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UL AND THE NATIONAL ELECTRICAL CODE

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To address this subject from the UL viewpoint, it is important to understand the history of UL's involvement with the National Electrical Code and its processes. This involvement began essentially with the inception of the code at the turn of the century. UL was in its infancy and the code was only a few pages in length, both sponsored by the National Board of Fire Underwriters, a fire insurance group. UL was established by the insurance industry to meet the need for an organization that could examine and test the materials that were coming into the marketplace with the introduction of electric lighting and which were intended to be installed in accordance with the (then few) provisions of the Code. The very early editions, as published by the National Board of Fire Underwriters, contained the installation requirements and the construction and performance requirements for the equipment such as wire, lampholders, and fuses. As the Code evolved, many changes in publishing format and procedures took place.

In 1911, the National Fire Protection Association became the sponsor of the Code, although it was still published by the National Board of Fire Underwriters. The instructions covering the use of the Code at that time and for many subsequent years contained the instruction: "All fittings and materials before being introduced should be submitted for examination and test to the Underwriters Laboratories." The processing of the Code was handled by one large meeting of a single committee.

As UL grew and wrote its own equipment standards, detailed construction and performance requirements were eliminated from the Code. The Code thus evolved into essentially an installation document, with equipment standards writing being left to others. The close ties of UL and the Code with the insurance industry changed with the evolution of the complete independence of UL as a corporation and the growth of NFPA as the sponsor of the code. This development resulted ultimately in the National Board of Fire Underwriters abandoning their publishing of the Code in favor of NFPA. The procedures of Code processing under NFPA direction evolved from a single committee into the present 23 code-making panels with specific procedures maintaining pace with modern concepts of due process. The Code text was modified to eliminate any reference to UL in view of the entry of other organizations in the field of product testing.

Throughout this evolution, UL's corporate position has been one of support for the National Electrical Code and participation in its work. UL only lists electrical equipment which can be installed in accordance with the provisions of the National Electrical Code. UL supports a representative on most of the code-making panels and actively participates in their work as one of the many interests represented. Actually, Underwriters Laboratories involvement with the National Electrical Code extends beyond participation as a member of code-making panels. Depending upon the circumstances, UL may be a Code enforcer with respect to product requirements, a proposer of change, an independent expert responding to someone else's proposed change, or an arbitrator seeking a compromise solution to differing Code views.

The need for this multiplicity of

roles is readily evident when we consider the interrelation of UL's electrical listings and the requirements of the Code.

The Code is intended to be suitable for mandatory application of those governmental bodies who choose to enact it as law in their jurisdiction. The authority supervising the enforcement has the responsibility for interpreting and for deciding upon the approval of equipment and materials used. This is detailed in Section 90-4 of the 1978 edition.

Section 110-2 clearly spells out that conductors and equipment are required to be approved, and the definition in Article 100 indicates that "approved" means acceptable to the authority having jurisdiction.

Section 110-3 requires equipment to be judged with reference to its installation and conformity with the Code provisions, its mechanical strength and durability, electrical insulation, heating and arcing effects. Recent editions of the Code contain the suggestion that "suitability of equipment may be evidenced by listing or labeling."

It is obvious that such items as mechanical strength and durability, electrical insulation, heating and arcing effects are technologically complex to the extent that they cannot be adequately judged by the observation techniques available to the field inspection authority. Such items can only be evaluated by laboratory testing techniques. The role of UL, and that of others in the field, is to develop and promulgate equipment standards that specifically cover the referenced features and then to test and identify complying equipment so that inspection authorities can with reasonable assurance conclude that the requirements of Section 110-3 have been met.

Section 90-6, concerning approval of equipment and materials, gives additional information concerning this subject: "Examination of equipment for safety. For specific items of equipment and materials covered by the Code, examinations for safety made under standard conditions will provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections. This avoids the necessity for repetition of examinations by different examiners, frequently with inadequate facilities for such work, and the confusion that would result from conflicting reports as to the suitability of devices and materials examined for a given purpose. It is the intent of this Code that factory-installed internal wiring of the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by an electrical testing laboratory that is nationally recognized as having the facilities described above and which requires suitability for installation in accordance with the Code."

Should Section 90-6 sound like a general description of the operation of Underwriters Laboratories, it is because UL has carefully tailored its operation to serve the electrical inspector when the inspector desires such help. Determination of compliance with the provisions of Section 90-6 have been used by municipal authorities as the criteria for specifying those testing organizations whose work they will accept.

As stated earlier, all electrical products bearing the UL listing mark must meet and be capable of being installed in accordance with the provisions of the National Electrical Code. As each new edition of the Code is issued, every change is reviewed by UL to determine the effect on current listed products and on UL's published safety standards. New products and systems presented to UL for evaluation must be judged under the new regulations, and installers must be assured the equipment can be installed under the new provisions of the Code. UL's electrical equipment evaluations and the National Electrical Code are therefore inherently related.

Consider the transformation of a few relatively straight-forward changes in the Code into actuality (in an installation). Table 373-6(a) of the 1978 National Electrical Code was

changed to require a bending space of 1½ inches for Number 8 AWG conductors where previous editions of the Code indicated that the space was "not specified." This simple change established the need for UL to change more than a dozen published and proposed product standards. In addition to information exchanges with industry groups and the actual standard changes, practical effective dates for redesign of the manufactured products need to be developed as the change will require that terminal compartments and enclosures be increased in size. Product lines of more than 300 manufacturers will need to be reviewed for compliance, and all manufacturing locations of those manufacturers will need to be visited by UL inspectors to ensure compliance on the production line.

Another apparently straight-forward change was an earlier addition to Section 500-2(b) of a surface temperature marking requirement for hazardous location equipment while operating in a 40°C ambient. Nonheat-producing devices such as junction boxes, conduit, and fittings were exempted from the requirement, but all other devices intended for hazardous location use were included. Effectively, all electrical products intended for use in hazardous locations that UL had ever listed needed a construction change, 21 published or proposed product standards needed consideration of revision to record the new requirement. And in many cases, both the manufacturers and UL needed to do extensive temperature testing work to find out what the proper temperature identification numbers to be marked should be.

Fortunately, most of the changes in the National Electrical Code do not have such significant impact on our work, for there are approximately 1000 revisions in the 1978 edition. However, a significant number do significantly impact. All such changes have been identified by Mr. Lloyd and by our representatives on each Code-making panel. Code coordinators in each department and office of UL have been appointed. These coordinators have been assigned the responsibility of making certain that standard changes under the control of that office are implemented at an early date.

Our work to implement Code changes has caused us to also be a proposer of further change. For example, the temperature marking change for Section 500-2(b) created so many problems to implement in the marketplace for snap switches, circuit breakers, and industrial control equipment with no corresponding increase in safety that UL sponsored a change in that section to eliminate the requirement for low-surface temperature devices.

Standards, codes, and regulations are inherently limiting to the innovativeness of the designer or engineer. The need for uniform installation requirements for the safe use of electricity is evident, but a means obviously must be in place to permit the new or different product to come into the marketplace, providing it does not detract from the generally accepted level of safety. We at UL are very much involved in serving this need, and our fact-finding investigation procedure is a well established method of producing data to support major changes in the National Electrical Code.

For those present who are unfamiliar with the procedure, we do just what the name implies: "fact-finding." We draw no formal conclusions in our report as to the merits of the product or system, although we may provide a summary or discussion of results. The work may be done for a single manufacturer or for a trade association or others. Our engineering approach in its broad concept may take the form of comparing the new product or system to those which it is intended to replace or supplement. For totally new products or systems, our approach is likely to be a collection of tests that our engineering team believes will assist the code-making panel in its deliberations. Where controversy resulting in a lack of consensus on a code proposal is involved, a fact-finding investigation may provide the needed facts so that the conflict can be resolved.

As an example, we can again reference Table 373-6(a) which specifies minimum wire bending space at terminals. The preprint of the proposed

amendments for the 1978 National Electrical Code contained a number of proposals for revising Table 373-6(a). One proposal called for increasing the present values in the table by one and one-half times, and another proposed two times for conductors that are bent or deflected more than once. These proposals were referred back to the panel to hold on docket for lack of consensus in the voting. The National Electrical Manufacturers Association felt that more information was needed concerning the problem, since any unnecessary increase would be wasteful of installation space, steel, field insulated wire lengths, carton or creating materials, shipping space, energy, and would unnecessarily increase costs. Accordingly, they engaged UL to conduct a fact-finding investigation to determine the actual bending space needed for installing conductors without damage to conductors, insulation, or equipment using present-day wire and installation methods. Because of the wide interest in this subject, UL established a steering committee to aid in the investigation. The steering committee consists of the chairmen of Panels 6, 9, and 11 or their designated representatives, along with representatives from IAEI, NECA, IEEE, MCA, and the concerned NEMA sections sponsoring the fact-finding investigation. UL is presently deeply involved in this investigation, which will entail conducting upwards of 75 wiring installations with wire sized from Number 8 AWG through 750mcm, using qualified electricians and under conditions which simulate adverse field wiring conditions. The final report will be ready for review when proposals for the 1981 Code are considered and will provide a basis for making proposals or evaluating the proposals made by others. UL is in a unique position to serve the role of fact-finding as it has no benefit to be derived from the outcome regardless of the facts developed and the response to those facts by the involved code-making panels.

Another example of fact-finding concerned a totally new concept, as illustrated by Article 328 covering flat conductor cable. This new wiring method fundamentally consists of flat copper conductors with top and bottom grounded metal shields intended for use primarily in commercial buildings. The system provides a means of distributing energy for power or signaling and communication. Power or signal output may be taken essentially at any point on the floor run by use of a special connector and receptacle. Tests were developed to evaluate not just the new types of conductors and connections under normal and abnormal conditions, but the performance of the assembly during routine floor cleaning, after removal of a receptacle in the floor, and of the special tools required.

Another of the important contributions we make to the National Electrical Code is one which has the least degree of public exposure even within the code writing community and involves our considerable efforts to resolve differing views. It seems important to state again that we can fulfill this role because of the unique position we occupy in having no economic gain or loss depending upon the outcome of any specific code proposal. It also helps to have the physical plant and staff expertise available and to have been involved for over 80 years with the reputation for doing our best to work toward a solution based on supportable information that is equitable to all parties and that serves the public interest.

Contrary to some belief, membership in a manufacturer group, an inspector group, an insuring group, or a utility group (or for that matter in the Underwriters Laboratories) does not ensure unanimity of opinion within that group. For example, within NEMA the subject of safe level of overcurrent protection to be required for various devices used in motor circuits has been debated for years among motor, motor control, wire, fuse, and circuit breaker manufacturers. Through two Codes when resolution of related code proposals were needed, UL staff, because of its independence, was called upon to chair subcommittees to recommend resolution.

Differences of opinion and requirements exist in the 1978 edition with respect to protection of control circuits, depending upon whether one is considering a motor control center under Article 430, a heater control circuit under Article 240, or remote control circuit under Article 725. As the proper interpretation needed to be determined so that the products in the marketplace bearing UL's listing mark could be caused to meet the Code provisions, UL staff did considerable work on the problem. UL staff was also asked to chair the committee to develop proposals for the next code edition to resolve the matter.

In summary, UL and the National Electrical Code were both created by the vision of the insurance underwriters. Involvement of UL in the code process has continued for more than 80 years; UL's current position is that of one voice of many different interests represented. Nevertheless, its background, knowledge, and reputation have permitted UL to continue to serve in many important code roles to help maintain the high level of protection of persons and property from hazards arising from the use of electricity.

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