Important New Code Requirements for SCCR Labeling of Data Center Equipment

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Short Circuit Current Ratings (SCCR) are required by Code on all types of data center power and cooling equipment. Owners, Specifying Engineers and Contractors need to understand these requirements to prevent Authorities Having Jurisdiction (AHJ's) from shutting down projects due to the presence of equipment with missing labeling. This document reviews the applicable codes and standards and provides examples of appropriate labels and submittal documentation.

EXECUTIVE SUMMARY

Beginning with the 2005 version of the Nation Electric Code (NEC), also known as NFPA-70, changes to the NEC impose some significant new requirements for Short Circuit Current Rating (SCCR) of electrical machinery including UPS, Air Conditioners and practically every other large power consuming or conversion device in today's Data Center.

This code, along with OSHA and UL standards for Data Center Equipment require clear marking of SCCR on each piece of data center power and cooling equipment.

Many specifiers and end users are unaware of these new requirements and are shocked when Inspectors (Authority Having Jurisdiction or "AHJ") halt projects or deny the use of the facility until questions regarding equipment not supplied with SCCR ratings are answered.

This document is intended to show how the codes and standards are interpreted regarding this requirement, and provide some examples for labels and revised submittal requirements.

National Electric Code Requirements

The National Electric Code (**NEC**) specifies general requirements for all electrical installations in Section 100 of the code. Beginning with the code revisions of 2005 and continuing thorough subsequent revisions, dramatic and substantial changes that effect owners, engineers, contractors and manufacturers have been implemented.

To begin with, ***Article 110.3-Examination, Identification, Installation, and Use of Equipment*** specifies that

> "*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.*
> >
> > *Informational Note: 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. Special conditions of use or other limitations and other pertinent information may be marked on the equipment, included in the product instructions, or included in the appropriate listing and labeling information.* ***Suitability of equipment may be evidenced by listing or labeling.***"

Based on this section of the code, most "Authorities Having Jurisdiction" (**AHJ's**) will require that equipment be listed and labeled in accordance with Underwriter Laboratories (**UL**) published standards. Equipment either improperly labeled or not labeled will most often not be allowed to be put into service by the AHJ, imposing costly delays on a project. Further discussion on UL will occur later in this article.

See Appendix A for further information on listed and labeled products.

Article 110.9-Interrupting Rating specifies that protective devices such as fuses and circuit breakers be specified and installed with in accordance with the following requirement:

> *"Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage not less than the current that must be interrupted."*

This requirement insures that short circuits will be definitively interrupted without a failure of the interrupting device. It does not require that downstream equipment survive without damage.

This requirement is commonly interpreted to mean it is acceptable for equipment damage to occur so long as it does not create a shock or other hazard to personnel, and does not create a fire hazard. In fact, the equipment can be non-repairable and meet this requirement!

If this requirement is not properly met severe injury or death can occur.

Under ***Article 100 – Definitions, Short-Circuit Current Rating*** was introduced in the 2008 code and is defined as follows:

"*The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria*."

Article 110.10 Circuit Impedance; Short-Circuit Current Ratings, and Other Characteristics further clarifies required system performance and the importance of using listed and presumably labeled equipment in all installations:

"*The overcurrent protective devices, the total impedance, the equipment short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without extensive damage to the electrical equipment of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors or between any circuit conductor and the equipment grounding conductor(s) permitted in 250.118.* ***Listed equipment applied in accordance with their listing shall be considered to meet the requirements of this section.***"

OSHA Requirements

OSHA is becoming a significant player in the data center. OSHA1910.303 (b)(4) and 1910.303 (b)(5) impose very similar requirements to the above referenced NEC Articles 110.09 and 110.10.

> **1910.303(b)(4):** *"Interrupting rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted*."
>
> **1910.303(b)(5):** *"Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway*."

Further, **OSHA Article 1910.303(e)(1)(ii)** requires electrical equipment without definition to be marked by the manufacturer with specific data including:

> "*Other markings giving voltage, current, wattage, or other ratings as necessary*."

The author would postulate that OSHA would consider whatever marking requirements specified by the NEC or a Listing agency to be "necessary".

Personal injury or property damage resulting from non-compliance with the requirements of OSHA and NEC in applying the above articles will put equipment suppliers, contractors, engineers and owners at risk of substantial and potentially severe financial penalties.

UL Standards

The NEC includes an informative annex (Annex A) providing a list of product safety standards used for product listing ***where that listing is required by this Code***. Under Annex A the following computer room products are required to be listed as follows, including the Product Standard Name and Number:

Product Standard Name	**Product Standard Number**
Heating and Cooling Equipment	UL 1995
Industrial Control Equipment	UL 508
Industrial Control Panels	UL 508A
Information Technology Equipment – Safety – Part 21: Remote Power Feeding	UL 60950-21
Power Conversion Equipment	UL 508C
Uninterruptible Power Systems	UL 1778

Computer Room Air Conditioner unit Labeling Requirements

Computer Room Air Conditioning units (CRAC's) are clearly covered by both the NEC and UL, and required to be marked for SCCR.

The applicable NEC section is **Article 440.4-Marking on Hermetic Refrigerant Motor-Compressors and Equipment, paragraph (B) Multi-motor and Combination-Load Equipment,** and specifies the following:

> "*Multi-motor and combination-load equipment shall be provided with a visible nameplate marked with the maker's name, ……., and* ***the short-circuit current rating*** *of the motor controllers or industrial control panel*."

In addition, NEC **Section 430 - Motors, Motor Circuits, and Controllers, Article 430.8 Marking on Controllers,** specifies the following:

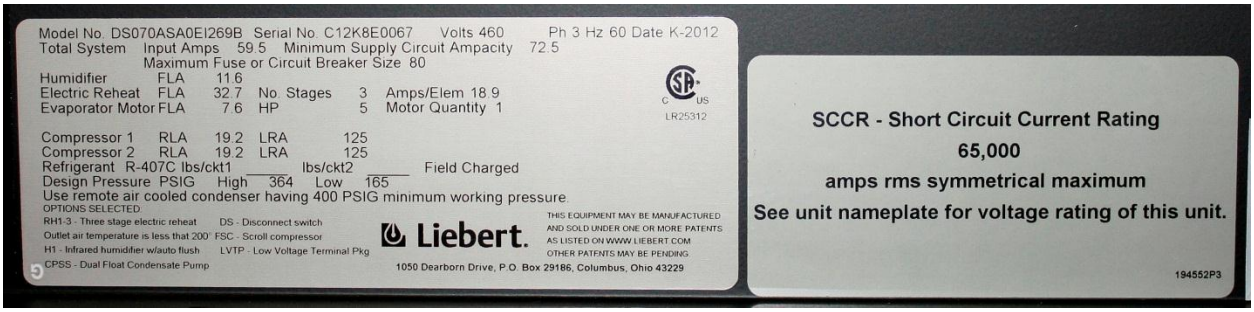
> "*A controller shall be marked with the manufacturer's name or identification, the voltage, the current or horsepower rating,* ***the short-circuit current rating****, ……..*"

Since virtually all packaged HVAC equipment includes multiple motors, minimally a fan and compressor, this section will apply.

With regard to listing requirements, per Annex A, **UL 1995 (CSA C22.2 No 236)** is the NEC requirement for HVAC/R equipment, covering most packaged HVAC equipment, including Computer Room Air Conditioning units (CRAC's).

As of July 30, 2012, adoption of the 3rd edition of UL 1995 requires compliance with the National Electrical Code (NEC), Article 440-4(B). The standard mandates that CRAC's have a marked Short Circuit Current Rating (SCCR) on their label.

The following is an example of a properly constructed UL approved label for a CRAC with the short circuit current ratings clearly indicated:



All AHJ's will be actively enforcing the SCCR requirement in accordance with the NEC. Design Professionals and Contractors should be familiar with this new requirement and insure their documents and specifications reflect the new requirements.

NEC **Article 409-Industrial Control Panels** governs the safe installation and inspection of Industrial Control Panels less than or equal to 600V. **Article 409.2-Definitions** establish a methodology to determine if equipment qualifies as an industrial control panel with the following two descriptions:

> "***Control Circuit***. *The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller, but does not carry the main power current.*
>
> ***Industrial Control Panel***. *An assembly of two or more components consisting of one of the following:*
>
> > *(1) Power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers*
> >
> > *(2) Control circuit components only, such as pushbuttons, pilot lights, selector switches, timers, switches, control relays*
> >
> > *(3) A combination of power and control circuit components.*
>
> *These components, with associated wiring and terminals, are mounted on or contained within an enclosure or mounted on a subpanel. The industrial control panel does not include the controlled equipment."*

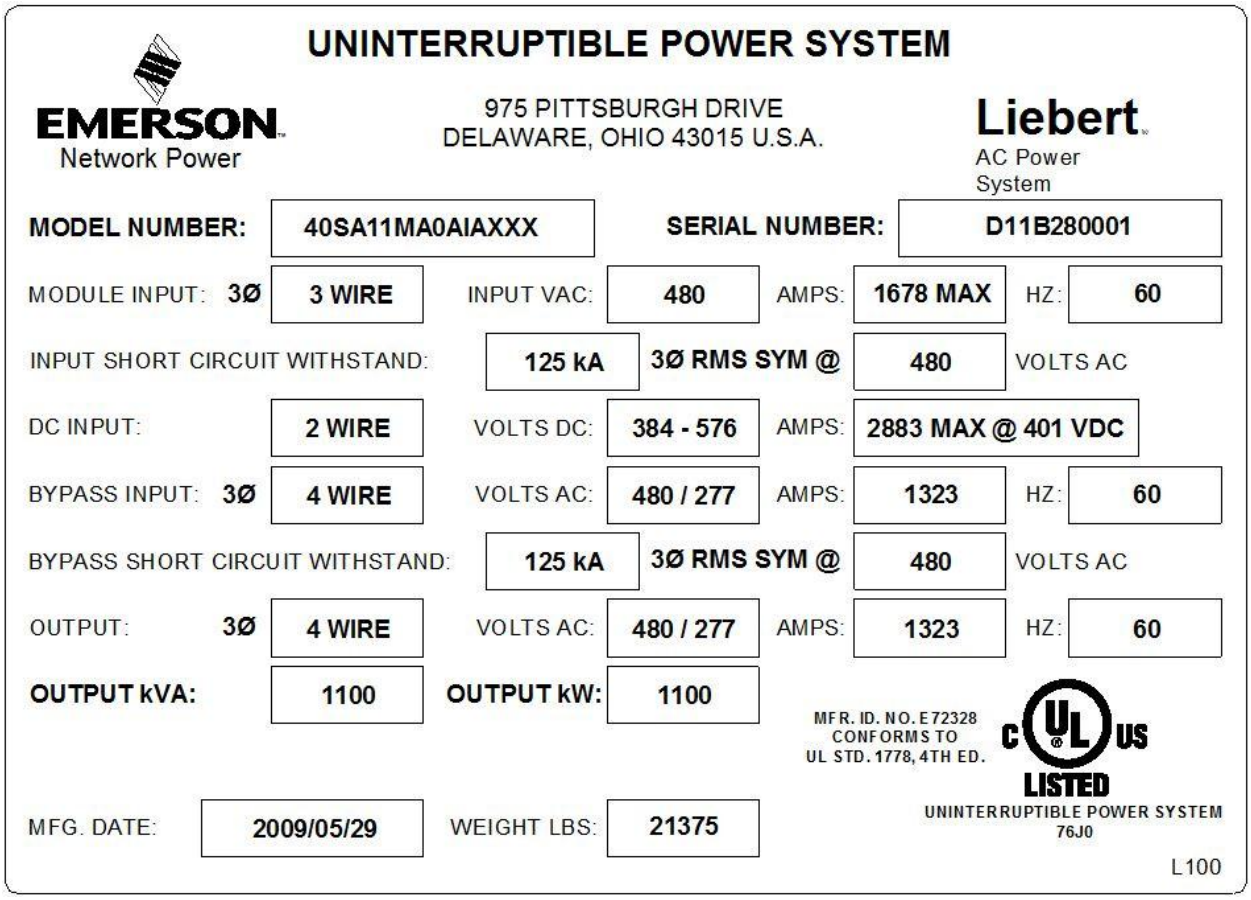
Clearly, equipment such as UPS qualifies as an Industrial Control Panel under section (3) and must be marked in accordance with the code. Marking requirements are defined later in the article.

NEC Article 409.110 – Marking requires Industrial Control Panels to be visibly labeled with each component's SCCR or with the complete assembly SCCR, as follows:

> An industrial control panel shall be marked with the following information that is plainly visible after installation …….. :
>
> (4) Short-circuit current rating of the industrial control panel based on one of the following:
>
> > a. Short-circuit current rating of a listed and labeled assembly
> > b. Short-circuit current rating established utilizing an approved method
>
> Informational Note: UL 508A-2001, Standard for Industrial Control Panels, Supplement SB, is an example of an approved method.
>
> Exception to (4): Short-circuit current rating markings are not required for industrial control panels containing only control circuit components.

With regard to listing requirements, per NEC Annex A, **UL 1778** is the NEC requirement for UPS designed "to ensure continuity of an alternating power source." This standard further indicates that the equipment is intended to be installed in accordance with **ANSI/NFPA 70**, otherwise known as the **NEC**. While UL 1778 does not specifically require SCCR labeling from the writers review of the standard, Annex II (normative) – Standards for components incorporates the requirements of ***Industrial Control Equipment – UL 508*** into the scope of the standard.

The following is an example of a properly constructed UL approved label for a UPS with the short circuit current ratings



UNINTERRUPTIBLE POWER SYSTEM

EMERSON Network Power

975 PITTSBURGH DRIVE
DELAWARE, OHIO 43015 U.S.A.

Liebert AC Power System

MODEL NUMBER:	**40SA11MA0AIAXXX**			**SERIAL NUMBER:**	**D11B280001**		
MODULE INPUT: **3Ø**	**3 WIRE**	INPUT VAC:	**480**	AMPS:	**1678 MAX**	HZ:	**60**
INPUT SHORT CIRCUIT WITHSTAND:	**125 kA**	**3Ø RMS SYM @**	**480**	VOLTS AC			
DC INPUT:	**2 WIRE**	VOLTS DC:	**384 - 576**	AMPS:	**2883 MAX @ 401 VDC**		
BYPASS INPUT: **3Ø**	**4 WIRE**	VOLTS AC:	**480 / 277**	AMPS:	**1323**	HZ:	**60**
BYPASS SHORT CIRCUIT WITHSTAND:	**125 kA**	**3Ø RMS SYM @**	**480**	VOLTS AC			
OUTPUT: **3Ø**	**4 WIRE**	VOLTS AC:	**480 / 277**	AMPS:	**1323**	HZ:	**60**
OUTPUT kVA:	**1100**	**OUTPUT kW:**	**1100**				
MFG. DATE:	**2009/05/29**	WEIGHT LBS:	**21375**				

MFR. ID. NO. E72328
CONFORMS TO
UL STD. 1778, 4TH ED.

c UL us LISTED

UNINTERRUPTIBLE POWER SYSTEM
76J0

L100

Labeling Requirements for other Data Center Equipment

NEC articles can potentially justify an AHJ requiring SCCR labels on many other types of equipment.

For instance, ***NEC Article 670-Industrial Machinery*** governs the safe installation and inspection of Industrial machines less than or equal to 600V. ***Article 670.2-Definitions*** establish a methodology to determine if equipment qualifies as an industrial machine:

> A power-driven machine (or a group of machines working together in a coordinated manner), not portable by hand while working, that is used to process material ……. [The associated electrical equipment, including the logic controller(s) and associated software or logic together with the machine actuators and sensors, are considered as part of the industrial machine.]"

NEC Article 670.3-Machine Nameplate Data requires Industrial Machines to be visibly labeled with each component's SCCR or with the complete assembly SCCR, as follows

> (A) Permanent Nameplate. A permanent nameplate shall be attached to the control equipment enclosure or machine and shall be plainly visible after installation. The nameplate shall include the following information:
>
> (1) Supply voltage, number of phases, frequency, and full load current
>
> (2) Maximum ampere rating of the short-circuit and ground-fault protective device
>
> (3) Ampere rating of largest motor, from the motor nameplate, or load
>
> (4) Short-circuit current rating of the machine industrial control panel based on one of the following:
>
> a. Short-circuit current rating of a listed and labeled machine control enclosure or assembly
> b. Short-circuit current rating established utilizing an approved method
>
> Informational Note: UL 508A-2001, Supplement SB, is an example of an approved method.

Determining SCCR

SCCR for individual components is determined during product testing by the manufacturing company. Assembly SCCR may be determined by the manufacturer, if the assembly is a UL listed product, or by an NEC approved method.

UL508A Supplement SB – Industrial Control Panels is the only method listed in the NEC for determining an assembly SCCR, being mentioned in the Fine Print Notes (FPN) under various articles mentioned in the above text. However, other related standards such as ***UL 508C-Power Conversion Devices*** would almost certainly be acceptable.

Per this standard, after the SCCR has been determined, the equipment label must be marked with multiple data, including the following:

> "Short Circuit Current: __kA rms symmetrical, __V maximum"

Also included would be the following information:

> "Short Circuit Rating of the main overcurrent protective device if provided (NFPA 79, UL508A 67.1.2)"
>
> "If the overcurrent protective device associated to a high fault control panel SCCR is not provided, and is to be installed locally, a marking on the nameplate must show the type of overcurrent protective device necessary for the high fault rating"

An SCCR value is considered "High Fault" when the assigned SCCR is greater than the "Standard SCCR" for the given component or assembly as defined in UL 508A Table SB 4.1. With the exception of motor controllers with much higher required ratings, all other devices are 10,000 Amps or less. This includes circuit breakers, terminal blocks, fuse holders, and other miscellaneous devices.

SCCR is normally calculated by the "weakest link" method, whereby the lowest rated component SCCR of an assembly determines the overall rating of the assembly.

If the assigned SCCR value is based on a High Fault Rating, the label must include the following warning:

> "**Risk of Fire or Electric Shock** – The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged. If burnout of a current element of an overload relay occurs, the complete overload relay must be replaced."

If an SCCR is not marked on the assembly, the assumed SCCR is 5,000 Amps. In most power circuits greater than 60 Amps, this rating will be insufficient to meet the requirements of the NEC.

Recommendations for Specifiers

The new SCCR requirements of the NEC represent a liability to specifiers of Data Center Equipment if not addressed at the design phase of a project.

To prevent potential liability specifications should be specifically modified to insure suppliers meet the following labeling requirements:

NEC ***Article 409.110 – Marking*** (Industrial Control Panels)

NEC ***Article 440.4-Marking on Hermetic Refrigerant Motor-Compressors and Equipment***

NEC ***Article 430.8 Marking on Controllers*** (Motors, Motor Circuits, and Controllers)

NEC ***Article 670.3-Machine Nameplate Data*** (Industrial Machinery)

It is suggested that electrical one-lines be clearly marked with both the available fault current at each point in the system, as well as the SCCR required on any equipment at that location in the circuit.

Specifications should clearly require the submission of data to substantiate compliance with plans and specifications prior to approval of the submitted equipment by the specifier. Failure to comply with this requirement should provide for automatic rejection of the equipment submittals.

If the AHJ prevents equipment from being energized due to inadequate SCCR after it is already installed, the expense to correct the problems can be costly and disruptive. The best way to prevent this from happening is to clearly specify the required SCCR levels before the project is bid.

On the following page a representative drawing for a typical UPS submittal is attached.

Appendix A – NEC Definitions of Listed and Labeled Equipment

Under ***Article 100 – Definitions, Identified*** is defined as follows:

> "***Identified***-Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular Code requirement.
>
> > Informational Note: Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a qualified testing laboratory (listing and labeling), an inspection agency, or other organizations concerned with product evaluation."

Labeled. 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.

Listed. 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 either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

> Informational 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.