

electrically isolated from any distribution system supplying areas other than the cell line working zone and shall be ungrounded. Power for these circuits shall be supplied through isolating transformers. Primaries of such transformers shall operate at not more than 1000 volts between conductors and shall be provided with proper overcurrent protection. The secondary voltage of such transformers shall not exceed 300 volts between conductors, and all circuits supplied from such secondaries shall be ungrounded and shall have an approved overcurrent device of proper rating in each conductor.

**(B) Noninterchangeability.** Receptacles and their mating plugs for ungrounded equipment shall not have provision for an equipment grounding conductor and shall be of a configuration that prevents their use for equipment required to be grounded.

**(C) Marking.** Receptacles on circuits supplied by an isolating transformer with an ungrounded secondary shall be a distinctive configuration, shall be distinctively marked, and shall not be used in any other location in the plant.

### 668.30 Fixed and Portable Electrical Equipment.

**(A) Electrical Equipment Not Required to Be Grounded.** Alternating-current systems supplying fixed and portable electrical equipment within the cell line working zone shall not be required to be grounded.

**(B) Exposed Conductive Surfaces Not Required to Be Grounded.** Exposed conductive surfaces, such as electrical equipment housings, cabinets, boxes, motors, raceways, and the like, that are within the cell line working zone shall not be required to be grounded.

**Δ (C) Wiring Methods.** Auxiliary electrical equipment such as motors, transducers, sensors, control devices, and alarms, mounted on an electrolytic cell or other energized surface, shall be connected to premises wiring systems using any of the following:

- (1) Multiconductor hard usage cord.
- (2) Wire or cable in suitable raceways or metal or nonmetallic cable trays. If metal conduit, cable tray, armored cable, or similar metallic systems are used, they shall be installed with insulating breaks such that they do not cause a potentially hazardous electrical condition.

**(D) Circuit Protection.** Circuit protection shall not be required for control and instrumentation that are totally within the cell line working zone.

**(E) Bonding.** Bonding of fixed electrical equipment to the energized conductive surfaces of the cell line, its attachments, or auxiliaries shall be permitted. Where fixed electrical equipment is mounted on an energized conductive surface, it shall be bonded to that surface.

**668.31 Auxiliary Nonelectrical Connections.** Auxiliary nonelectrical connections, such as air hoses, water hoses, and

the like, to an electrolytic cell, its attachments, or auxiliary equipment shall not have continuous conductive reinforcing wire, armor, braids, and the like. Hoses shall be of a nonconductive material.

### 668.32 Cranes and Hoists.

**(A) Conductive Surfaces to Be Insulated from Ground.** The conductive surfaces of cranes and hoists that enter the cell line working zone shall not be required to be grounded. The portion of an overhead crane or hoist that contacts an energized electrolytic cell or energized attachments shall be insulated from ground.

**(B) Hazardous Electrical Conditions.** Remote crane or hoist controls that could introduce hazardous electrical conditions into the cell line working zone shall employ one or more of the following systems:

- (1) Isolated and ungrounded control circuit in accordance with 668.21(A)
- (2) Nonconductive rope operator
- (3) Pendant pushbutton with nonconductive supporting means and having nonconductive surfaces or ungrounded exposed conductive surfaces
- (4) Radio

**668.40 Enclosures.** General-purpose electrical equipment enclosures shall be permitted where a natural draft ventilation system prevents the accumulation of gases.

## ARTICLE 669

## Electroplating

**669.1 Scope.** This article applies to the installation of the electrical components and accessory equipment that supply the power and controls for electroplating, anodizing, electropolishing, and electrostripping. For purposes of this article, the term *electroplating* shall be used to identify any or all of these processes.

Because of the extremely high currents and low voltages normally involved, conventional wiring methods cannot be used in electroplating, anodizing, electropolishing, and electrostripping processes. Section 669.6 permits the use of bare conductors supported from insulators in systems exceeding 50 volts direct current (dc). Some systems in the aluminum anodizing process have potentials up to 240 volts. Warning signs in accordance with 669.7 are required to be posted to indicate the presence of bare conductors.

**669.3 General.** Equipment for use in electroplating processes shall be identified for such service.

**669.5 Branch-Circuit Conductors.** Branch-circuit conductors supplying one or more units of equipment shall have an ampacity



of not less than 125 percent of the total connected load. The ampacities for busbars shall be in accordance with 366.23.

**669.6 Wiring Methods.** Conductors connecting the electrolyte tank equipment to the conversion equipment shall be in accordance with 669.6(A) and (B).

**(A) Systems Not Exceeding 60 Volts Direct Current.** Insulated conductors shall be permitted to be run without insulated support, provided they are protected from physical damage. Bare copper or aluminum conductors shall be permitted where supported on insulators.

**(B) Systems Exceeding 60 Volts Direct Current.** Insulated conductors shall be permitted to be run on insulated supports, provided they are protected from physical damage. Bare copper or aluminum conductors shall be permitted where supported on insulators and guarded against accidental contact up to the point of termination in accordance with 110.27.

**669.7 Warning Signs.** Warning signs shall be posted to indicate the presence of bare conductors. The warning sign(s) or label(s) shall comply with 110.21(B).

#### 669.8 Disconnecting Means.

**(A) More Than One Power Supply.** Where more than one power supply serves the same dc system, a disconnecting means shall be provided on the dc side of each power supply.

**(B) Removable Links or Conductors.** Removable links or removable conductors shall be permitted to be used as the disconnecting means.

**669.9 Overcurrent Protection.** Direct-current conductors shall be protected from overcurrent by one or more of the following:

- (1) Fuses or circuit breakers
- (2) A current-sensing device that operates a disconnecting means
- (3) Other approved means

#### ARTICLE

#### 670

#### Industrial Machinery

Δ **670.1 Scope.** This article covers the nameplate data for, overvoltage protection for, and the size and overcurrent protection of supply conductors to industrial machinery.

Informational Note No. 1: See NFPA 79, *Electrical Standard for Industrial Machinery*, for further information.

The equipment and wiring of industrial machinery, for which different component parts may be purchased and assembled at the location of use, must be installed in accordance with the applicable articles in the NEC®. Machinery assembled by the

manufacturer, in accordance with NFPA 79, *Electrical Standard for Industrial Machinery*, then disassembled for shipping and reassembled at its place of use, comes under only Article 670 and any NEC sections referenced herein. In this case, the machinery is treated as a package unit.

The information to be included on the nameplate allows for proper conductor sizing, overcurrent protection of the feeder or branch circuit supplying the industrial machine, and integration of the machine into the facility electrical system.

Informational Note No. 2: See 110.26 for information on the workspace requirements for equipment containing supply conductor terminals.

Informational Note No. 3: See NFPA 79, *Electrical Standard for Industrial Machinery*, for information on the workspace requirements for machine power and control equipment.

Working clearances around control equipment enclosures and compartments containing equipment operating at 1000 volts or less and that are an integral part of an industrial machine are contained in Section 11.5 in NFPA 79. The requirements of NFPA 79 closely parallel those found in 110.26(A), but some requirements in NFPA 79 allow smaller clearances under very specific conditions of operation and equipment construction.

#### 670.3 Machine Nameplate Data.

Informational Note: See 430.22(E) and 430.26 for duty cycle requirements.

Δ **(A) Permanent Nameplate.** A permanent nameplate shall be attached to the outside of the control equipment enclosure or on the machine immediately adjacent to the main control equipment enclosure that is 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 using an approved method

Informational Note: See UL 508A-2017, *Industrial Control Panels, Supplement SB*, for an example of an approved method.

- (5) Electrical diagram number(s) or the number of the index to the electrical drawings

The full-load current shown on the nameplate shall not be less than the sum of the full-load currents required for all motors and other equipment that can be in operation at the same time under normal conditions of use. Where unusual type loads, duty cycles, and so forth require oversized conductors or permit