



Content
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Electrical Engineering Calculations for Power Systems - Load, Ampacity, Voltage Drop, Motor and Transformer Sizing

[View Course Details](#)

COURSE DATES AND TIMES

Why Electrical Engineering Calculations Matter

This 12-hour live online instructor-led course is based on the NFPA 70 National Electrical Code (NEC). Every module is built around worked examples and practice problems, so participants learn both the engineering method behind each calculation and the code requirements that determine the final answer.

Every electrical design decision starts with a calculation. Conductor size, breaker rating, transformer kVA, equipment interrupting rating and voltage at the load are all determined by calculations, and an error in any one of them carries through to every calculation that follows. An undersized conductor overheats. An underrated breaker can fail violently during a fault. Excessive voltage drop causes motors to overheat and equipment to malfunction.

Most engineering graduates understand electrical theory, but few have applied it to a real design problem. Knowing the three-phase power formula is not the same as sizing the conductors, overload protection, breaker and disconnect for a 75 HP motor 275 feet from a motor control center, and then confirming the voltage drop and the available fault current. That practical skill is usually learned slowly on the job, often through mistakes that a senior engineer has to catch.

Engineering software performs these calculations quickly, but it cannot tell an engineer when the input data is wrong. Engineers who understand the calculations can check software results, recognize an unreasonable answer and explain their design decisions to reviewers, inspectors and clients. This is the foundation for every more advanced power system study.

Course Overview

The course follows the calculations an electrical engineer performs when designing a facility's power distribution system, from the individual load back to the utility transformer.

Day 1 begins with a short, practical review of electrical calculation fundamentals:

- single-phase and three-phase power formulas,
- kW, kVA, kVAR and power factor,
- how to check whether an answer is reasonable.

It then covers load calculations and load schedules, conductor ampacity and derating, voltage drop, conduit fill, and overcurrent protection and grounding conductor sizing.

Day 2 covers motor circuit calculations, then transformer sizing and protection, then available fault current and equipment ratings, then power factor correction. It finishes with an integrated design project in which participants calculate their way through a small industrial facility, followed by a course review and final assessment.

Codes and standards referenced:

- NFPA 70 National Electrical Code (NEC), 2023 and 2026 Editions
- NEC Chapter 9 Conductor Properties, Raceway and Conduit Fill Tables
- ANSI C84.1 Electric Power Systems and Equipment – Voltage Ratings
- IEEE 3000 Standards Collection for Industrial and Commercial Power Systems
- Manufacturer data for motors, transformers and protective devices

Learning Outcomes

Participants will be able to:

- Apply single-phase and three-phase power formulas to calculate current, kW, kVA, kVAR and power factor, and check results for reasonableness.
- Calculate panel, feeder and service loads using demand factors and continuous load requirements, and determine spare capacity in existing systems.
- Select conductors by applying termination temperature limits, ambient temperature correction, bundling adjustment and overcurrent protection requirements.
- Calculate voltage drop, size conductors to meet voltage drop limits, determine maximum circuit lengths and select raceway sizes using conduit fill calculations.
- Size motor branch circuits and multiple-motor feeders, including conductors, overload protection, short-circuit and ground-fault protection and disconnects.
- Size transformers and their overcurrent protection, and calculate available fault current to verify equipment interrupting ratings and SCCRs.
- Calculate power factor correction and combine all course calculations to complete the basic electrical design of a small industrial facility.

WHO SHOULD ATTEND

- Junior Electrical Engineers
- Engineers-in-Training (EITs)

- Recent Electrical Engineering Graduates
- Electrical Designers and Drafters
- Electrical Engineering Technologists and Technicians
- Consulting and EPC Engineers
- Plant, Facility and Project Engineers
- Mechanical and Civil Engineers Moving Into Electrical Design
- Electrical Contractors, Estimators and Project Managers
- Engineering Managers Training New Hires

STUDENTS RECEIVE

- Electrical Engineering Calculations Course Certificate
- 1.2 CEU Credits (12 Professional Development Hours)
- Electrical Engineering Formulas & Calculations Handbook
- Student Workbook With Worked Examples, Practice Problems and Full Solutions
- A FREE Digital Electricity Today T&D Magazine Subscription
- \$100 Coupon Toward Any Future Electricity Forum Course (Restrictions Apply)
- Course Materials In PDF Format

COURSE OUTLINE

Electrical Engineering Calculations Training – Course Outline

DAY ONE

FUNDAMENTALS, LOADS, CONDUCTORS AND PROTECTION

MODULE 1 – ELECTRICAL CALCULATION FUNDAMENTALS

- Units, Prefixes and Unit Conversions
- Ohm's Law and the Power Formulas
- Single-Phase and Three-Phase Power and the $\sqrt{3}$ Factor
- kW, kVA, kVAR, Power Factor and Efficiency
- Calculating Current From kW, kVA and Horsepower
- Quick Checks for Reasonable Answers

MODULE 2 – LOAD CALCULATIONS AND LOAD SCHEDULES

- Connected Load, Demand Load and Demand Factors
- Continuous and Noncontinuous Loads and the 125% Rule
- Lighting, Receptacle and Equipment Load Calculations
- Panel, Feeder and Service Load Calculations
- Existing Loads, Spare Capacity and Future Growth

- Developing a Panel Load Schedule

MODULE 3 – CONDUCTOR AMPACITY AND DERATING

- Load Current and Required Conductor Ampacity
- Copper and Aluminum Conductors and Insulation Temperature Ratings
- Termination Temperature Limitations
- Ambient Temperature Correction and Bundling Adjustment Factors
- Parallel Conductors and Neutral Sizing
- Final Conductor Selection and the Next-Size-Up Rule

MODULE 4 – VOLTAGE DROP CALCULATIONS

- Single-Phase and Three-Phase Voltage Drop Formulas
- Resistance, Impedance and the K-Factor Method
- Percentage Voltage Drop and Recommended Limits
- Sizing Conductors for Voltage Drop
- Maximum Circuit Length Calculations
- Feeder Plus Branch-Circuit Voltage Drop and Motor Starting

MODULE 5 – CONDUIT FILL AND RACEWAY SIZING

- Conductor Cross-Sectional Areas
- Allowable Percentage Fill
- Calculating Total Conductor Area
- Selecting Raceway Size
- Including Equipment Grounding Conductors
- Conduit Fill and Ampacity Adjustment

MODULE 6 – OVERCURRENT PROTECTION, BREAKER SIZING AND GROUNDING CONDUCTORS

- Overcurrent Protection Principles and Standard Ratings
- Continuous Loads: Standard-Rated and 100%-Rated Devices
- Protecting Conductors After Derating
- Trip Ratings Versus Interrupting Ratings
- Equipment Grounding Conductor Sizing
- Upsizing Grounding Conductors for Voltage Drop

DAY TWO

MOTORS, TRANSFORMERS, FAULT CURRENT AND SYSTEM DESIGN

MODULE 7 – MOTOR CIRCUIT CALCULATIONS

- Horsepower, kW and Motor Current: Nameplate Versus Table Current
- Branch-Circuit Conductor Sizing
- Overload Protection
- Short-Circuit and Ground-Fault Protection
- Motor Disconnect Sizing and Starting Current
- Multiple-Motor Feeder Conductors and Protection

MODULE 8 – TRANSFORMER SIZING AND PROTECTION

- Transformer kVA Sizing From Calculated Load and Growth
- Primary and Secondary Current and Turns Ratio
- Transformer Overcurrent Protection
- Primary and Secondary Conductor Sizing
- Secondary Conductor Protection for Delta-Wye Transformers
- Transformer Loading and Selection

MODULE 9 – AVAILABLE FAULT CURRENT AND EQUIPMENT RATINGS

- Why Available Fault Current Matters
- Transformer Impedance Method
- Impedance Tolerance and Worst-Case Fault Current
- Point-to-Point Method for Downstream Equipment
- Motor Contribution
- Interrupting Ratings, SCCR and Equipment Adequacy

MODULE 10 – POWER FACTOR CORRECTION CALCULATIONS

- The kW, kVA and kVAR Power Triangle
- Capacitor kVAR Calculations
- Current Reduction After Correction
- Capacitor Conductor and Protection Sizing
- Avoiding Overcorrection
- Energy and Efficiency Calculations

MODULE 11 – INTEGRATED ELECTRICAL DESIGN PROJECT

- Service, MCC, Lighting, Process and Transformer Loads
- MCC Feeder and Motor Branch-Circuit Design
- Lighting Panel, Process Heater and Dry-Type Transformer Circuits
- Service Sizing and Utility Transformer Loading
- Voltage Drop and Conduit Sizing
- Available Fault Current at Major Equipment

COURSE REVIEW AND FINAL ASSESSMENT

- Review of Key Calculations and Common Errors
- Questions and Answers
- Final Assessment

COURSE TIMETABLE

Both Days:

Start: 10:00 a.m. Eastern Time

Finish: 4:30 p.m.

Contact us Today for a FREE quotation to deliver this course at your company's location.

[Request Quote](#)