 through 175	Over 125 through 250	30	50
Over 175 through 325	Over 250 through 400	50	80
Over 325 through 500	Over 400 through 850	60	100
Over 500	Over 850	80	125

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Cable Selection Guide

Ex. Current Capacity of a 3 - 250mm² THWN-2 Cable in raceway

Table 3.10.2.6.(B)16 = 425A
 Ambient Temperature 31 to 35 deg. = 0.96
 Cable Laying Factor = 100%

250mm² Ampacity = 425 x 0.96 x 1
 = 408 A

Ex. Current Capacity of a 3 - 250mm² THWN-2 Cable in Cable Tray Triplex Uncovered

Table 3.10.2.6(B)17 = 685 A
 Ambient Temperature 31 to 35 deg. = 0.96
3.92.2.71(A)(2) Cable Laying Factor = 65%

250mm² Ampacity = 685 x 0.96 x 0.65
 = 427 A

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PEC 2017 Provisions

Lighting and Power



Table 2.20.2.3 General Lighting Loads by Occupancy

Type of Occupancy	Unit Load Volt - amperes/ m ²
Armories and auditoriums	8
Banks	28*
Barber shops and beauty parlors	24
Churches	8
Clubs	16
Court rooms	16
Dwelling units*	24
Garages — commercial (storage)	4
Hospitals	16
Hotels and motels, including apartment houses without provision for cooking by tenants*	16
Industrial commercial (loft) buildings	16
Lodge rooms	12
Office buildings	28*
Restaurants	16
Schools	24
Stores	24
Warehouses (storage)	2
In any of the preceding occupancies except one-family dwellings and individual dwelling units of two-family and multifamily dwellings:	
Assembly halls and auditoriums	8
Halls, corridors, closets, stairways	4
Storage spaces	2

*See 2.20.2.5(J).
 *See 2.20.2.5(K).

Table 2.20.3.3 Lighting Load Demand Factors

Type of Occupancy	Portion of Lighting Load to Which Demand Factor Applies (Volt-Amperes)	Demand Factor (Percent)
Dwelling units	First 3,000 at	100
	From 3,001 to 120,000 at	35
	Remainder over 120,000 at	25
Hospitals*	First 50,000 or less at	40
	Remainder over 50,000 at	20
Hotels and motels, including apartment houses without provision for cooking by tenants*	First 20,000 or less at	50
	From 20,001 to 100,000 at	40
	Remainder over 100,000 at	30
Warehouses (storage)	First 12,500 or less at	100
	Remainder over 12,500 at	50
All others	Total volt-amperes	100

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Lighting and Power



(I) Receptacle Outlets. Except as covered in 2.20.2.5(J) and (K), receptacle outlets shall be calculated at not less than **180 volt-amperes for each single or for each**

Section 2.20.2.5(I)

multiple receptacle on one yoke. A single piece of equipment consisting of a multiple receptacle comprised of **four or more receptacles** shall be calculated at not less than 90 volt-amperes per receptacle. This provision shall not be applicable to the receptacle outlets specified in 2.10.1.11(C)(1) and (C)(2).

(1) Spacing. Receptacles shall be installed such that no point measured horizontally along the floor line of any wall space is more than **1800 mm** from a receptacle outlet.

Section 2.10.3.3(A)(1)

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Panelboard

4.8.3 Panelboards

4.8.3.7 Overcurrent Protection. In addition to the requirement of 4.8.3.1, a panelboard shall be protected by an overcurrent protective device having a rating not greater than that of the panelboard. This overcurrent protective device shall be located within or at any point on the supply side of the panelboard.

Exception No. 2: Individual protection shall not be required for a panelboard protected on its supply side by two main circuit breakers or two sets of fuses having a combined rating not greater than that of the panelboard. A panelboard constructed or wired under this exception shall not contain more than 48 overcurrent devices.

4.8.4.5 Maximum Number of Overcurrent Devices. A panelboard shall be provided with physical means to prevent the installation of more overcurrent devices than that number for which the panelboard was designed, rated, and listed.

For the purposes of this section, a 2-pole circuit breaker or fusible switch shall be considered two overcurrent devices; a 3-pole circuit breaker or fusible switch shall be considered three overcurrent devices.



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PEC 2017 Provisions Lighting and Power



Load Calculation Parameters for Lighting Panelboard :

1. Use Table 2.20.2.3 – General Lighting Loads by Occupancy
2. For Dwelling Units use 0.024 kVA per sq. m, for Industrial, commercial building use 0.016 kVA per sq. m.
3. Use 0.18 kVA for duplex outlet, PEC 1, 2017, 2.20.2.5(i), 0.090 kVA per four or more receptacle in one yoke or 0.011 kVA per sq. m, PEC 1, 2017 2.20.2.5(k).
4. For Feeder Current, consider load as continuous load:

$$I_{30} = \sqrt{3} (\text{Highest } I_{10 \text{ LOAD}}) + I_{30 \text{ LOAD}}$$

$$I_{\text{feeder}} = 125\% \times I_{30} \quad \text{PEC 1, 2017 2.10.2.3(A)}$$

The tables were derived for PEC 1, 2017, Table 3.10.2.6(B)16 and Table 3.10.2.6(B)(2)(a) with applied derating factor.

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PEC 2017 Provisions Lighting and Power



Load Calculation Parameters for Lighting Panelboard :



6. For grounding conduction use Table 2.50.6.13 from PEC 1, 2017,
7. For over-current protection use Inverse Time Molded Case Circuit Breaker.

$$I_{\text{MCCB}} = I_{30} \times 125\%$$

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LOAD SCHEDULE

Lighting and Power

Panel Name: LP-1-1		LOAD SCHEDULE										Main Feeder Size				Main BREAKER	
Panel Location: Optical Glass Material Storage		LP-1-1										50mm2 THHN R,Y,Bk AT 100 A				100 A	
Enclosure: Nema-1												22 mm2 THHN GREEN AF 125 A				125 A	
System: 220 V, 3-ph, 3-wire, 60 Hz												1 SET IN CABLE TRAY P 3 P				3 P	
Ckt. No.	Load Description Panel ID	Load in kW	Load in kVA	DF (%)	Demand kVA	Volts	Connected Load Current, Amperes				Breaker			Conductor (mm ²)	Conduit (mm dia.)		
							3-ph	AB	BC	CA	AT	AF	P				
1	12-HF32Wx2		1.32	100%	1.32	220		6.00			20	63	2	X3.5+G3.5	EMT, 15		
2	10-HF32Wx2		1.10	100%	1.10	220		5.00			20	63	2	X3.5+G3.5	EMT, 15		
3	10-HF32Wx2		1.10	100%	1.10	220				5.00	20	63	2	X3.5+G3.5	EMT, 15		
4	13-HF32Wx2 + 6-CFL26W		1.79	100%	1.79	220				8.14	20	63	2	X3.5+G3.5	EMT, 15		
5	4 - EML + 6 - EXL + 2-HF32Wx2		0.58	100%	0.58	220			2.64		20	63	2	X3.5+G3.5	EMT, 15		
6	4 - EML + 5 - EXL		0.36	100%	0.36	220			1.64		20	63	2	X3.5+G3.5	EMT, 15		
7	5 - DCO		0.90	60%	0.54	220		4.10			20	63	2	X3.5+G3.5	PVC, 20		
8	5 - DCO		0.90	60%	0.54	220		4.10			20	63	2	X3.5+G3.5	PVC, 20		
9	2 - DCO (Polishing Room)		0.36	60%	0.22	220				1.64	20	63	2	X3.5+G3.5	PVC, 20		
10	3 - DCO Grinding / Material Storage)		0.54	60%	0.32	220				2.46	20	63	2	X3.5+G3.5	PVC, 20		
11	1 - Hand Dryer		1.50	60%	0.90	220			6.82		20	63	2	X3.5+G3.5	PVC, 20		
12	1 - Hand Dryer		1.50	60%	0.90	220			6.82		20	63	2	X3.5+G3.5	PVC, 20		
13	FACP (Office Room)		1.00	60%	0.60	220		4.55			20	63	2	X3.5+G3.5	EMT, 15		
14	Spare			60%		220					20	63	2				
15	Spare			60%		220					20	63	2				
16	Spare			60%		220					20	63	2				
17	Spare			60%		220					20	63	2				
18	Spare			60%		220					20	63	2				
Total			12.95	79%	10.27			23.75	17.92	17.24							

For Feeder Current :

3Ph + 1Ph Load = 41.14 A

25% Continuous load = 10.29 A

Total Current = 51.43 A

For Overcurrent Device

Total Current = 51.43 A

Note :

Duplex C.O. @ 0.18 kVA per PEC 1, 2017, 2.20.2.5(i)

HF32Wx2 Fixture @ 0.11kVA per Supplier Data

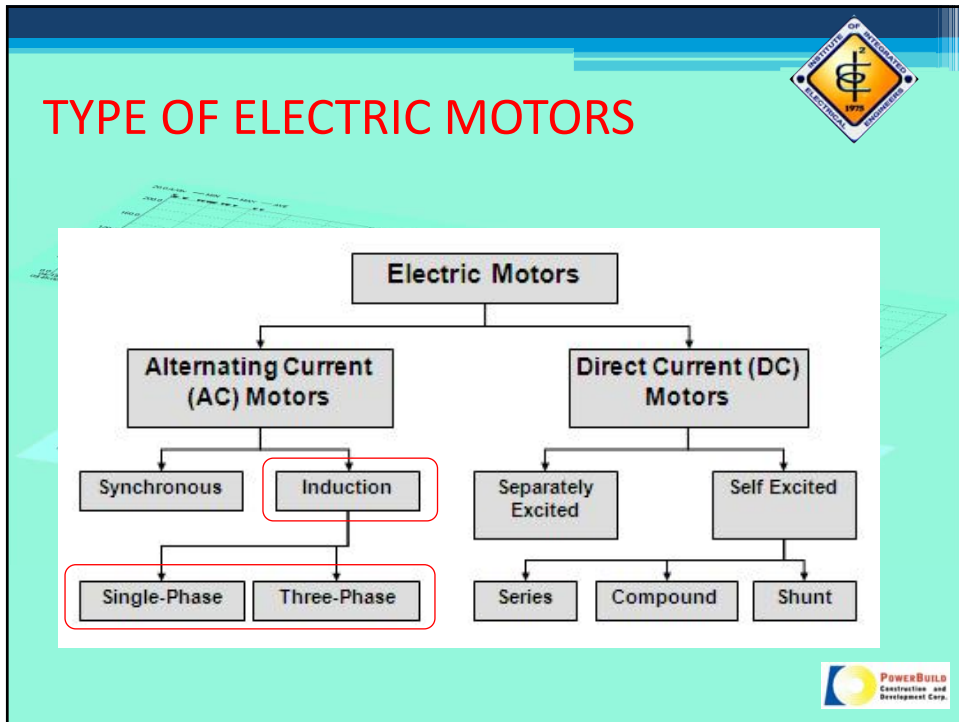
Emergency Light @ 0.06kVA per Supplier Data

Exit Light @ 0.03kVA per Supplier Data

Hand Dryer @ 1.5kVA per Supplier Data



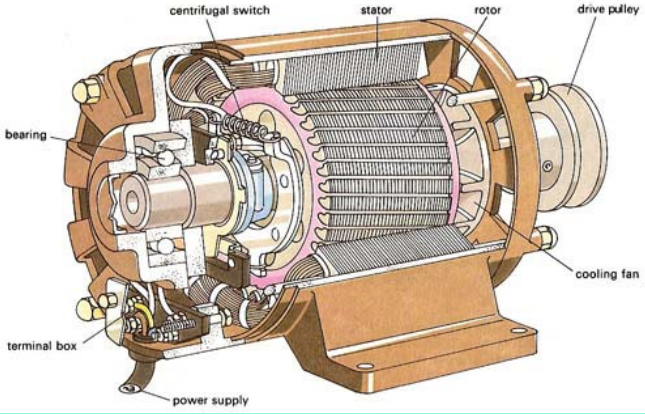

CFL26W @ .06kVA per Supplier Data

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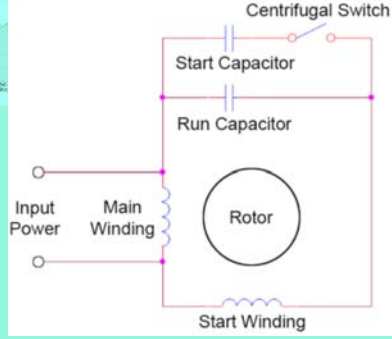

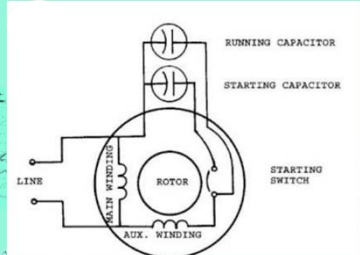
SINGLE PHASE MOTOR



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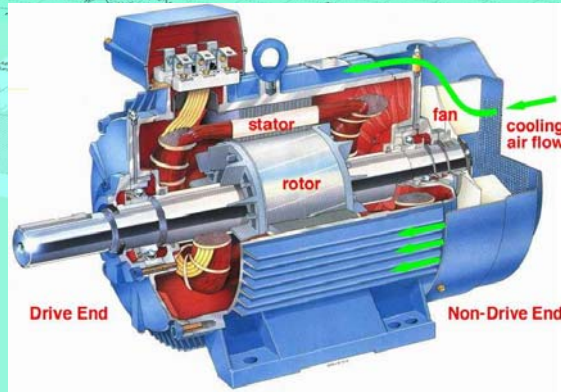
SINGLE PHASE MOTOR

CENTRIFUGAL SWITCH



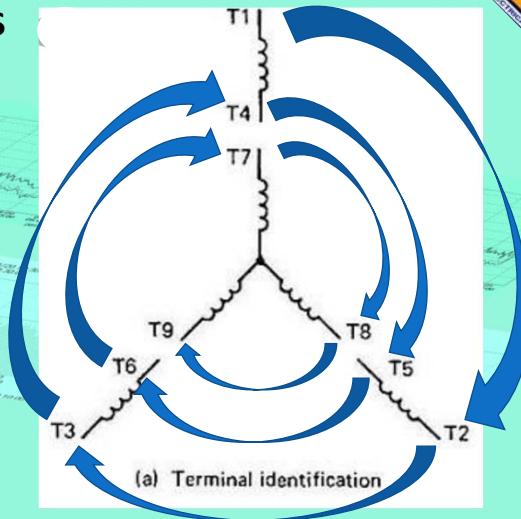
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THREE PHASE MOTOR



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THREE PHASE MOTOR TERMINALS

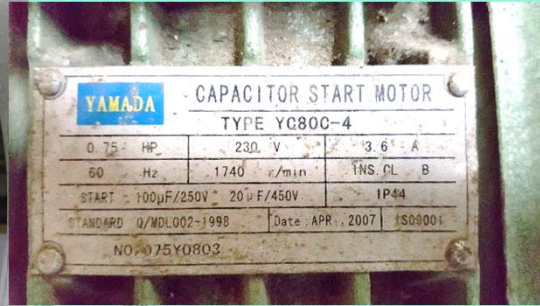
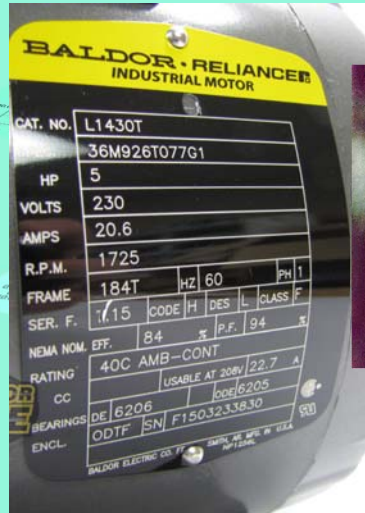


- 3 LEADS - U, V, W.
- 6 LEADS - U1, V1, W1,
 U2, V2, W2
- 9 LEADS - T1 - T9
- 12 LEADS - T1 - T12



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MOTOR NAMEPLATE



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LOAD SCHEDULE

Motor Full Load Current



Table 4.30.14.4 Full-Load Current, Three-Phase Alternating-Current Motors

The following values of full-load currents are typical for motors running at speeds usual for belted motors and motors with normal torque characteristics.

The voltages listed are rated motor voltages. The currents listed shall be permitted for system voltage ranges of 110 to 120, 220 to 240, 440 to 480, and 550 to 600 volts.

Horsepower	Induction-Type Squirrel Cage and Wound Rotor (Amperes)								Synchronous-Type Unity Power Factor ¹ (Amperes)			
	115 Volts	200 Volts	208 Volts	230 Volts	400 Volts	460 Volts	575 Volts	2300 Volts	230 Volts	460 Volts	575 Volts	2300 Volts
1/2	4.4	2.5	2.4	2.2	1.3	1.1	0.9	-	-	-	-	-
3/4	6.4	3.7	3.5	3.2	1.8	1.6	1.3	-	-	-	-	-
1	8.4	4.8	4.6	4.2	2.3	2.1	1.7	-	-	-	-	-
1 1/2	12.0	6.9	6.6	6.0	3.3	3.0	2.4	-	-	-	-	-
2	13.6	7.8	7.5	6.8	4.3	3.4	2.7	-	-	-	-	-
3	19.2*	11.0	10.6	9.6	6.1	4.8	3.9	-	-	-	-	-
5	30.4*	17.5	16.7	15.2	9.7	7.6	6.1	-	-	-	-	-
7 1/2	44.0*	25.3	24.2	22	14	11	9	-	-	-	-	-



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LOAD SCHEDULE

Motor Full Load Current



Horsepower	Induction-Type Squirrel Cage and Wound Rotor (Amperes)								Synchronous-Type Unity Power Factor ¹ (Amperes)			
	115 Volts	200 Volts	208 Volts	230 Volts	400 Volts	460 Volts	575 Volts	2300 Volts	230 Volts	460 Volts	575 Volts	2300 Volts
10	56.0*	32.2	30.8	28	18	14	11	-	-	-	-	-
15	84.0*	48.3	46.2	42	27	21	17	-	-	-	-	-
20	108.0*	62.1	59.4	54	34	27	22	-	-	-	-	-
25	136.0*	78.2	74.8	68	44	34	27	-	53	26	21	-
30	160.0*	92	88	80	51	40	32	-	63	32	26	-
40	208.0*	120	114	104	66	52	41	-	83	41	33	-
50	260.0*	150	143	130	83	65	52	-	104	52	42	-
60	-	177	169	154	103	77	62	16	123	61	49	12
75	-	221	211	192	128	96	77	20	155	78	62	15
100	-	285	273	248	165	124	99	26	202	101	81	20
125	-	359	343	312	208	156	125	31	253	126	101	25
150	-	414	396	360	240	180	144	37	302	151	121	30
200	-	552	528	480	320	240	192	49	400	201	161	40
250	-	-	-	604*	403	302	242	60	-	-	-	-
300	-	-	-	722*	482	361	289	72	-	-	-	-
350	-	-	-	828*	560	414	336	83	-	-	-	-
400	-	-	-	954*	636	477	382	95	-	-	-	-
450	-	-	-	1030*	-	515	412	103	-	-	-	-
500	-	-	-	1180*	786	590	472	118	-	-	-	-

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LOAD SCHEDULE

Motor Full Load Current



Table 4.30.14.2 Full-Load Currents in Amperes, Single-Phase Alternating-Current Motors


The following values of full-load currents are for motors running at usual speeds and motors with normal torque characteristics. The voltages listed are rated motor voltages. The currents listed shall be permitted for system voltage ranges of 110 to 120 and 220 to 240 volts.

Horsepower	115 Volts	200 Volts	208 Volts	230 Volts	Horsepower	115 Volts	200 Volts	208 Volts	230 Volts
1/6	4.4	2.5	2.4	2.2	1 1/2	20	11.5	11.0	10
1/4	5.8	3.3	3.2	2.9	2	24	13.8	13.2	12
1/3	7.2	4.1	4.0	3.6	3	34	19.6	18.7	17
1/2	9.8	5.6	5.4	4.9	5	56	32.2	30.8	28
3/4	13.8	7.9	7.6	6.9	7 1/2	80	46.0	44.0	40
1	16	9.2	8.8	8.0	10	100	57.5	55.0	50

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LOAD SCHEDULE

Motor Cable Ampacity




4.30.2.2 Single Motor. Conductors that supply a single motor used in a continuous duty application shall have an ampacity of not less than 125 percent of the motor full-load current rating, as determined by 4.30.1.6(A)(1), or not less than specified in 4.30.2.2(A) through (G).

Section 4.30.3.3(C)

(C) Wye-Start, Delta-Run Motor. For a wye-start, delta-run connected motor, the ampacity of the branch-circuit conductors on the line side of the controller shall not be less than 125 percent of the motor full-load current as determined by 4.30.1.6(A)(1). The ampacity of the conductors between the controller and the motor shall not be less than 72 percent of the motor full-load current rating as determined by 4.30.1.6(A)(1).

Section 4.30.2.2


FPN: The individual motor circuit conductors of a wye-start, delta-run connected motor carry 58 percent of the rated load current. The multiplier of 72 percent is obtained by multiplying 58 percent by 1.25.



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LOAD SCHEDULE

Motor Overload Protection




4.30.3.2 Continuous-Duty Motors.

(A) More Than 1 Horsepower. Each motor used in a continuous duty application and rated more than 1 hp shall be protected against overload by one of the means in 4.30.3.2(A)(1) through (A)(4).

(1) Separate Overload Device. A separate overload device that is responsive to motor current. This device shall be selected to trip or shall be rated at no more than the following percent of the motor nameplate full-load current rating:

Motors with a marked service factor	125%
1.15 or greater	
Motors with a marked temperature rise 40°C or less	125%
All other motors	115%



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LOAD SCHEDULE



Motor Short Circuit Protection

Table 4.30.4.2 Maximum Rating or Setting of Motor Branch-Circuit Short-Circuit and Ground-Fault Protective Devices

Type of Motor	Percentage of Full-Load Current			
	Nontime Delay Fuse ¹	Dual Element (Time-Delay) Fuse ¹	Instantaneous Trip Breaker	Inverse Time Breaker ²
Single-phase motors	300	175	800	250
AC polyphase motors other than wound-rotor	300	175	800	250
Squirrel cage - other than Design B energy-efficient	300	175	800	250
Design B energy-efficient	300	175	1100	250
Synchronous ³	300	175	800	250
Wound-rotor	150	150	800	150
DC (constant voltage)	150	150	250	150



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LOAD SCHEDULE



Motor Feeder Cable and Short Circuit Protection

4.30.2.4 Several Motors or a Motor(s) and Other Load(s). Conductors supplying several motors, or a motor(s) and other load(s), shall have an ampacity not less than the sum of each of the following:

- (1) 125 percent of the full-load current rating of the highest rated motor, as determined by 4.30.1.6(A)
- (2) Sum of the full-load current ratings of all the other motors in the group, as determined by 4.30.1.6(A)
- (3) 100 percent of the noncontinuous non-motor load
- (4) 125 percent of the continuous non-motor load.



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LOAD SCHEDULE

Motor Feeder Cable and Short Circuit Protection

4.30.5.2 Rating or Setting — Motor Load.

(A) Specific Load. A feeder supplying a specific fixed motor load(s) and consisting of conductor sizes based on 4.30.2.4 shall be provided with a protective device having a rating or setting not greater than the largest rating or setting of the branch-circuit short-circuit and ground-fault protective device for any motor supplied by the feeder [based on the maximum permitted value for the specific type of a protective device in accordance with 4.30.4.2, or 4.40.3.2(A) for hermetic refrigerant motor-compressors], plus the sum of the full-load currents of the other motors of the group.



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Airconditioning

4.40.4.2 Single Motor-Compressor. Branch-circuit conductors supplying a single motor-compressor shall have an ampacity not less than 125 percent of either the motor-compressor rated-load current or the branch-circuit selection current, whichever is greater.

For a wye-start, delta-run connected motor-compressor, the selection of branch-circuit conductors between the controller and the motor-compressor shall be permitted to be based on 72 percent of either the motor-compressor rated-load current or the branch-circuit selection current, whichever is greater.

FPN: The individual motor circuit conductors of wye-start, delta-run connected motor-compressors carry 58 percent of the rated load current. The multiplier of 72 percent is obtained by multiplying 58 percent by 1.25.

4.40.4.3 Motor-Compressor(s) With or Without Additional Motor Loads. Conductors supplying one or more motor-compressor(s) with or without an additional motor load(s) shall have an ampacity not less than the sum of each of the following:

- (1) The sum of the rated-load or branch-circuit selection current, whichever is greater, of all motor-compressors
- (2) The sum of the full-load current rating of all other motors
- (3) 25 percent of the highest motor-compressor or motor full load current in the group.

4.40.3 Branch-Circuit Short-Circuit and Ground-Fault Protection

4.40.3.1 General. The provisions of Part 4.40.3 specify devices intended to protect the branch-circuit conductors, control apparatus, and motors in circuits supplying hermetic refrigerant motor-compressors against overcurrent due to short circuits and ground faults. They are in addition to or amendatory of the provisions of Article 2.40.

4.40.3.2 Application and Selection.

(A) Rating or Setting for Individual Motor-Compressor. The motor-compressor branch-circuit short-circuit and ground-fault protective device shall be capable of carrying the starting current of the motor. A protective device having a rating or setting not exceeding 175 percent of the motor-compressor rated-load current or branch-circuit selection current, whichever is greater, shall be permitted, provided that, where the protection specified is not sufficient for the starting current of the motor, the rating or setting shall be permitted to be increased but shall not exceed 225 percent of the motor rated-load current or branch-circuit selection current, whichever is greater.



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LOAD SCHEDULE



Load calculation parameters for Air-Conditioning and Motor Loads :

1. For motor loads, PEC 2017, Table 4.30.14.4. for the I_{FLC} of the motor.
2. For over-current protection for motor, PEC 1, 2017 4.30.3.2(A)1

$$I_{\text{Overload}} = I_{3\phi\text{FLA}} \times 115\%$$

3. For short circuit and ground fault protection PEC 1, 2017 4.30.4.2

$$I_{\text{MCCB}} = I_{3\phi\text{FLA}} \times (250\%)$$



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LOAD SCHEDULE



Load calculation parameters for Air-Conditioning and Motor Loads :

4. For Feeder Current, consider load as continuous load


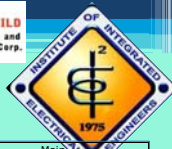
$$I_{\text{feeder}} = 125\% \times I_{3\phi} \quad \text{PEC 1, 2017 4.30.2.4}$$

5. For grounding conductor use Table 2.50.6.13 from PEC 1, 2017



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LOAD SCHEDULE


Panel Name: PP-VENT-2-1		LOAD SCHEDULE						Main Feeder Size				Main BREAKER		
Panel Location: 2F		PP-VENT-2-1						50 mm2 THHN R,Y,Bk AT				125 A		
Enclosure: Nema-1								22 mm2 THHN G AF				125 A		
System: 220 V, 3-ph, 3-wire, 60 Hz								1 SET IN CABLE TRAY				P		
Min. RMS Sym. Current: KVAIC												P		
Ckt. No.	Load Description Panel ID	Load in KW	Load in KVA	DF (%)	Demand KVA	Volts	Connected Load Current (A)				Breaker		Conductor (mm ²)	Conduit (mmdia.)
							3-ph	AB	BC	CA	AT	AF		
1	SF-2-4	1.50	1.88	80%	1.50	220	4.94					20 63 3	Y3.5+G3.5	RSC, 15
2	SF-2-5	0.75	0.94	80%	0.75	220	2.47					20 63 3	Y3.5+G3.5	RSC, 15
3	EF-2-13	0.75	0.94	80%	0.75	220	2.47					20 63 3	Y3.5+G3.5	RSC, 15
4	EXF-1-6	2.24	2.80	80%	2.24	220	7.35					20 63 3	Y3.5+G3.5	RSC, 15
5	EXF-1-7	2.24	2.80	80%	2.24	220	7.35					20 63 3	Y3.5+G3.5	RSC, 15
6	Spare			80%		220						20 63 3		
7	EF-2-4,5,6,7,8,9	0.51	0.64	80%	0.51	220		2.91				20 63 2	Y3.5+G3.5	RSC, 15
8	EF-2-10,11,12	0.30	0.38	80%	0.30	220		1.73				20 63 2	Y3.5+G3.5	RSC, 15
9	Discharge Waste Pump, SP-1-1	0.40	0.50	80%	0.40	220			2.28			20 63 2	Y3.5+G3.5	RSC, 15
10	Discharge Waste Pump, SP-1-2	0.40	0.50	80%	0.40	220			2.28			20 63 2	Y3.5+G3.5	RSC, 15
11	Discharge Waste Pump, SP-2-1	0.40	0.50	80%	0.40	220			2.28			20 63 2	Y3.5+G3.5	RSC, 15
12	Spare			80%		220						20 63 2		
13	Spare			80%		220						20 63 2		
14	Spare			80%		220						20 63 2		
Total		9.48	11.88	80%	9.50		24.58	4.64	2.28	4.56				

For Feeder Current : 3Ph + 1Ph Load = 32.62 A @ 80% DF = 26.10 A Plus 25% Highest Current = 1.84 A Total Current = 27.94 A	For Overcurrent Device : Highest CB Rating = 20 A Remaining Load = 25.27 A @ 80% DF = 20.22 A Total Current = 40.22 A
--	---

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LOAD SCHEDULE

Fire Pumps



a.) Determine the I_{LR}A of the Fire Pump :

PEC 1 2017 Table 4.30.1.7(B) Code "G" 5.6 to 6.29 kVA/HP multiplier.

I_{LR}A = 5.9 kVA/hp x IFLC for 25Hp motor
= 5.9 x 71 A = 418.9 A

b.) For Over-Current Device

Use 500AT/600AF 3P Inverse Time MCCB


c.) For Branch Circuit Conductor

I_{BCC} = 71 x 1.25 = 88.75A

Use 3-30 mm² THHN, 1R,1Y,1Bk with 1-14mm² THHN,1G

Table 4.30.1.7(B) Locked-Rotor Indicating Code Letters

Code Letter	Kilovolt-Amperes per Horsepower with locked Rotor
A	0 - 3.14
B	3.15 - 3.54
C	3.55 - 3.99
D	4.0 - 4.49
E	4.5 - 4.99
F	5.0 - 5.59
G	5.6 - 6.29
H	6.3 - 7.09
J	7.1 - 7.99
K	8.0 - 8.99
L	9.0 - 9.99
M	10.0 - 11.19
N	11.2 - 12.49
P	12.5 - 13.99
R	14.0 - 15.99
S	16.0 - 17.99
T	18.0 - 19.99
U	20.0 - 22.39
V	22.4 - and up

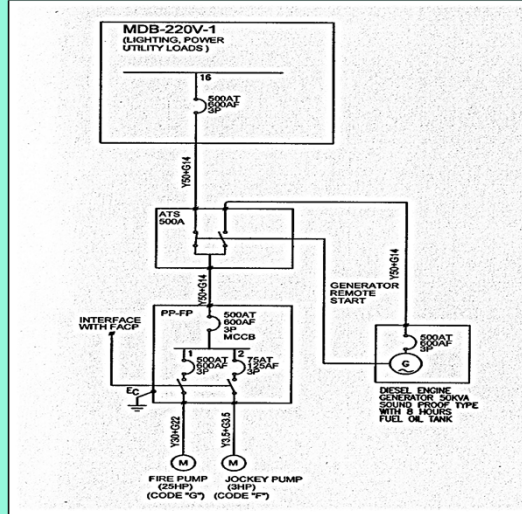


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LOAD SCHEDULE

Fire Pumps

Article 6.95



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Capacitor

ARTICLE 4.60 – CAPACITORS

4.60.1.8 Conductors.

(A) **Ampacity.** The ampacity of capacitor circuit conductors shall not be less than 135 percent of the rated current of the capacitor. The ampacity of conductors that connect a capacitor to the terminals of a motor or to motor circuit conductors shall not be less than one-third the ampacity of the motor circuit conductors and

(B) **Overcurrent Protection.** An overcurrent device shall be provided in each ungrounded conductor for each capacitor bank. The rating or setting of the overcurrent device shall be as low as practicable.

(A) **Time of Discharge.** The residual voltage of a capacitor shall be reduced to 50 volts, nominal, or less within 1 minute after the capacitor is disconnected from the source of supply.

(C) **Disconnecting Means.** A disconnecting means shall be provided in each ungrounded conductor for each capacitor bank and shall meet the following requirements:

- (1) The disconnecting means shall open all ungrounded conductors simultaneously.
- (2) The disconnecting means shall be permitted to disconnect the capacitor from the line as a regular operating procedure.
- (3) The rating of the disconnecting means shall not be less than 135 percent of the rated current of the capacitor.



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Arc Welders

6.30.2 Arc Welders

6.30.2.1 Ampacity of Supply Conductors. The ampacity of conductors for arc welders shall be in accordance with 6.30.2.2(A) and (B).

(A) Individual Welders. The ampacity of the supply conductors shall be not less than the I_{req} value on the rating plate. Alternatively, if the I_{req} is not given, the ampacity of the supply conductors shall not be less than the current value determined by multiplying the rated primary current in amperes given on the welder rating plate by the factor shown in Table 6.30.2.1(A) based on the duty cycle of the welder.

(B) Group of Welders. Minimum conductor ampacity shall be based on the individual currents determined in 6.30.2.1(A) as the sum of 100 percent of the two largest welders, plus 85 percent of the third largest welder, plus 70 percent of the fourth largest welder, plus 60 percent of all remaining welders.

6.30.2.2 Overcurrent Protection. Overcurrent protection for arc welders shall be as provided in 6.30.2.2(A) and (B). Where the values as determined by this section do not correspond to the standard ampere ratings provided in 2.40.1.6 or where the rating or setting specified results in unnecessary opening of the overcurrent device, the next higher standard rating or setting shall be permitted.

(A) For Welders. Each welder shall have overcurrent protection rated or set at not more than 200 percent of I_{max} . Alternatively, if the I_{max} is not given, the overcurrent protection shall be rated or set at not more than 200 percent of the rated primary current of the welder.

Table 6.30.2.1(A) Duty Cycle Multiplication Factors for Arc Welders

Duty Cycle	Multiplier for Arc Welders	
	Nonmotor Generator	Motor Generator
100	1.0	1.0
90	0.95	0.96
80	0.89	0.91
70	0.84	0.86
60	0.78	0.81
50	0.71	0.75
40	0.63	0.69
30	0.55	0.62
20 or less	0.45	0.55



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Resistance Welders

6.30.3 Resistance Welders

(A) Individual Welders. The rated ampacity for conductors for individual welders shall comply with the following:

- (1) The ampacity of the supply conductors for a welder that may be operated at different times at different values of primary current or duty cycle shall not be less than 70 percent of the rated primary current for seam and automatically fed welders, and 50 percent of the rated primary current for manually operated nonautomatic welders.

Table 6.30.3.1(A)(2) Duty Cycle Multiplication Factors for Resistance Welders

Duty Cycle (%)	Multiplier
50	0.71
40	0.63
30	0.55
25	0.50
20	0.45
15	0.39
10	0.32
7.5	0.27
5 or less	0.22

(B) Groups of Welders. The ampacity of conductors that supply two or more welders shall not be less than the sum of the value obtained in accordance with 6.30.3.1(A) for the largest welder supplied and 60 percent of the values obtained for all the other welders supplied.

FPN: Explanation of Terms

- (1) The *rated primary current* is the rated kilovolt-amperes (kVA) multiplied by 1 000 and divided by the rated primary voltage, using values given on the nameplate.
- (2) The *actual primary current* is the current drawn from the supply circuit during each welder operation at the particular heat tap and control setting used.
- (3) The *duty cycle* is the percentage of the time during which the welder is loaded. For instance, a spot welder supplied by a 60-Hz system (216,000 cycles per hour) and making 400 15-cycle welds per hour would have a duty cycle of 2.8 percent (400 multiplied by 15, divided by 216,000, multiplied by 100). A seam welder operating 2 cycles "on" and 2 cycles "off" would have a duty cycle of 50 percent.

(A) For Welders. Each welder shall have an overcurrent device rated or set at not more than 300 percent of the rated primary current of the welder. If the supply conductors for a welder are protected by an overcurrent device rated or set at not more than 200 percent of the rated primary current of the welder, a separate overcurrent device shall not be required.



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DEMAND FACTOR



Demand Factor is the ratio of the = Maximum Demand / Total Connected Load

Ex. The plant has a 20kW motor connected to a 15kW load

$$DF = 15kW / 20kW = 75\%$$

The total connected outlet is 10 DCO but during normally on

7 DCO are used at any time

$$DF = 0.18VA \times 7 / 0.18VA \times 10 = 70\%$$

This factor can be applied to each individual load, and to the total load.



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DIVERSITY FACTOR



Diversity Factor is the sum of the Individual Maximum Demand / Maximum Demand of the System

Diversity occurs in an operating system because all loads connected to the system are not operating simultaneously or are not simultaneously operating at their maximum rating.


Ex. One feeder has a maximum demand of 100kVA and one feeder has a maximum demand of 50kVA, but the maximum demand of the two feeder is 120kVA.

$$\begin{aligned} \text{Diversity Factor} &= \text{Total Maximum Demand} / \text{Total System Demand} \\ &= 100kVA + 50kVA / 120kVA = 1.25 \quad \text{or } 80\% \end{aligned}$$



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LOAD SCHEDULE



LOAD SCHEDULE												
Panel Name: LP-1-1		LP-1-1										
Panel Location: Optical Glass Material Storage												
Enclosure: Nema-1												
System: 220 V, 3-ph, 3-wire, 60 Hz												
Min. RMS Sym. Current: KAIC												
Ckt. No.	Load Description	Load in kW	Load in kVA	DF (%)	Demand kVA	Volts	Connected Load Current, Amperes			Main Feeder Size	Main BREAKER	
							3-ph	AB	CA		AT	AF
		1.32	1.32	100%	1.32	220	6.00			50mm2 THHN R,Y,Bk	100	A
		1.10	1.10	100%	1.10	220	5.00			22 mm2 THHN GREEN	125	A
		1.10	1.10	100%	1.10	220				1 SET IN CABLE TRAY	P	3
4	13-HF32Wx2	1.79	1.79	100%	1.79	220						
5	4- EML + 6 - EXL + 2-HF32Wx2	0.58	0.58	100%	0.58	220		2.64	20	63	2	X3.5+G3.5 EMT, 15
6	4 - EML + 5 - EXL	0.36	0.36	100%	0.36	220		1.64	20	63	2	X3.5+G3.5 EMT, 15
7	5 - DCO	0.90	0.54	60%	0.54	220	4.10		20	63	2	X3.5+G3.5 PVC, 20
8	5 - DCO	0.90	0.54	60%	0.54	220	4.10		20	63	2	X3.5+G3.5 PVC, 20
9	2 - DCO (P)	0.36	0.22	60%	0.22	220		1.64	20	63	2	X3.5+G3.5 PVC, 20
10	3 - DCO	0.41	0.32	60%	0.32	220		2.46	20	63	2	X3.5+G3.5 PVC, 20
11	1 - Hand Dryer	1.50	0.90	60%	0.90	220		6.82	20	63	2	X3.5+G3.5 PVC, 20
12	1 - Hand Dryer	1.50	0.90	60%	0.90	220		6.82	20	63	2	X3.5+G3.5 PVC, 20
13	FACP (Office Room)	1.00	0.60	60%	0.60	220	4.55		20	63	2	X3.5+G3.5 EMT, 15
14	Spare			60%		220			20	63	2	
15	Spare			60%		220			20	63	2	
16	Spare			60%		220			20	63	2	
17	Spare			60%		220			20	63	2	
18	Spare			60%		220			20	63	2	
	Total		10.27			220	23.75	17.92	17.24			

For Feeder Current :


- 3ph + 1ph Load = 41.14 A
- 25% Continous load = 10.29 A
- Total Current = 51.43 A

For Overcurrent Device

- Total Current = 51.43 A


Note :

- Duplex C.O. @ 0.18 kVA per PEC 1, 2017, 2.20.2.5(i)
- HF32Wx2 Fixture @ 0.11kVA per Supplier Data
- Emergency Light @ 0.06kVA per Supplier Data
- Exit Light @ 0.03kVA per Supplier Data
- Hand Dryer @ 1.5kVA per Supplier Data
- CFL26W @ .06kVA per Supplier Data



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LOAD SCHEDULE



LOAD SCHEDULE												
Panel Name: LP-1-1		LP-1-1										
Panel Location: Optical Glass Material Storage												
Enclosure: Nema-1												
System: 220 V, 3-ph, 3-wire, 60 Hz												
Min. RMS Sym. Current: KAIC												
Ckt. No.	Load Description	Load in kW	Load in kVA	DF (%)	Demand kVA	Volts	Connected Load Current, Amperes			Main Feeder Size	Main BREAKER	
							3-ph	AB	CA		AT	AF
		1.32	1.32	100%	1.32	220	6.00			50mm2 THHN R,Y,Bk	100	A
		1.10	1.10	100%	1.10	220	5.00			22 mm2 THHN GREEN	125	A
		1.10	1.10	100%	1.10	220				1 SET IN CABLE TRAY	P	3
4	13-HF32Wx2 + 6-CFL26W	1.79	1.79	100%	1.79	220						
5	4- EML + 6 - EXL + 2-HF32Wx2	0.58	0.58	100%	0.58	220		2.64	20	63	2	X3.5+G3.5 EMT, 15
6	4 - EML + 5 - EXL	0.36	0.36	100%	0.36	220		1.64	20	63	2	X3.5+G3.5 EMT, 15
7	5 - DCO	0.90	0.54	60%	0.54	220	4.10		20	63	2	X3.5+G3.5 PVC, 20
8	5 - DCO	0.90	0.54	60%	0.54	220	4.10		20	63	2	X3.5+G3.5 PVC, 20
9	2 - DCO	0.36	0.22	60%	0.22	220		1.64	20	63	2	X3.5+G3.5 PVC, 20
10	3 - DCO	0.54	0.32	60%	0.32	220		2.46	20	63	2	X3.5+G3.5 PVC, 20
11	1 - Hand Dryer	1.50	0.90	60%	0.90	220		6.82	20	63	2	X3.5+G3.5 PVC, 20
12	1 - Hand Dryer	1.50	0.90	60%	0.90	220		6.82	20	63	2	X3.5+G3.5 PVC, 20
13	FACP (Office Room)	1.00	0.60	60%	0.60	220	4.55		20	63	2	X3.5+G3.5 EMT, 15
14	Spare			60%		220			20	63	2	
15	Spare			60%		220			20	63	2	
16	Spare			60%		220			20	63	2	
17	Spare			60%		220			20	63	2	
18	Spare			60%		220			20	63	2	
	Total		10.27			220	23.75	17.92	17.24			

For Feeder Current :


- 3ph + 1ph Load = 41.14 A
- 25% Continous load = 10.29 A
- Total Current = 51.43 A

For Overcurrent Device


- Total Current = 51.43 A

Note :


- Duplex C.O. @ 0.18 kVA per PEC 1, 2017, 2.20.2.5(i)
- HF32Wx2 Fixture @ 0.11kVA per Supplier Data
- Emergency Light @ 0.06kVA per Supplier Data
- Exit Light @ 0.03kVA per Supplier Data
- Hand Dryer @ 1.5kVA per Supplier Data
- CFL26W @ .06kVA per Supplier Data




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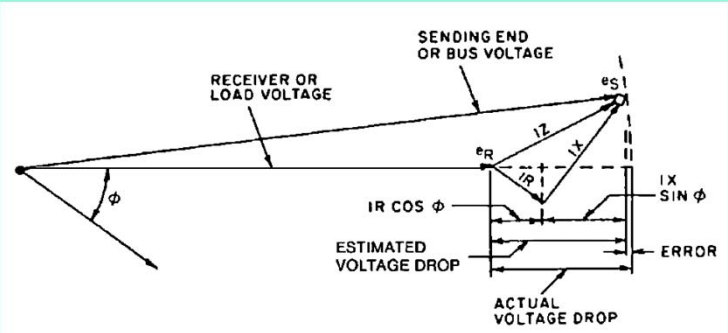
Voltage Drop



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Voltage Drop



For exact calculations, the following formula may be used:

$$\text{actual voltage drop} = e_s + IR \cos \phi + IX \sin \phi - \sqrt{e_s^2 - (IX \cos \phi - IR \sin \phi)^2}$$



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Voltage Drop



The approximate formula for the voltage drop is

$$V = IR \cos \phi + IX \sin \phi$$

where

Voltage system	Multiply by
Single-phase	2
Three-phase	1.732

- V is the voltage drop in circuit, line to neutral
- I is the current flowing in conductor
- R is the line resistance for one conductor, in ohms
- X is the line reactance for one conductor, in ohms
- ϕ is the angle whose cosine is the load power factor
- $\cos \phi$ is the load power factor, in decimals
- $\sin \phi$ is the load reactive factor, in decimals



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Voltage Drop



Table 10.1.1.9 Alternating-Current Resistance and Reactance for 600-Volt Cables, 3-Phase, 60 Hz, 75°C -Three Single Conductors in Conduit

Conductor Size [mm ² (sq in.)]	Ohms to Neutral per 305 m														
	XL (Reactance) for All Wires		Alternating-Current Resistance for Uncoated Copper Wires			Alternating-Current Resistance for Aluminum Wires			Effective Z at 0.85 PF for Uncoated Copper Wires			Effective Z at 0.85 PF for Aluminum Wires			
	PVC, Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	PVC Conduit	Aluminum Conduit	Steel Conduit	
2.0 (1.6)	0.058	0.073	3.1	3.1	3.1	-	-	-	2.7	2.7	2.7	-	-	-	
3.5 (2.0)	0.054	0.068	2.0	2.0	2.0	3.2	3.2	3.2	1.7	1.7	1.7	2.8	2.8	2.8	
5.5 (2.6)	0.050	0.063	1.2	1.2	1.2	2.0	2.0	2.0	1.1	1.1	1.1	1.8	1.8	1.8	
8.0 (3.2)	0.052	0.065	0.78	0.78	0.78	1.3	1.3	1.3	0.69	0.69	0.70	1.1	1.1	1.1	
14	0.051	0.064	0.49	0.49	0.49	0.81	0.81	0.81	0.44	0.45	0.45	0.71	0.72	0.72	
22	0.048	0.060	0.31	0.31	0.31	0.51	0.51	0.51	0.29	0.29	0.30	0.46	0.46	0.46	
30	0.045	0.057	0.19	0.20	0.20	0.32	0.32	0.32	0.19	0.19	0.20	0.30	0.30	0.30	
38	0.046	0.057	0.15	0.16	0.16	0.25	0.26	0.25	0.16	0.16	0.16	0.24	0.24	0.25	
50	0.044	0.055	0.12	0.13	0.12	0.20	0.21	0.20	0.13	0.13	0.13	0.19	0.20	0.20	
60	0.043	0.054	0.10	0.10	0.10	0.16	0.16	0.16	0.11	0.11	0.11	0.16	0.16	0.16	
80	0.042	0.052	0.077	0.082	0.079	0.13	0.13	0.13	0.088	0.092	0.094	0.13	0.13	0.14	
100	0.041	0.051	0.062	0.067	0.063	0.10	0.11	0.10	0.074	0.078	0.080	0.11	0.11	0.11	
125	0.041	0.052	0.052	0.057	0.054	0.085	0.090	0.086	0.066	0.070	0.073	0.094	0.098	0.10	
150	0.041	0.051	0.044	0.049	0.045	0.071	0.076	0.072	0.059	0.063	0.065	0.082	0.086	0.088	
175	0.040	0.050	0.038	0.043	0.039	0.061	0.066	0.063	0.053	0.058	0.060	0.073	0.077	0.080	
200	0.040	0.049	0.033	0.038	0.035	0.054	0.059	0.055	0.049	0.053	0.056	0.066	0.071	0.073	
250	0.039	0.048	0.027	0.032	0.029	0.043	0.048	0.045	0.043	0.048	0.050	0.057	0.061	0.064	
325	0.039	0.048	0.023	0.028	0.025	0.036	0.041	0.038	0.040	0.044	0.047	0.051	0.055	0.058	
375	0.038	0.048	0.019	0.024	0.021	0.029	0.034	0.031	0.036	0.040	0.043	0.045	0.049	0.052	
400	0.038	0.048	0.019	0.024	0.021	0.029	0.034	0.031	0.036	0.040	0.043	0.045	0.049	0.052	
500	0.037	0.046	0.015	0.019	0.018	0.023	0.027	0.025	0.032	0.036	0.040	0.039	0.042	0.046	

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Voltage Drop



Section 2.10.2.2

FPN No. 4: Conductors for branch circuits as defined in Article 1.1, sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest outlet does not exceed 5 percent, provide reasonable efficiency of operation. See FPN No. 2 of 2.15.1.2(A)(1) for voltage drop on feeder conductors.

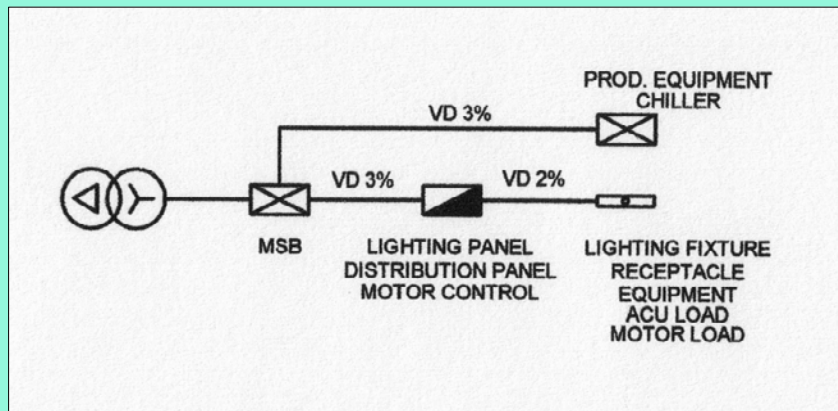
Section 2.15.1.2

FPN No. 2: Conductors for feeders, as defined in Article 1.1, sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest outlet does not exceed 5 percent, will provide reasonable efficiency of operation.



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Voltage Drop



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Voltage Drop

Voltage Drop Calculation 3ø

$$VD_{3\phi} = \sqrt{3} \times I \times ((L/305)/S) \times (R \cos \phi + X \sin \phi)$$

Where :

R is in $\Omega/305$ m PEC 2017, Table 10.1.1.9

X is in $\Omega/305$ m PEC 2017, Table 10.1.1.9

Cos ϕ = 0.80 (power factor)

S is the number of parallel cable

Voltage Drop Calculation 1ø

$$VD_{1\phi} = 2 \times I \times ((L/305)/S) \times (R \cos \phi + X \sin \phi)$$

Where :

R is in $\Omega/305$ m PEC 2017, Table 10.1.1.9

X is in $\Omega/305$ m PEC 2017, Table 10.1.1.9

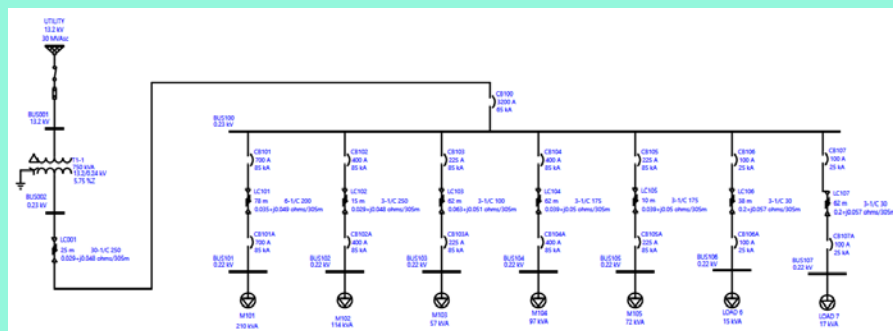
Cos ϕ = 0.80

S is the number of parallel cable




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Voltage Drop



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Voltage Drop




Voltage Drop Calculation 3Ø for LC001

$$\begin{aligned}
 \mathbf{VD_{3\phi}} &= \sqrt{3} \times \mathbf{I} \times ((\mathbf{L}/305)/\mathbf{S}) \times (\mathbf{R} \cos \phi + \mathbf{X} \sin \phi) \\
 &= \sqrt{3} \times 1454\mathbf{A} \times ((25\mathbf{m}/305)/10) \times \\
 &\quad ((0.0290 \times 0.8) + (0.0480 \sin (\cos^{-1} 0.8))) \\
 &= \mathbf{1.08 V} \\
 \mathbf{\%VD} &= (1.08 \mathbf{V} / 231 \mathbf{V}) \times 100 = \mathbf{0.47 \% - OK}
 \end{aligned}$$


Voltage Drop Calculation 3Ø for LC101

$$\begin{aligned}
 \mathbf{VD_{3\phi}} &= \sqrt{3} \times \mathbf{I} \times ((\mathbf{L}/305)/\mathbf{S}) \times (\mathbf{R} \cos \phi + \mathbf{X} \sin \phi) \\
 &= \sqrt{3} \times 527\mathbf{A} \times ((78\mathbf{m}/305)/2) \times \\
 &\quad ((0.0350 \times 0.8) + (0.0490 \sin (\cos^{-1} 0.8))) \\
 &= \mathbf{6.71 V} \\
 \mathbf{\%VD} &= (6.71 \mathbf{V} / 230\mathbf{V}) \times 100 = \mathbf{2.92\%}
 \end{aligned}$$




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Voltage Drop



Voltage Drop Calculation

Cable No.	From	To	Source Voltage (V)	kVA (Demand)	Demand Current (A)	Cable Type	Size (mm2)	Cable Per Phase	Length (m)	Wire Resistance R(Ω/305m)	Wire Inductance X(Ω/305m)	Power factor	Voltage drop(V)	Voltage drop(%) <3%	Receiving Voltage (V)
MAIN CABLE															
LC001	T1-1	BUS100	231	582.00	1454.67	THHN	250	10	25	0.0290	0.0480	0.8	1.08	0.47%	230
MDP PANEL															
LC101	MDP	M101	230	210.00	527.16	THHN	200	2	78	0.0350	0.0490	0.8	6.71	2.92%	223
LC102	MDP	M102	230	114.00	286.17	THHN	250	1	15	0.0290	0.0480	0.8	1.27	0.55%	229
LC103	MDP	M103	230	57.00	143.09	THHN	100	1	62	0.0630	0.0510	0.8	4.09	1.78%	226
LC104	MDP	M104	230	97.00	243.50	THHN	175	1	62	0.0390	0.0500	0.8	5.25	2.28%	225
LC105	MDP	M105	230	72.00	180.74	THHN	175	1	10	0.0390	0.0500	0.8	0.63	0.27%	229
LC106	MDP	LOAD 6	230	15.00	37.65	THHN	30	1	38	0.2000	0.0570	0.8	1.58	0.69%	228
LC107	MDP	LOAD 7	230	17.00	42.67	THHN	30	1	62	0.2000	0.0570	0.8	2.92	1.27%	227



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Voltage Drop



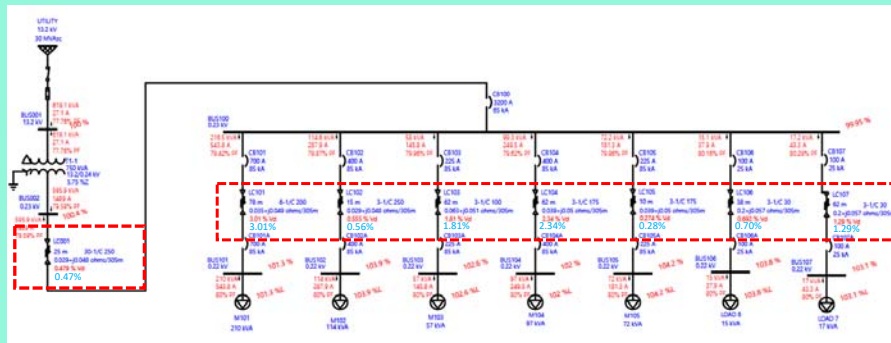
Voltage Drop Calculation

Cable No.	From	To	Source Voltage (V)	kVA (Demand)	Demand Current (A)	Cable Type	Size (mm ²)	Cable Per Phase	Length (m)	Wire Resistance R _(at 305m)	Wire Inductance X _(at 305m)	Power factor	Voltage drop(V)	Voltage drop(% <math><3\%</math>)	Receiving Voltage (V)
MAIN CABLE															
LC001	T1-1	BUS100	231	582.00	1460.99	THHN	250	10	25	0.0290	0.0480	0.8	1.08	0.47%	230
MDP PANEL															
LC101	MDP	M101	230	210.00	543.71	THHN	200	2	78	0.0350	0.0490	0.8	6.92	3.01%	223
LC102	MDP	M102	230	114.00	287.42	THHN	250	1	15	0.0290	0.0480	0.8	1.28	0.56%	229
LC103	MDP	M103	230	57.00	145.62	THHN	100	1	62	0.0630	0.0510	0.8	4.16	1.81%	226
LC104	MDP	M104	230	97.00	248.91	THHN	175	1	62	0.0390	0.0500	0.8	5.37	2.34%	225
LC105	MDP	M105	230	72.00	181.53	THHN	175	1	10	0.0390	0.0500	0.8	0.64	0.28%	229
LC106	MDP	LOAD 6	230	15.00	37.98	THHN	30	1	38	0.2000	0.0570	0.8	1.60	0.70%	228
LC107	MDP	LOAD 7	230	17.00	43.24	THHN	30	1	62	0.2000	0.0570	0.8	2.96	1.29%	227



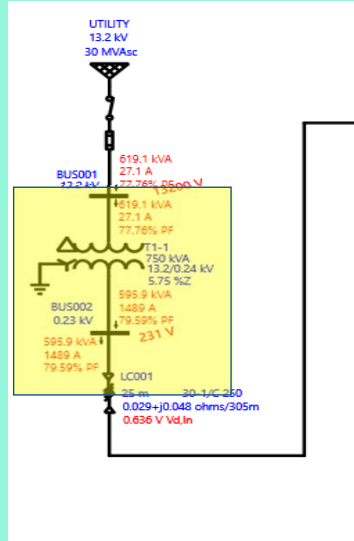
89

Voltage Drop



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Voltage Drop



Transformer Secondary Voltage Rating : 240V

Transformer Terminal Voltage : 231V



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Voltage Drop



Transformer Voltage Drop Calculation 3 ϕ

Data : 750kVA, 240V Sec., %Z 5.75, X/R 3.96

Load : I 1460.99A, PF=0.8

$$\%R = \%Z \cos \text{Arctan} (X/R) = 1.40\%$$

$$\%X = \%Z \sin \text{Arctan} (X/R) = 5.57\%$$

$$R \text{ Actual} = (\%R/100)(V)^2 / TR_{VA} = 0.001081 \text{ ohms}$$

$$X \text{ Actual} = (\%X/100)(V)^2 / TR_{VA} = 0.004282 \text{ ohms}$$

$$VD_{3\phi} = \sqrt{3} \times I \times (R_{tr} \cos \phi + X_{tr} \sin \phi)$$

$$= \sqrt{3} \times 1460.99A \times ((0.001081 \times 0.8) + (0.004280 \sin (\cos^{-1} 0.8)))$$

$$= 8.69 \text{ V} ; 240V - 8.69V = \mathbf{231V \text{ terminal voltage}}$$

$$\%VD = (8.69V / 240 \text{ V}) \times 100 = 3.62 \%$$



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**THANK YOU FOR
ALL THE
BLESSINGS...**



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