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Estimating Electrical Construction

Revised

by

Mark C. Tyler

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Acknowledgements

The author wishes to express his appreciation to the following companies and organizations for furnishing materials used in the preparation of various portions of this book:

American Arbitration Association — 1633 Broadway, 10th Floor, New York, NY 10019

Appleton Electric Company — 9377 W. Higgins Road, Rosemont, IL 60018

Calculated Industries, Inc. — 4840 Hytech Drive, Carson City, NV 89706

Hubbell Lighting, Inc. (Formerly Marvin Electric Manufacturing Company) — 584 Derby
Milford Road, Orange, CT 06477

Leviton Manufacturing Company, Inc. — 201 North Service Road, Melville, NY 11747

Lithonia Lighting — P.O. Box A, Conyers, GA 30012

Square D Company — 1415 South Roselle Road, Palatine, IL 60067

Trade Service Publications, Inc. — 15092 Avenue of Science, San Diego, CA 92128

Westinghouse Electric Corporation — 1000 Westinghouse Drive, Cranberry Township, PA 16066

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Library of Congress Cataloging-in-Publication Data

Tyler, Mark C.

Estimating electrical construction, revised / by Mark C. Tyler.

p. cm.

Rev. ed. of: Estimating electrical construction / by Edward J. Tyler. 1983.

Includes index.

ISBN 978-1-57218-253-0

1. Electrical engineering--Estimates. I. Tyler, Edward J. Estimating electrical construction. II. Title.

TK435.T93 2011

621.319'24--dc22

2011005598

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Edited by Brian E. P. Beeston and Michelle Striler

Template Devona Quindoy, dqartdesigns.com

Layout by Devona Quindoy & Joan Hamilton

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Chapter 1

What Does It Take to Be an Electrical Estimator?

ELECTRICAL CONTRACTING IS A relatively new business. Masonry, plumbing, framing, roofing and most construction trades can trace their roots back hundreds or even thousands of years. There weren't any electricians or electrical contractors 150 years ago. The electrification of America didn't begin until the 1880s when the first commercial power-generating station was built in New York City.

In the early days of electrical contracting, there was no electrical code. Installation practice was poor by today's standards. In one group of 65 mills where electric power was installed in the 1890s, there were 23 serious fires — in the first six months! Still, the demand for electricity increased rapidly. During the 1890s, trade associations, insurers and manufacturers developed standards that became the *National Electrical Code*®, first published in 1897.

The *NEC*® is revised every three years to better protect people and property. Revisions are determined after studies by code committees and have resulted in better electrical materials, more advanced designs and improved installation procedures. Constant code changes make

the work of electrical contractors and electrical estimators more difficult. But they also make for better, safer, and more durable electrical installations.

As the electrical contracting business developed and matured, the role of professional electrical estimators became more specialized. Anyone can quote prices for electrical work. Most states require that both electricians and electrical contractors be licensed; but electrical estimators need no license at all. Under the law, company owners, managers, engineers, supervisors, electricians and salespeople can quote prices for electrical work. Technicians from telephone companies, alarm system manufacturers, and electrical equipment manufacturers often quote installation prices for their specialized electrical work.

But please don't misunderstand. Estimating the cost of electrical work can be a very detailed, exacting discipline. It takes specialized skills and knowledge to create reliable estimates for electrical work. That's why electrical estimating is so important to the success of any electrical contracting company. Most work is awarded

through competitive bidding. The lowest qualified bidder usually gets the job. Profit margins can be thin, especially when work is scarce. The penalty for a haphazard estimate can be a major loss, and no electrical contracting company needs more of those. Nearly every electrical contracting company needs the best effort of at least one qualified electrical estimator.

The Electrical Estimator

At one time, most electrical estimators were also electricians, usually with at least six to eight years of experience in the field. Experienced electricians tend to be good at reading drawings. They understand contract specifications and are proficient at following the *NEC* — essential skills for every electrical estimator. Years ago, master electricians commonly drafted electrical layouts, showing receptacles, switches and fixtures. These drawings became supplements to the architectural drawings and were used by installers to lay out the work. Material takeoffs and cost estimates were created from electrical drawings prepared by a master electrician. That's still true today on small, service-type projects.

But work on larger projects is much more specialized today. Electrical estimators seldom draft electrical drawings and almost never specify materials or equipment. Those tasks are typically done by trained specialists, usually electrical engineers or Computer-Aided Design and Drafting (CADD) professionals. Many larger projects are “design-build” jobs, where the contractor is responsible for both the design and construction. There's no competitive bidding, but estimates are still required. On design-build projects, the electrical estimator operates as a member of the design team, developing ROM (rough order of magnitude) prices for budget purposes.

The electrical estimators I know come from varied backgrounds. Most worked as installers before taking a desk job as a service estimator or residential estimator for a small- to medium-

sized electrical contracting company. With additional experience and training, it's common to transition to more complex, more technical projects.

Some electrical estimators begin a career on the staff of a larger electrical contracting company. A typical estimating department in a large electrical contracting firm will have one or two junior or trainee estimators along with several more experienced estimators. When an electrical estimator has developed the skills and contacts necessary to be successful, many begin consulting, or even start electrical contracting companies of their own. Some of the busiest and most successful electrical estimators I know are freelancers. Both the rewards and the risks are greater when working for yourself. But clearly there are advantages to working at your own pace and setting your own hours.

An electrical estimator's primary task is to develop a reliable estimate of job costs. In practice, it seldom stops there. Experienced electrical estimators often play a major advisory role, recommending preferred installation details, identifying risks and opportunities in the job, and maximizing value while minimizing costs. A good electrical estimator can make a significant contribution to any electrical construction team.

On very large projects, there will often be a chief estimator and several junior estimators. In one of our practice examples, you'll figure the cost of work planned by the electrical design group. When done, you'll hand the estimate over to the senior estimator who will combine all estimates to calculate the project cost. That total goes to company managers who will set a percentage for markup, turning the estimate into a bid.

Electrical estimating can be either full- or part-time work. Most smaller electrical contracting companies don't bid enough jobs to keep an electrical estimator busy full-time. The company owner may be the only qualified electrical estimator available. Some smaller electrical contractors don't even have an estimator on staff. Instead, they call on a freelance estimator when the need arises.

Many electrical contracting firms, both large and small, put the electrical estimator to work as project manager when a bid is accepted. After winning the job, the electrical estimator puts on a hard hat and manages the project. That creates a tight feedback loop, making the project manager a better estimator (more aware of costs) and the estimator a better project manager (more aware of installation issues).

The best electrical estimators have an instinct for finding jobs with better-than-average profit potential — and identifying jobs with more risk than potential reward. That's why a skilled electrical estimator is a valuable asset to any electrical contracting company — possibly the most valuable member of the team. Electrical estimators are the first line of defense against financial loss.

No matter where you fit in the picture, I hope you've decided to build the qualifications required to create a successful career in electrical estimating. Opportunities are plentiful. This manual is designed as a stepping stone along your career path.

The Design Team

Construction is far more complex today than in 1890 when buildings were first wired for electrical service. Today it takes a team of professionals to complete nearly any commercial or industrial building.

Every job starts with a property owner. The property owner sets the job in motion and pays the bills, frequently from loan proceeds made available by a commercial lender. The property owner isn't usually a member of the design team, but selects at least the leader of that team, the architect.

The architect plans a project that meets the needs of the property owner. The architect may also act as the property owner's representative, supervising construction to ensure compliance

with plans and specifications. The architect prepares the construction documents. These include an advertisement for bids, instructions to bidders, the contract, general and special conditions to the contract, project specifications, project drawings, and guidelines for administration of the contract. On larger projects, the architectural firm will usually retain consulting engineers to advise on technical phases of the project. These can include a structural engineer, a mechanical engineer and an electrical engineer.

The structural engineer (SE) designs the skeleton of the project, the foundation, and supporting members. The SE plans equipment bases, suspended members, seismic and wind resistance and other structural components.

The mechanical engineer (ME) designs the Heating, Ventilating and Air Conditioning (HVAC) system, plumbing and drainage.

Rewards for Electrical Estimators

Electricians are among the highest paid construction tradesmen, and electrical estimators are among the best-paid estimators in the construction industry. Most larger electrical contracting companies offer novice estimators a fair beginning salary with periodic increases. Some base an estimator's salary on a percentage of the rate paid to journeymen electricians. The percentage is low in the beginning but can be counted on to increase with experience and competence. Most electrical estimators work on salary, get paid either weekly or bimonthly, and receive good benefits. Advancement opportunities are excellent for progressive electrical estimators. As the planner of new work, you can make an important contribution to the success of your company.

Working conditions tend to be good. But time is a major limitation for most electrical estimators. Accuracy (quality) is important, of course. But so is quantity. The more jobs you bid, the more contracts you're likely to win. Bid dates are set by the owner or the prime (general) contractor. You have little or no control over timing. The clock can become an electrical estimator's worst enemy. Most bids are due on a particular day at a specific time. A heavy workload can require putting in extra hours at the office — a small sacrifice for a successful bid.

Estimating Electrical Construction

The electrical engineer (EE) designs the electrical system: power generation (either the primary or standby), primary and back-up lighting, a communications system (telephone and voice mail), the computer network, a paging system, a sound system, an employee-recognition security system, an intrusion system, and a fire alarm system. The electrical engineer must work closely with the architect, the structural engineer and the mechanical engineer. Electrical estimators have to estimate quantities and costs for nearly anything an EE can design.

The design team's work isn't done until construction is complete. The design team may be responsible for on-site inspections as the project progresses. The architect's contract with a consulting engineer usually requires inspections to ensure that installation complies with the plans and specifications. Consultants check the shop drawings (submittals) prepared by manufacturers and subcontractors to be sure the finished product will meet the property owner's and architect's expectations.

The Construction Team

A prime contractor has a contract with the property owner and leads the construction team, usually with the help of a few subcontractors. The prime contractor receives direction from the design team (plans and specs), instruction from the property owner (the contract) and rules from the building codes (including the *NEC*).

The bid documents usually require the contractor to supply a *bid bond*. If the contractor's bid is selected, the bid bond "binds" the contractor to sign the construction contract at the bid price. Most invitations to bid also require that the contractor supply a *performance bond* guaranteeing that work will be completed as shown in the plans. Bid bonds and performance bonds are underwritten by licensed bonding companies and are purchased at the expense of the contractor or subcontractor whose performance is guaranteed. If the contractor or

subcontractor can't or won't finish the work, the bonding company hires another company to complete the job — and then tries to recover against the defaulting contractor.

The contractor must also provide insurance coverage for casualty losses and other hazards. Most electrical contractors also take out the building permit for the electrical portion of the job. Chapter 11, *Other Costs to Consider*, has more information on bonds, insurance, licenses and taxes.

On most jobs, there will be a prime contractor (the *prime*) and subcontractors (the *subs*). Sometimes there will be subs to the subs. A sub's responsibilities are very similar to those of the prime — just on a smaller scale. An electrical sub submits a bid to do electrical work described in the plans and specs. But that's not all. Subs have to meet all requirements of the contract, including bonds, insurance, licenses and taxes.

The prime contractor is responsible for the work of first-tier subcontractors as though the work was being done by the prime contractor's own crews. Second-tier subs are responsible for the work of third-tier subs, and so on.

On a large job that lasts many months, the property owner will usually make progress payments once or twice a month, creating a cascade of payments that go from prime to first-tier to second-tier, etc. If a contract doesn't allow for progress payments, the prime and subs may have to take out loans to finance the project. Interest on such a loan would then become another cost on your estimate form. We'll discuss progress payments in more detail in Chapter 11.

Subcontractors usually have little or no direct contact with either the architect or the property owner. They deal with the contractor one tier above and, of course, the inspector.

On small jobs, like renovating the electrical system of an existing building, the electrical contractor may be the prime contractor, working directly with the property owner. Again, one or

more subs may be called on to do specialty work. The entire construction team may consist of the property owner, the contractor, the estimator, the foreman, and an office manager who checks the estimates and keeps the company books.

Whether an electrical contractor is the prime or the sub, the duties will be similar:

- Finding a job that matches company capabilities
- Estimating the cost of the job
- Submitting a bid to the property owner (if the electrical contractor is the prime), or to the prime (if the electrical contractor is a sub)
- Selling the bid — jobs don't usually just fall into your lap
- Signing a contract if the bid is selected
- Planning the work (much of this happens in the estimating phase)
- Doing the work — following the plans, specs, contract and code
- Getting the work signed off — and adding another satisfied customer to your list

Changes in Electrical Contracting

Traditionally, construction projects have three primary players: the property owner, the designer (architect and engineer) and the general contractor. But there are many variations. In a design-build job, the designer is also the builder (the general contractor). Most states permit a builder to do design work for a project constructed by that builder, though the same builder-architect couldn't do design work for construction by others. More often, the builder isn't the designer — but still may be part of the design team, counseling on preferred materials and installation methods and even suggesting

alternatives that can save money or add value to the building. The company I currently work for is a design-build firm. We do it all, using our own staff.

Some very large companies have their own construction division. If that's the case, the property owner may wear all three hats — property owner, designer and contractor. A builder who is also the property owner will usually administer the contract and set the construction schedule.

Most property owners don't have the time or the background to manage a complex construction project. It's usually easier, faster, and cheaper to assign the project to a dependable, experienced builder. In that case, the owner may prefer to have the builder take full charge of both project design and construction (design-build).

You'll also hear construction professionals talking about mechanical, electrical and plumbing (MEP) or mechanical, electrical, data and plumbing (MEDP) teams. Either way, it's a team approach which combines design and estimating for the largest project sub-components. Estimators, designers, detailers and engineers work together as a team to meet the needs of the owner within a budget set by the property owner.

LEED® certification is another topic you'll hear more about in the future. The U.S. Green Building Council has adopted a certification program called the Leadership in Energy and Environmental Design (LEED) standard. There are four levels of certification: certified, silver, gold, and platinum. The more energy efficient the design, the higher the rating. Energy efficiency has an obvious advantage and a less obvious disadvantage. Energy efficiency makes sense in a world of high fuel costs. But energy efficiency also has its price. The more energy efficient a building, the higher the initial cost. That's why LEED certification is good business for electrical estimators. Property owners want to know, "Can we afford LEED certification? And if so, at what level?" Electrical estimators help owners make good decisions about LEED certification.

All electrical contractors, from the smallest residential firm to the largest multi-state company, have an interest in avoiding waste of electrical resources. They support restrictions on the use of incandescent lamps, promote fluorescent alternatives, solar generation for homes, commercial and industrial applications, better electrical management systems and designs for large commercial installations.

Key Elements of a Bid

The estimating process begins with the plans and specs and ends with the presentation of the bid. Bidding electrical work can be a complex process and may involve many hours of detailed work. Leave out any step and your bid can go from “first to worst.”

Your job as an electrical estimator is to calculate the cost of completing the electrical work on a project. That’s your *estimated cost*, your cost to the contractor for doing the work. *Bid price* is the figure quoted to the prime contractor or the property owner — what the property owner has to *pay*. The difference between cost and price is *profit*. We’ll discuss both overhead and profit in detail in Chapter 10, *Overhead and Profit*.

A Successful Bid

Winning a contract for electrical work is seldom easy. In fact, an estimator who’s successful 25 percent of the time is the happy exception to the rule. As an electrical estimator, assume you’ll have many more defeats than victories. No lawyer, doctor, or baseball player would get by with a construction estimator’s success ratio. An electrical estimator who wins as few as 10 percent of the jobs he bids belongs in the estimating hall of fame. A doctor buries his losses; a lawyer visits his in jail. You’re lucky: The worst outcome is simply rejection.

Even on the contracts you win, you may have to defend your work. One common criticism: “Why was our bid so much lower than the next lowest bid? You left too much money on the table. We could have made thousands more.” So keep good records. Be ready to defend your estimates against someone else’s 20/20 hindsight.

You bid a job to get the contract. Obviously, it’s wise to bid as low as possible. But bid too low too often and your company will eventually go broke. A successful bid covers all costs: labor, materials, equipment, overhead (managers, office, taxes, insurance, etc.) and still has a little left over — your profit. Being the low bidder and getting the job isn’t always what you want. If you end up losing money on the job, you’d have been better off losing the bid and letting the “winner” take the loss. A good bid is high enough to earn a profit but low enough to get the work.

Finding the best bid price is a careful balancing act. Most competitors will have similar labor, material and equipment costs. Overhead costs can vary widely. Profit expectations also vary from contractor to contractor. As an electrical estimator, your primary concern will be the hard costs (labor, material, equipment) and overhead. Company management will decide how much to add for profit. In a small firm, the company owner will make decisions on profit margin. In a larger company, the head of the electrical contracting division may set the profit margin.

There may only be a few companies in the area qualified to handle the job you’re bidding. If you’re one of those companies, winning the job may be easy. But if there’s a lot of competition for the same job, bidding will be competitive. If all bids meet job requirements, the contract will usually be awarded to the lowest bidder. If it’s a government or public contract, the lowest qualified bidder will *always* get the work. But if it’s a private contract, anything can happen: The lowest bidder doesn’t automatically get the job. We’ll deal more with this topic in Chapter 15, *Smart Bidding*.

The Estimate

Electrical estimating is more art than science. Electrical contractors know that most of the profit or loss in a job comes from an estimator's desk, not the construction site. By that, they mean that estimates for most work are going to vary more than the actual cost of doing the work. A good electrical estimate becomes an operating budget once the contract is signed. The project manager's job is to live within that budget. It doesn't always happen, of course. Mistakes in material purchasing and poor use of field manpower can blow any estimate out of the water. But that should be uncommon in a well-run electrical contracting company.

There are three basic ways to estimate electrical work:

- Pure guesswork — which I certainly don't recommend!
- Pencil, paper, and estimating forms
- Computer software specifically designed for estimating

Most electrical estimating is done with a computer. Quantity takeoff is usually done by hand, either based on a site visit or construction plans. Use a computer program to compile the list of materials and labor quantities. The computer converts those quantities into extended costs and accumulates totals for each segment of the project, including labor, material, subcontracts, tool and vehicle expenses, etc. Finally, markup and profit are added to complete the bid. I'll assume that you have a modern computer available for

electrical estimates. And I'll also assume that you have pencil, paper and measuring scale available for doing what's still done best with pencil, paper and a measuring scale. Takeoff is covered in Chapter 5, *Doing an Accurate Material Takeoff*.

If you don't understand the basics of electrical estimating, a computer will only make things worse — at warp speed. Knowing how to drive nails doesn't make you an expert carpenter. Knowing how to use an electrical estimating program doesn't make you an expert electrical estimator. You have to understand the process from start to finish. Good tools just make it easier. In the chapters that follow, we'll do a couple of manual estimates with pencil and paper to help you understand the process and develop experience.

When you have electrical estimating with pencil and paper under your belt, and you've developed estimating habits that consistently deliver an estimate you can rely on, it's time to advance into the world of computer estimating. Once you've done the takeoff, a computer will make it easier to collect and organize material costs, manhours, labor and equipment costs, and totals. Then I'll introduce you to the companion volume to this book: *National Electrical Estimator*, a pricing manual, published annually, with quarterly updates, which includes the estimating software program *National Estimator*. Estimating software will just about eliminate transcription and calculation errors (the estimator's woe) and will always simplify changes and revisions. *National Estimator* lets you add any overhead and profit amount you select, then print the estimate (for internal use), and a bid using *QuickBooks Pro*.

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Practical References for Builders

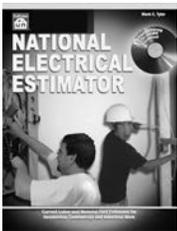
Commercial Electrical Wiring

Make the transition from residential to commercial electrical work. Here are wiring methods, spec reading tips, load calculations and everything you need for making the transition to commercial work: commercial construction documents, load calculations, electric services, transformers, overcurrent protection, wiring methods, raceway, boxes and fittings, wiring devices, conductors, electric motors, relays and motor controllers, special occupancies, and safety requirements. This book is written to help any electrician break into the lucrative field of commercial electrical work. Updated to the 1999 NEC. **320 pages, 8½ x 11, \$36.50**

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National Electrical Estimator



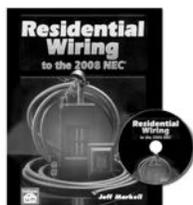
This year's prices for installation of all common electrical work: conduit, wire, boxes, fixtures, switches, outlets, loadcenters, panelboards, raceway, duct, signal systems, and more. Provides material costs, manhours per unit, and total installed cost. Explains what you should know to estimate each part of an electrical system. Includes a CD-ROM with an electronic version of the book with *National Estimator*, a stand-alone *Windows™* estimating program, plus an interactive multimedia video that shows how to use the disk to compile construction cost estimates. **552 pages, 8½ x 11, \$62.75. Revised annually**

National Construction Estimator

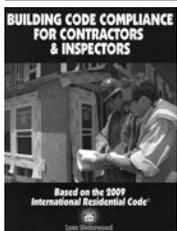
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This completely revised manual explains in simple terms how to install rough and finish wiring in new construction, alterations, and additions. It takes you from basic electrical theory to current wiring methods that comply with the 2008 *National Electrical Code*. You'll find complete instructions on troubleshooting and repairs of existing wiring, and how to extend service into additions and remodels. Hundreds of drawings and photos show you the tools and gauges you need, and how to plan and install the wiring. Includes demand factors, circuit loads, the formulas you need, and over 20 pages of the most-needed 2008 NEC tables to help your wiring pass inspection the first time. Includes a CD-ROM with an Interactive Study Center that helps you retain what you've learned, and study for the electrician's exam. Also on the CD is the entire book in PDF format, with easy search features so you can quickly find answers to your residential wiring questions. **248 pages, 8½ x 11, \$42.00**



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Have you ever failed a construction inspection? Have you ever dealt with an inspector who has his own interpretation of the Code and forces you to comply with it? This new book explains what it takes to pass inspections under the 2009 *International Residential Code*. It includes a Code checklist — with explanations and the Code section number — for every trade, covering some of the most common reasons why inspectors reject residential work. The author uses his 30 years' experience as a building code official to provide you with little-known information on what code officials look for during inspections.

232 pages, 8½ x 11, \$32.50

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The most popular pocket-sized electrical book in America. Ugly's is used by electricians, engineers, designers and maintenance workers, instructors and the military. This unique book explains bending conduit, *National Electrical Code* tables, wiring configurations, complex electrical formulas, and much more. This 2011 edition contains all the electrical material that has made this reference famous, but also reflects 2011 NEC changes and new color-coded wiring diagrams. Also includes updated coverage of Alternative Energy, Combination Circuits, Conductor Properties, Conduit Bending, Conversion Tables, Insulation Charts, Metric System, Ohm's Law, and a General First Aid Section. **198 pages, 4 x 6, \$18.95**

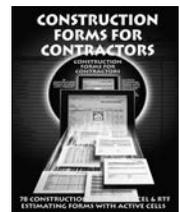
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California Journeyman Electrician's Preparation & Study Guide

This book has been published to meet the demands of graduating apprentices and journeymen electricians in the State of California who must now meet requirements of the new California Electrical Licensing Law that requires journeymen electricians pass a test. It's designed with sample questions and answers, definitions, illustrations, and study tips to help you pass the exam on the first try. Although written for the California exam, it can be used as a study guide for any state electrician's exam that's based on the 2002 NEC. **96 pages, 8½ x 11, \$26.00**

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This unique calculator, based on the 2002 *National Electrical Code* and updateable to future NEC codes, solves electrical problems in seconds: Calculates wire sizes, gives you integrated voltage drop solutions, conduit sizing for 12 types of conduit, and finds motor full-load amps per the current NEC. Also offers one-button parallel and de-rated wire sizing, computes fuse and breaker sizes, sizes overload protection, calculates service and equipment grounding conductor sizes, finds NEMA starter sizes, works in volts, volt-amps, watts, kVA, kW, PF%, and DC resistance, and even operates as a math calculator. **3½ x 7, \$99.95**

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DeWalt Electrical Code Reference

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88 pages, 5 x 8, \$19.95. By: American Contractors Exam Service

Wiring a House

A master electrician gives you the tips and shortcuts he's learned in over 30 years of wiring houses to meet code and to provide years of reliable service. Here you'll learn what materials work best in what application, which tools get the job done in the fastest time, and how to figure out and design the right wiring layout for any residential job, whether the entire house, or just a room. You also see how to install main service panels, ensure that the house is properly grounded, and install receptacles, GFCIs, switches, fixtures and appliances per *NEC* requirements. Dozens of diagrams and full-color illustrations show you exactly how the work goes together.

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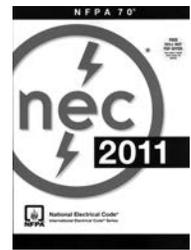
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