ELECTRICAL INSPECTION GUIDEBOOK

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Preface

This book is designed to explain the "why's" as well as the "how-to's" involved in observation of electrical construction quality, giving the complete roles and responsibilities of the electrical inspector. Those involved in electrical inspection—architectural/engineering firms, government agencies, and municipal building departments, for example—will be able to find out exactly what is expected of them and how to carry out their duties properly.

Presenting handy checklists to work from, this book shows the reader exactly what should be reviewed and inspected in areas such as rough wiring, electric services, grounding, materials, wiring devices, underground wiring, overhead wiring, and electrical equipment. It further correlates construction inspection with successful management procedures, including use of documentation, change orders, progress payments, and construction scheduling with modern methods.

The chapters are arranged in a structural sequence intended to follow the way electrical systems are installed in buildings. Described are the inspection duties involved with each of these components. Explanations of OSHA (National Electrical Code) requirements as they apply to the inspector are also covered.

This book also fills the reader in on the inspector's role involving change orders, progress payments, documentation, and supervising testing of completed electrical systems.

John E. Traister

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Chapter 1
Electrical Inspection

In nearly all but the very small electrical installations, contract specifications—as prepared by architects and engineers—require inspection or approval of the various items of material and the installation methods. Furthermore, all electrical construction is usually subjected to city, county, state, or power company inspection to determine if materials and equipment or installation methods conform to requirements of the National Electrical Code (NEC). Such inspections are made during the progress of roughing-in, at times determined by the extent to which the wiring system is to be concealed within the building structure and, finally, upon completion of the project.

It is not unusual to find two or more public authorities having inspection jurisdiction over a given job and occasionally, inspectors may not agree in their interpretation of the NEC requirements. When such a situation occurs, contact the National Fire Protection Association (NFPA); the National Electrical Code Committee has established interpretation procedures.

Most local inspection authorities have no jurisdiction over building construction on projects owned or leased by the federal government. Each of the various federal governmental agencies establishes its *own* inspection procedures and requirements covering both the type and quality of material and its installation, as well as its own design and inspection departments.

While all governmental agencies usually base their requirements on the NEC, they may differ slightly from the NEC's minimum requirements.

All electrical inspectors who anticipate working with such agencies should familiarize themselves with the inspection and installation regulations of the particular government agency having jurisdiction over any building or project they may be assigned.

1.1 QUALIFICATIONS OF AN ELECTRICAL INSPECTOR

A successful electrical inspector must have a thorough working knowledge of the National Electrical Code and have the ability to read and interpret blueprint (working drawings) and specifications. He should be able to compile reports and prepare correspondence. For these reasons, an electrical inspector should have the equivalent of at least a high school education, not necessarily a formal education, but the equivalent of 12 years of elementary and secondary schooling.

There is no substitute for experience, and all inspectors who are placed in responsible charge of electrical construction work should have had prior experience on construction work. The experience should demonstrate an intimate knowledge of electrical materials including trade names used in the field. For example, if an electrician refers to wiring methods as "Romex" and "BX", the inspector should know that these terms mean nonmetallic-sheathed cable and metal-clad cable respectively. He should also have a good knowledge of electrical practices, installation methods, techniques, equipment, and tools.

The ability to read and work regularly from working drawings and specifications and the ability to read and understand Federal specifications and commercial standards is absolutely necessary.

Probably the best way to acquire the experiences mentioned above is to actually work as an electrician on several projects. However, many successful electrical inspectors have gained this knowledge by working under experienced personnel.

Most electrical inspectors must be in good health and physically capable to meet the demands of the work. For example, he may be required to climb ladders or walk several flights of stairs to reach an area with work to be inspected. He may be required to climb down into manholes and then crawl through a tunnel containing electrical wiring that must be inspected.

If persons who anticipate working as an electrical inspector lack any of the above qualifications, they should take steps to rectify the situation, or possibly seek another profession.

1.2 ELECTRICAL INSPECTION DEFINED

Basically, electrical inspection is the observation of quality—quality of materials and quality of workmanship. The electrical inspector must have the ability to judge these qualities, detect any errors and

omissions, and then make certain that discrepancies are corrected before any further work is carried out or before the job receives final approval.

1.3 THE ROLE OF THE ELECTRICAL INSPECTOR

The electrical inspector must be able to look upon and view critically the particular phase of the construction project to which he is assigned. He must closely follow the progression of each stage of the electrical construction and be alert to existing conditions as well as problems that might arise in the future. When the inspector notices through his periodic inspections that certain phases of the work are not being performed in accordance with the NEC or local ordinances, or when other problems occur, he must immediately report these errors, violations, or problems to the proper authorities for further action.

FIG. 1-1: The electrical inspector must be able to look upon and view critically all types of electrical construction projects to which he is assigned.

Those inspectors working for architectural/engineering firms must further make sure that all work is performed in accordance with the plans and specifications or any other architectural addenda.

In most cases, the inspector is not authorized (as an individual) to revoke, alter, substitute, enlarge, relax, or release any requirements of any specifications, plans, drawings, etc. In addition, the inspector is normally not authorized to approve or accept any segment of the work that is contrary to the construction documents. At no

time should the individual inspector stop the construction work or interfere with the contractor's employees; this is a job for "management."

In effect, the inspector acts as liaison between the contractor and the owner or architect. How effective he can be in his role depends mainly on how he handles himself in this relationship. He must display knowledge, experience, integrity, ability, and the use of good judgement.

1.3.1 Specific Duties

The responsibilities of the electrical inspector employed by municipal building departments include the following:

1. Checking all electrical contractors working in the jurisdiction as to qualifications, valid licenses, permits, etc.

2. Checking the qualifications of those in responsible charge of a project if other than a qualified electrical contractor.

3. Reviewing contract drawings and specifications to insure that they meet with provisions set forth in the NEC, local ordinances, etc.

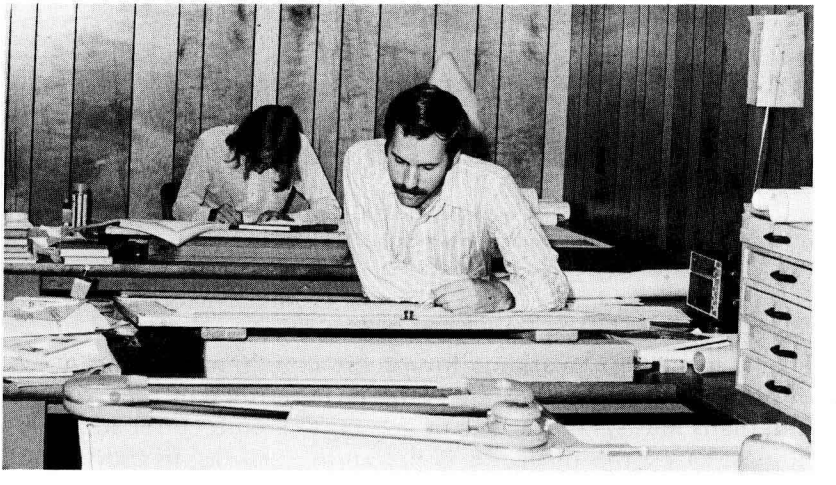

FIG. 1-2: One of the many jobs of an electrical inspector is to review contract documents to ensure that they meet with provisions set forth in the National Electrical Code.

4. Making periodic visits to the various projects to which the inspector is assigned to view critically the quality of materials, methods, and workmanship. These visits should be planned so as not to hold up the construction any more than is absolutely necessary.

5. Rejecting work that does not comply with NEC requirements or local ordinances.

6. Being alert to all construction work in a jurisdiction and making certain that applications have been filed by the contractor requesting periodic inspections.

Those inspectors working for architectural/engineering firms and governmental agencies will normally have the following responsibilities:

1. Making certain that the electrical contractor complies with the approved construction documents, that is, the working drawings, specifications, and contractual provisions for the project.

2. Monitoring the project to insure that the project progresses according to schedule, and reporting any problems.

3. Coordinating and monitoring material approvals and certain tests that may be required.

4. Interpreting construction documents and settling minor disputes.

5. Approving progress payments and checking all work against progress payment requests.

6. Approval of shop drawings, materials, samples, etc.

7. Monitoring change orders and making recommendations for approval or rejection.

From the above list, it is obvious that the electrical inspector has different responsibilities and authorities, dependent upon the organizational set-up under which he is working, and upon his own capabilities. Each inspector should understand his own level of technical knowledge and accept his responsibilities without overstepping his authority.

1.4 THE NATIONAL ELECTRICAL CODE (NEC)

Because of the potential fire and explosion hazards caused by the improper handling and installation of electrical wiring, certain rules in the selection of materials, quality of workmanship, and precautions for safety must be followed. In order to standardize and simplify these rules and provide some reliable guide for electrical construction, the National Electrical Code (NEC) was developed. The NEC, originally prepared in 1897, is frequently revised to meet changing conditions such as improved equipment and materials and new fire hazards. The Code is a result of the best efforts of electrical engineers, manufacturers of electrical equipment, insurance underwriters, firefighters, and other concerned experts throughout the country.

The NEC is now published by the NFPA (National Fire Protection Association), 470 Atlantic Ave., Boston, Mass. 02210. It contains specific rules and regulations intended to help in "the practical safeguarding of persons and property from hazards arising from the use of electricity. . . ." The NEC contains provisions considered necessary for safety. Compliance therewith and proper maintenance will result in an installation essentially free from hazard, but not necessarily efficient, convenient, or adequate for good service for future expansion of electrical use.

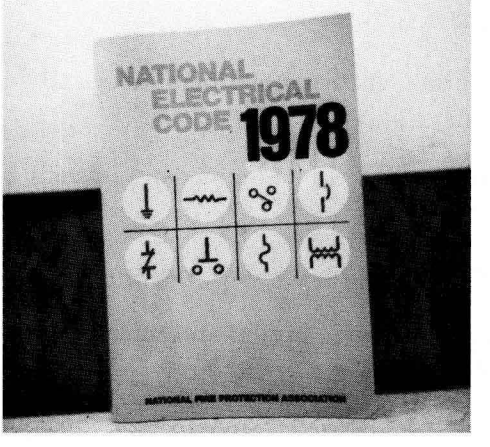

FIG. 1-3: The National Electrical Code Book—the electrical inspector's Bible.

The NEC has become the "Bible" of the electrical construction industry and anyone involved in electrical work—in any capacity—

must obtain an up-to-date copy of it, keep it handy at all times, and refer to it frequently.

1.5 LOCAL CODES AND ORDINANCES

A number of towns and cities have their own local electrical codes or ordinances. In general, these are based on, or are similar to, the NEC, but on certain classes of work they may have a few specific rules that are usually more rigid than the NEC.

In addition to the NEC and local ordinances of certain cities, there may exist with local power companies some special rules regarding location of service-entrance wires, meter connections, and similar details that must be satisfied before connection can be made to a building.

1.6 UNDERWRITERS' LABORATORIES

If approved wiring methods are used to install the electrical wiring in a building, but low quality materials are used, the complete installation may still be dangerous. Therefore, insurance companies have led the way to insure minimum standards of quality in electrical materials which, through experiment and experience, lead to a maximum of usefulness with the least amount of danger.

The American Insurance Association (AIA) has established a testing organization known as Underwriters' Laboratories (UL), Inc., with testing facilities in several locations throughout the United States. Manufacturers may submit samples of their products to these laboratories for testing before they are manufactured on a large scale. If the products pass the exhaustive tests in accordance with established standards, they are listed in the UL official published list and are then known as "Listed by Underwriters' Laboratories, Inc." Such UL approved items usually have a UL label attached directly to the product. In some cases, this UL "label" is molded or stamped into the merchandise—into bakelite, steel, or porcelain parts of wiring devices.

Underwriters' Laboratories is a nonprofit organization supported by the manufacturers who submit merchandise; that is, for testing the merchandise, Underwriters' Laboratories charges a fee, which pays for the inspectors' expenses and supports the laboratories in general.

A UL label assures the user that the manufacturer of the item has submitted to the laboratories for testing samples that were

found to meet the required minimum safety standards. It is then presumed that the manufacturer will maintain the same quality in future production of the same item.

FIG. 1-4: Those products that pass the exhaustive tests of Underwriters' Laboratories Inc. usually have a UL label attached directly to the product.

An item approved by Underwriters' Laboratories, however, does not mean that the item is approved for all uses. Rather, a UL label means that the item or device as labelled is safe *only* for the purpose for which it was intended; NEC regulations must still be followed. Type NM cable, for example, cannot be used as a service-entrance cable just because it happens to bear the UL label.

The UL label furthermore means that the item meets the minimum safety requirements; one kind may meet the requirements, while another may far exceed them. Therefore, quality cannot really be judged from the UL label alone.

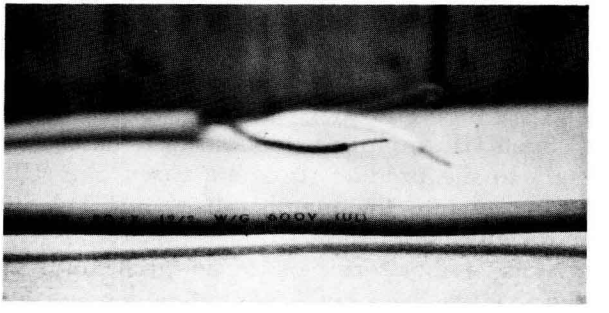

FIG. 1-5: This piece of NM cable is UL listed; however, the cable can be used for installations only as approved by the NEC.