



Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation

Developed by

**American Council for Electrical Safety
(ACES)**

A Division of the

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Introduction

This document is a recommended practice for the procedures that should be utilized in evaluating unlabeled electrical equipment for compliance with nationally recognized standards and the local jurisdiction's acceptability criteria. The National Electrical Code Sections 90.7 and 110.3(A) provide guidance to a jurisdictional inspector on certain aspects of unevaluated equipment that should be considered.

90.7 Examination of Equipment for Safety.

For specific items of equipment and materials referred to in this Code, examinations for safety made under standard conditions 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 on the suitability of devices and materials examined for a given purpose.

It is the intent of this Code that factory-installed internal wiring or 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 a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this Code.

FPN No. 1 - See requirements in 110.3.

FPN No. 2- Listed is defined in Article 100.

FPN No. 3- Annex A contains an informative list of product safety standards for electrical equipment.

110.3 Examination, Identification, Installation, and Use of Equipment.

(A) Examination. In judging equipment, considerations such as the following shall be evaluated:

(1) Suitability for installation and use in conformity with the provisions of this Code

FPN: Suitability of equipment use may be identified by a description marked on or provided with a product to identify the suitability of the product for a specific purpose, environment, or application. Suitability of equipment may be evidenced by listing or labeling.

(2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided

(3) Wire-bending and connection space

(4) Electrical insulation

(5) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service

(6) Arcing effects

(7) Classification by type, size, voltage, current capacity, and specific use

(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment

It is understood by the NEC that this is a minimal review with the inherent limitations for completion of this type work by jurisdictional inspectors. It also recognizes that a comprehensive evaluation by a recognized testing laboratory is desirable for completeness and better uniformity. This document is to expand on the foundation set forth in the above NEC references to provide equipment evaluations where there is not a listing or label present.

1.0 Purpose and Scope

The primary purposes of this document are twofold. First, this recommended practice is to provide information on the basic evaluation process to Authorities Having Jurisdiction (AHJ) so they might have something to use in determining the adequacy and completeness of completed evaluations and evaluation reports submitted by recognized third party evaluation providers. Secondly this document, when adopted and implemented by third parties, provides for uniformity and consistency in the overall evaluation process used to complete evaluations and evaluation reports on unlabeled equipment.

The process detailed in this recommended practice will not result in a "listing" or "product certification" or in a "product certification". The only units of any equipment that will achieve an "evaluated" status are those that undergo this procedure and no assessments are made or assumed for past or future like equipment produced by the manufacturer.

New or used electrical equipment not "listed" or "labeled" as a complete unit is considered to be unevaluated by a third party and will be subject to a thorough inspection, required testing and final evaluation as required by an Authority Having Jurisdiction (AHJ). This equipment may be found installed or designed for installation using either fixed wiring methods (also known as hard wire) or cord and plug connections to the facility. The overall evaluation of such non-labeled equipment is for the purpose of attaining "approval" of the complete installation including the subject equipment by the local electrical jurisdiction, or other AHJ, as provided for in Section 110-2 of the National Electrical Code, quoted below. This document is not intended to be used for lot inspections.

110.2 Approval.

The conductors and equipment required or permitted by this Code shall be acceptable only if approved.

FPN: See 90.7, Examination of Equipment for Safety, and 110.3, Examination, Identification, Installation, and Use of Equipment. See definitions of Approved, Identified, Labeled, and Listed.

Listed or labeled equipment that is modified after or during installation may be dealt with in one of two ways. If the modifications do not affect the basic safe design and critical components, then a field investigation process by the listing laboratory that ultimately reinstates that original listing and validates the label is used. Where the modifications are extensive, such that basically a new model or new product has been created, this "new model" would require an evaluation along the lines in this recommended practice to be completed and an alternate label to the listing label applied supported by a technical engineering report.

The third party evaluation company completes the necessary inspections, testing and evaluation of the equipment, and complies a written technical report detailing the work completed and status of the subject equipment's compliance with the appropriate product standards, electrical codes, safety orders and any requirements of the local jurisdiction. Equipment evaluations are not completed using the NEC as the basis for internal construction, the applicable product safety standards are the appropriate reference source for this, but properly evaluated equipment always includes the necessary aspects to ensure the equipment can be installed in accordance with the NEC.

If upon completion of inspection, testing and evaluation it is determined that the equipment meets all the relevant requirements, the evaluation company applies a label to the equipment indicating compliance.

2.0 Definitions

2.1 *Authority Having Jurisdiction (AHJ)* [NFPA] - The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

2.2 *Batch/Lot Inspection and Testing* - **The process where samples of like items are taken from a batch or lot, in a specified quantity and are then processed (inspected, tested or evaluated) and the findings analyzed to determine if statistically the batch or lot is deemed acceptable. ANSI/ASQC Z1.4 "Sampling Procedures and Tables for Inspection by Attributes" determines the quantities to be sampled and the level of certainty of an acceptable lot.**

2.3 *Critical Component - Electrical Safety Critical Parts* are those electrical components or assemblies used in a power or safety circuit, whose proper operation is critical to the safe performance of the system or circuit including but not limited to the following:

- 1) All electrical components acting as a protective device to interrupt current in an abnormal condition such as circuit breakers, circuit protectors, fuses, overload or thermal relays.
- 2) All components and wiring for the EMO system including power supply, EMO contactor or interrupting device and pushbuttons.
- 3) All hardware or firmware components and wiring for safety interlock circuits.
- 4) All devices that are in an area that is classified as a Hazardous Location must have the appropriate rating for the area such as Class I Division I or Class I Division 2 unless listed as intrinsically safe.
- 5) Those components that upon evaluation present a risk of fire or shock in their use or application.

These devices must be approved and used in accordance with their listing or the "conditions of acceptability" that is part of the component's recognition.

Note, it is possible and understood that like components can exist on equipment where one is required to be approved (listed) since it is used in a safety circuit or other as described above, and the other is not used in such a circuit. In these cases like components will be treated differently.

2.4 *Emergency Main Off (EMO) [NFPA 79]* also known as **Emergency Stop and Emergency Machine Off** - A category 0 stop device that overrides all other controls to remove power from all control actuators and bring the equipment to a safe standby condition.

2.5 *Evaluation* - The process used to determine the conformance of an electrical product to the relevant product safety standard(s). Evaluation is part of the process for Listing, recognizing components and for "field evaluating" products.

- 2.6 **Evaluated Mark** - the mark or symbol applied by the third party evaluating company to indicate conformance to the relevant product safety standard(s). This mark is distinct from the mark or label applied to indicate a product is "Listed" or "recognized".
- 2.7 **Field Evaluation** - The process used for one-of-a-kind, limited production, used, or modified products that are not listed or labeled under a full listing and certification program. The process is completed at the point of manufacturing, interim points of distribution, in the evaluating company's facilities or at the final installation site or a combination of the above.
- 2.8 **Field Inspection** - The process where listed equipment has had some modifications completed after it left the point of manufacturing. Initiated by the AHJ, the listing agency is contacted by the manufacturer to complete an inspection to validate that the modifications did not impact the original listing. Upon completion the original listing is reaffirmed.
- 2.9 **Interrupting Rating (AIC)** A rating based on the highest root-mean-square (rms) alternating current that the fuse or circuit breaker is required to interrupt under the conditions specified. The interrupting rating, in itself, has no direct bearing on any current-limiting effect of the fuse or the circuit breaker.
- 2.10 **Labeled [NFPA]** - Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
- 2.11 **Listing [NFPA]** - Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Note: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. Use of the system employed by the listing organization allows the authority having jurisdiction to identify a listed product.

2.12 Modified Equipment - Electrical products that have been listed or recognized but have had changes in design, components, or construction, after leaving the point of manufacture, from the original manufactured and certified product. Equipment that is being used in an application different than the intended design as evidenced by the listing or recognition.

2.13 Overcurrent - Any current in excess of the rated current of the equipment or the rated ampacity (current-carrying capacity) of the conductor. It may result from overload, short circuit, or ground fault.

Ground Fault [NFPA] - An unintentional, electrically conducting connection between an ungrounded or grounded conductor of an electrical circuit and the normally non-current-carrying conductors, metallic enclosures, metallic raceways, or metallic equipment.

Overload [NFPA] - Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Short Circuit - An unintentional, electrically conducting connection between two or more ungrounded conductors or ungrounded and grounded conductor(s) creating an electrical circuit of very low impedance resulting in a very high fault current.

2.14 Recognized Components - devices, assemblies, subassemblies that have not completed all the required inspections and testing to be listed. Recognized components are incomplete or restricted in performance capabilities so as not to warrant their use as field-installed components. These components are partially complete and must have additional inspections, testing and evaluation completed in the final end use equipment for the applied use. Recognized components have Conditions of Acceptability that need to be incorporated into the design, application and final product evaluation.

2.15 Supplementary Protector - Overcurrent device, primarily for overload protection, that is applied in the secondary of control circuits or for appliances. Supplementary protectors are not suitable for use as branch circuit protection.

2.16 Unlabeled or Unlisted Equipment - Equipment that does not have any evidence of listing, or recognition as evidenced by a label or mark of a recognized testing agency recognized by the AHJ.

3.0 Procedures Overview

3.1 Determination of Product Safety Standard

The first step is to determine the appropriate product safety standard that applies to the equipment to be evaluated. Where no one product safety standard can be found, a compilation of applicable parts of other product safety standards is to be assembled.

3.2 Evaluation Elements

All equipment evaluations involving non-labeled, used and modified equipment will cover the following aspects:

Review of Equipment Drawings

Nameplate and Markings

Suitability for installation in accordance with the NEC

Enclosure evaluation

Environmental Suitability

Visual inspection of critical components for evidence of listing or recognition by a NRTL and correct application in accordance with the listing or recognition.

Damaged Components

Grounding

Electrical Clearances

Guarding of Live Parts

Wiring Methods and Ratings

Electrical testing may include, but is not limited to:

****.* Insulation resistance**

****.* Heat rise testing**

****.* Dielectric withstand**

****.* Ground continuity tests**

4- Leakage current tests

****.* Safety circuit functional tests - interlocks and emergency off**

4.0 Pre-Site Preparation

- 4.1 The following information/material should be made available to the evaluator prior to or upon arrival on site

For complex equipment, at least one complete set of accurate drawings for the specific equipment to be evaluated. For simple equipment one set of basic electrical schematics of the power circuits should be provided.

4- Layout drawing showing components with designators that match the schematic and actual marks on the or adjacent to the components

**.* Schematic of all the power circuits, line voltage, control, safety interlock and EMO

Bill of material for all critical components including certification (s)

Conditions of acceptability for any recognized components.

4.2 Used Equipment

Used equipment presents some evaluation requirements seldom encountered in new equipment including the following for examples:

Damaged components such as oil soaked wiring, damaged enclosures with excessive openings, damaged items such as conduit, fittings and transformers

The equipment is found not suitable for the intended use such as industrial environments with enclosures not using oil tight control devices, field modifications that differ from the original design and equipment that is being relocated into a classified hazardous location.

Equipment drawings are not available so the evaluation must produce a schematic and possibly layout drawings to complete the evaluation of the circuitry.

The manufacturer no longer exists or no longer has the technical support for the equipment so that component certifications, drawings or other documentation is not available. This may cause additional inspections and/or testing to be done to determine suitability of components or validate the design.

If the scope of the project involves used equipment, these and any other relevant issues should be communicated and resolved as best as possible at the beginning of the evaluation.

4.3 Standard(s)

Determine the appropriate standard, based on the standard's scope, for the equipment to be evaluated based on the equipment design and intended application. Where no single standard applies to the equipment, then applicable portions of related standards for subassemblies and supplementary standards need to be applied.

The primary standard to be used is to be a nationally recognized product safety standard written and maintained by a standards development organization that issued product safety standards such as Underwriters Laboratories, Factory Mutual Research Corporation and Institute of Electrical and Electronic Engineers. These standards are generally ANSI adopted. Supplementary standards may include ones from manufacturing organizations such as NEMA or general safety bodies such as the National Fire Protection Association.

4.4 Jurisdictional Notification

Provide a notification letter to the electrical jurisdiction that the project is to commence and what evaluation company will be performing the work. This helps the individuals receiving correction notices (clients) that they have in fact acted within the time allotted for action and also lets the jurisdiction know who will be performing the work. Some jurisdictions may request that such a letter not be provided and in that case this item can be omitted.

5.0 Construction Inspection

- 5.1 Perform the construction inspections using the mechanical construction sections of the standard or standard(s) as the guide for this part. This part would include evaluation of the components and markings such as the following examples:

Nameplate is complete including the applicable information based on the standard and the NEC

Provisions for mounting in accordance with the NEC

Installation instruction showing raceway entry points, supply conductor wiring methods, supply conductor types, field wiring torque values, and installer supplied overcurrent protection

Adequate wire bending space is provided for all field wiring (power supply conductors, load conductors leaving enclosure, control, signaling and data) in accordance with the standard and the NEC.

Enclosure construction for:

**Suitable construction materials, metallic or non-metallic
Listed and labeled for the intended environment or evaluated for
the intended environment as part of the project.
Corrosion protection of internal and external parts
Hinged doors open at least 90 degrees
Proper door bonding for hinged doors that have electrical
equipment mounted on the door
No access to live parts through any opening in the enclosure walls
or ventilation openings**

Main disconnecting means provided

**Main overcurrent protection either supplied internally or specified by the
installation instructions**

Supply conductor connection point clearly identified

Components:

**Match the bill of material or create one from inventory of equipment
Critical components are to be listed or recognized and labeled by a
NRTL
Components are properly mounted
Adequate spacing is provided around components for mounting,
termination and heat dissipation under maximum designed loading**

Overcurrent protection is inspected for:

**Proper protection of conductors per the conductor ampacity
Power supplies including power supplies for PLCs and computers
Transformers - power and control**

Motors

- o **Fractional horsepower single device**
- o **Short circuit and ground fault protection provided and
properly rated**
- o **Overload protection provided and properly set or rated.**

Maintenance receptacle overcurrent protection provided.

Heater loads have proper overcurrent protection and grouping

- a **Plug strips and portable power taps have proper protection**

Maintenance receptacles and lighting

**Separate circuit(s) identified
Class A GFCI protection as applicable**

Wiring

Correct color code or other identification used. Where color is used, the grounded (neutral) and grounding (equipment grounding and bonding) conductors have specified colors.
Insulation types rated for the application and intended environment
Conductor temperature ratings adequate
Ampacity for load served and overcurrent protection provided
Flame rating of VW-1 or equivalent on insulation
Proper use of flexible cords
Proper use and physical protection of flexible cables
Separation of low energy circuits from power circuits

Markings

Access warnings for shock hazard
Multiple source warnings
Environmental restrictions such as "Indoor Use Only"
Field wiring type such as "Copper Conductors Only"
Component designations that match the layout and schematic drawings
Control device functional identification
Equipment grounding terminal marking

Grounding

There is provision for terminating the supply equipment grounding conductor to a dedicated terminal
One conductor per terminal for all equipment grounding conductors in ground fault paths
Equipment grounding conductors are properly identified by color coding (green or green with one or more yellow stripes) or by other suitable markings
All conductive enclosure doors and panels are properly bonded

6.0 Electrical Testing

- 6. The test program will follow as closely as practical the requirement of the applicable standard, taking into consideration the limits of the non-laboratory setting and the need for the equipment being evaluated to perform its intended function after the test(s).**

Insulation resistance test on power circuit with all sensitive electronic components such as line filters and Rf filters disconnected

Ground continuity of bonded parts to supply equipment grounding conductor termination point
Measure the input voltage while under maximum design load
Measure the input full load current while at the maximum design load normal operation
Temperature rise testing of terminals, heat producing devices (transformers, power supplies, coils, heaters) and components that may be affected by an elevated ambient caused by other heat producing components
Safety interlock circuit function testing
EMO shutdown

6.2 The following electrical tests are to be completed as required by the applicable product standard as a production or routine test.

- Leakage current only on cord and plug connected equipment
- Dielectric withstand (hipot) on power circuits
- Other production tests as specified

7.0 Reporting and Documentation

Each project shall have a complete engineering report written documenting the evaluation process and the evaluation results. The report may be done in stages with the first being a preliminary assessment or discrepancy report where the client needs to resolve issues before the evaluation can proceed. However the communication on unacceptable issues is completed, at the conclusion of the evaluation, the final written report will be prepared, reviewed and issued.

7.1 Title Page

The title page should include the following items:

The identification of the company performing the evaluation, which can be accomplished by the use of letterhead paper or printing the companies letterhead at the top of the page
The name of the equipment that was evaluated
The actual facility name and full address where the final installation takes place
The name and full address of the jurisdiction that has inspection responsibility over the final installation site
The date the report was prepared
The project number or identifier
The signature and title of the person preparing the report, typically the evaluator

The signature and title of the person performing the technical review

7.2 The report contents should contain the following as a minimum:

7.2.1 A summary including the following:

The individual that initiated the project and the company affiliation
The location where the preliminary inspection was completed
The location where the final inspection and testing was completed if different from the preliminary site location
Who was the evaluator
The date(s) the preliminary inspection was completed
The date the final inspection, testing, evaluation and application of the label was accomplished
A summary statement of the findings as of the time the report was prepared
The name of the jurisdiction responsible for the final approval of the installation if the project was required by a jurisdiction

7.2.2 Conditions of Acceptability

A statement or series of statements establishing any conditions of acceptability that must be adhered to in order to maintain the label as valid. For example, the equipment may be suitable for an indoor dry location only, or the equipment is stated a not being suitable for installation in a hazardous location.

7.2.3 Standards

List the complete citations of the primary and any major support standards used to complete the evaluation. The citation should be complete enough that any subsequent audit can clearly identify the exact edition, and revision of the standard(s) used.

7.2.4 Equipment Identification and Nameplate

The equipment nameplate information should be documented clearly for each piece that was evaluated. This would include the following:

Product name
Product manufacturer's name
Model identification
Serial number for each unit evaluated
Electrical ratings
Mechanical ratings as applicable
Evaluation firm label serial number

7.2.5 Procedures

Detail the procedures used to inspect, test and evaluate the product. These should be separated into the major category areas as detailed in sections 4 and 5 of this document with sufficient explanation for clear understanding to all parties involved - client, jurisdiction and possibly the end user.

7.2.6 Evaluation

The evaluation section should include the following:

A brief product description of what it is and how it basically works

Key evaluation results including:

Enclosure

Guarding of live parts

Grounding

Wiring of the manufactured product

Overcurrent protection application and suitability

Discrepancies for each item found including a description of the issue found, explanation of the hazards from that discrepancy, the standards reference citation, the required action to resolve and finally the actual resolution that was completed and accepted.

Electrical testing results

Test instrumentation calibration information

7.2.7 Appendices or Attachments

The following items should be considered for inclusion with the report as appendices or attachments:

Reference drawings used for the evaluation

Data sheet(s) documenting the test results from each of the electrical tests

The bill of material (Critical Components list)

Photographs of the discrepancies found, the resolution that was completed and the over all equipment

Field notes, checklists or other supporting data that would benefit the client.

8.0 Label Application

8.1 Application Time

When all identified issues are fully resolved, all electrical testing is satisfactorily completed and the evaluation has determined the equipment meets the essential requirements of the standard(s) being applied, then a label is to be applied to the equipment.

8.2 Label Minimum Contents

The label should contain the registered mark of the evaluation company and some means of unique identification or serialization. The label should also have a means to identify if the equipment has more than one major assembly and therefore has more than one serialized label applied. The evaluation label used should clearly differentiate this evaluation from "listing" or "recognition" of components.

8.3 Label Location

The evaluation label should be in the area of the equipment nameplate with consideration given for the expected environmental and operating conditions that could cause deterioration to the label.

8.4 Label Control

The evaluator or evaluation company must directly apply all labels and no manufacturer, distributor, contractor or installer is to ever handle the evaluation labels. To achieve a label, 100 percent of the equipment to be labeled must undergo the above process by the evaluation company. See section 2.3 for the processes for multiple units. In no case is a label to be applied to a product that has not been evaluated by the third party. This process is in place of the typical requirements for a manufacturer's quality assurance program and the laboratory follow-up program found with listings. If the manufacturer wants to apply labels, then he should be directed to complete a listing for the equipment with the requisite follow-up program in place.

The evaluator would then enter the label information into the field data sheets or paperwork and eventually the information is entered into the label control system set up by the evaluation company.

Annex A Multiple Units of Same Equipment

Note: This annex is provided for informational purposes only and can be used only when the Authority Having Jurisdiction, the third party testing company and the client agree on the process.

There are many cases where there are multiple units of the same equipment to be evaluated. In this case at least one unit will be completely evaluated according to this procedure and be labeled. The below procedures are not intended for use for "lot" inspections or evaluations. The remaining units can be dealt with in any of the following ways:

Each additional unit can be inspected, tested and evaluated by the evaluation firm as needed to insure each unit is built the same as the "accepted" prototype unit. This process will result in an evaluation label on each unit and the evaluation company becomes in essence the manufacturer's quality assurance inspectors. or

With prior AHJ approval, the process has the first unit completed as above, then a representative sampling of additional units are inspected to determine with a reasonable degree of assurance that all the remaining units are constructed the same as the "accepted" prototype. Only the units that were examined by the evaluator will have a label applied. Sample quantities should be determined by a standard such as ANSI/ASQC Z1 .4 "Sampling Procedures and Tables for Inspection by Attributes" or

With prior AHJ approval, the prototype is evaluated and the manufacturer declares all the remaining units are constructed the same as the "accepted" prototype. The evaluation company will only label the prototype and will not apply a label to any other units. With the labeled unit and the declaration from the manufacturer, the AHJ completes the approval of the installation.