

STANDARD INFORMATION

Standard Number: UL 508C

Standard Name: Power Conversion Equipment

Standard Edition and Issue Date: 4th Edition Dated May 16, 2016

Date of Revision: May 16, 2016

Date of Previous Revision of Standard: 3rd Edition Revision Dated November 9, 2010

EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

Effective Date: **May 16, 2019** (Revised products)

IMPACT, OVERVIEW, AND ACTION REQUIRED

Impact Statement: Continuing Certification

NOTE: Effective immediately, UL 61800-5-1 will be exclusively used for evaluation of new products unless the Applicant requests in writing that current requirements be used along with their understanding that their listings will be withdrawn on the Effective Date of February 1, 2020 unless product is found to comply with the new/revise requirements. New products are defined as:

- Any model or models that belong to a new series of drives (not previously Listed or Recognized to UL 508C)
- Any new model to an existing series (currently Listed or Recognized to UL 508C) that requires an associated change to the ratings or construction details section of the Certification report for that series
- May 16, 2019 has been established as the Effective Date for the change in certification requirements from UL 508C 3rd Ed. to UL 508C 4th Ed.
- February 1, 2020 has been established as the Effective Date for the change in certification requirements according to the revisions published in UL 61800-5-1 on February 24, 2017, in order to align with the current effective date of UL 61800-5-1 1st Ed.
- As of February 1st, 2020, UL 508C will be withdrawn. This is the implementation date.
- Existing certifications of equipment to prior versions of UL 508C will be allowed to maintain certification and not be withdrawn on or after the Effective Date of May 16, 2019 for UL 508C 4th Ed., provided there are no changes to the equipment design that require a certification decision in accordance with the latest published Standard Revision. Changes requiring a certification decision after May 16, 2019 and until February 1st, 2020, will require the equipment (in its entirety) to be evaluated to the latest Standard Revision, UL 508C, 4th Edition. Changes to the equipment design after the UL 61800-5-1 Effective Date of February 1st, 2020, will require the equipment to be evaluated to UL 61800-5-1, 1st Ed., revised February 24th, 2017.
- After February 1st, 2020, only UL 61800-5-1 will be used for drive investigations.



Overview of Changes:

- Modification of Short-Circuit Testing Requirements
- Revision of Ratings for Capacitors in AC Circuits
- Revision of Marking and Instruction Requirements to Use Appropriate Signal Words
- Revision of Frequency Requirements for Dielectric Voltage Withstand Testing
- Revision of Breakdown of Components Testing in Secondary Circuits
- Revision of Table 63.1 to Include Marking Requirements in 56.6 and 56.7
- Slash and Straight Voltage Ratings for Drives with a 3-Phase Input
- Revision to the conductor temperature limit during the Temperature Test, Section 40
- Revision of 56.7 to align with requirements in NFPA 70
- Revisions to Section 68, Plenum Rated Drives

Specific details of new/revised requirements are found in table below.

If the applicable requirements noted in the table are not described in your report(s), these requirements will need to be confirmed as met and added to your report(s) such as markings, instructions, test results, etc. (as required).

Client Action Required:

Information – To assist our Engineer with review of your Listing Reports, please submit technical information in response to the new/revised paragraphs noted in the attached or explain why these new/revised requirements do not apply to your product (s).

Current Listings Not Active? – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records. We will do this at no charge as long as Intertek is notified in writing prior to the review of your reports.

STANDARD INFORMATION

CLAUSE	VERDICT	COMMENT
<p>Additions to existing requirements are <u>underlined</u> and deletions are shown lined out below.</p>		
<p>The following changes reflect the changes from the 3rd to 4th edition</p>		
1	Info	Scope
1.4		<p>Equipment intended for use in hazardous locations as defined by the National Electrical Code, NFPA 70, shall be evaluated to the Standard for Industrial Control Equipment for Use in Hazardous (Classified) Locations, UL 698 <u>Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, UL 1203.</u></p>



21	Info	Capacitors
21.2		<p>An across-line capacitor shall be rated for the voltage (square root of 2 times the input value) and the temperature rating of the circuit involved and it shall comply with the Dielectric Voltage Withstand Test, Section 44. A capacitor in an ac circuit shall have rms and peak voltage ratings not less than the voltage of the circuit involved. Capacitors investigated to either the Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14, or the Standard for Electromagnetic Interference Filters, UL 1283, are considered to have a peak voltage rating of 1.4 times the rms rating.</p>
21.3		<p>A means shall be provided to discharge each bus capacitor to a voltage level below 50 V DC within 1 minute.</p> <p>Exception: Drives are not required to comply with this discharge requirement when they are provided with instructions that read, “CAUTION WARNING – Risk of Electric Shock ,” followed by instructions to discharge the specific capacitor or indicating the time required for the capacitor to discharge to a level below 50 V DC.</p>
32	Info	Isolated Secondary Circuits
32.7	Info	Limiting impedance circuits
32.7.3		<p>The 15-watt power limitation of the impedance shall not be exceeded under single component fault conditions. A limiting impedance relied upon to reduce the risk of electric shock as in 29.1(b) shall comply with 29.1(b) under single component fault conditions.</p> <p>Exception No. 1: When the circuit limited by the 15-watt impedance is enclosed, the effect of single component fault conditions is not evaluated.</p> <p>Exception No. 2: A single resistor serving as a limiting impedance is considered to comply with this requirement without further investigation.</p> <p>Exception No. 3: A single capacitor serving as a limiting impedance is considered to comply with this requirement without further investigation when the capacitor complies with requirements in the Standard for Capacitors and Suppressors for Radio and Television Type Appliances, UL 1414. <u>Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14.</u></p>
36	Info	Spacings
36.9	Info	Spacings for drives evaluated in accordance with UL 840
36.9.4		<p>In conducting evaluations in accordance with the requirements in the Standard for Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment, UL 840, the following shall be used:</p> <p>g) The Phase-to-Ground Rated System Voltage used in the determination of Clearances shall be the <u>maximum of (1) and (2):</u></p>



- 1) The largest rated voltage for equipment rated supply voltage in accordance with 59.6(a); and
- 2) The largest lower rated voltage for equipment rated in accordance with 59.6(b).

This Phase-to-Ground Rated System Voltage shall be rounded to the next higher value (in the table for determining clearances for equipment) for all points on the supply side of an isolating transformer or the entire product when no isolating transformer is provided. The System Voltage used in the evaluation of secondary circuitry is not prohibited from being interpolated with interpolation continued across the table for the Rated Impulse Withstand Voltage Peak and Clearance; and

Info **DEVICE PERFORMANCE**

39 Info **General**

39.1 The performance of industrial power conversion equipment shall be investigated by subjecting a representative sample or samples in commercial form to the tests described in Sections 40 – 55. Representative models for test shall be determined by engineering analysis of the drive series. Additional considerations with respect to representative model include, but are not limited to, the range of cross-sections of conductors, both input and output, that must be accommodated by multiple rated drive controllers, and the effects of input impedance modification (for example, input reactors) provided optionally or recommended for use with the product. Table 39.1 specifies the tests and indicates those tests to be conducted in sequence.

39.7 During the tests, equipment shall be mounted and wired so as to represent the intended use. ~~Except as indicated in the Terminal Torque Test, Section 51,~~ All field wiring terminal blocks or wire connectors shall be tightened to the value of torque marked on the product.

40 Info **Temperature Test**

Maximum temperatures for internal parts

Materials and components	°C	°F
1. Rubber- or thermoplastic-insulated conductors	75 b	167 b
^b <u>For rubber- or thermoplastic-insulated conductors, the temperature shall not exceed the maximum operating temperature specified for the wire in question and for standard insulated conductors other than those specified in item 1, reference shall be made to the National Electrical Code (NEC), ANSI/NFPA 70, and the maximum temperature shall not exceed the maximum operating temperature specified in the NEC for the wires.</u>		

Table 40.1



40.9		<p>The thermocouple method for temperature measurement as specified in Table 40.1 consists of the determination of temperature by use of a potentiometer type instrument and thermocouples that are applied to the hottest accessible parts. The thermocouples are to be made of wires not larger than 24 AWG (0.21 mm²) and not smaller than 30 AWG (0.05 mm²). The thermocouples and related instruments are to be accurate and calibrated in accordance with standard laboratory practice. The thermocouple wire is to conform with the requirements specified in the <u>Initial Calibration Tolerances for Thermocouples table on Initial Values of EMF versus Temperature Measurement tables in the Standard Specification and Temperature- Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ISA MC96.1 ASTM E230/E230M.</u></p>
41	Info	Abnormal Operation Tests
41.1	Info	General
		<i>New clause added;</i>
41.1.2		<p>The test circuit for equipment with a 3-phase input shall have three wires. The voltage in 39.3 between any two phases shall be the maximum of (a) and (b):</p> <p>a) The largest rated voltage for equipment rated in accordance with 59.6(a); and b) The largest higher rated voltage for equipment rated in accordance with 59.6(b).</p> <p>Exception: The test circuit for equipment rated in accordance with 59.6(b) is able to have a fourth wire, designated "S" in Figure 41.1(B), when the electrical source is wye-connected and the fourth wire connects to the center of the wye.</p>
44	Info	Dielectric Voltage-Withstand Test
44.1	Info	General
		<i>New clause added;</i>
44.1.4		Testing conducted with a sinusoidal potential in accordance with 44.1.1 shall be conducted at any frequency from 50 to 60 Hz, ± 2 Hz.
45	Info	Short Circuit Test – Standard Fault Currents
45.2	Info	Test circuit current/voltage
45.2.5		<p>The test circuit for equipment with a 3-phase input shall have three wires. The voltage in 45.2.4 between any two phases shall be the maximum of (a) and (b):</p> <p>a) The largest rated voltage for equipment rated in accordance with 59.6(a); and b) The largest higher rated voltage for equipment rated in accordance with 59.6(b).</p> <p>Exception: The test circuit for equipment rated in accordance with 59.6(b) is able to have a fourth wire, designated "S" in Figures 45.1(B) and 45.2(B), when the electrical source is wye-connected and the fourth wire connects to the center of the wye.</p>
45.4	Info	Ground fuse



As shown in Figure 45.1(A), a 30 ampere nontime delay ground fuse shall be connected, by means of a 4 – 6 ft (1.22 m – 1.83 m) long 10 AWG (2.59 mm) copper wire ~~in accordance with one of the following~~: between the enclosure and the main input power terminal judged least at risk of arcing to earth ground, with the main input ground connection removed. For 3-phase drives, the main input power terminal judged least at risk of arcing to earth ground is the L2 terminal.

45.4.1

Exception No. 1: The ground fuse is able to be connected between the enclosure and earth ground, with the main input ground connection removed.

Exception No. 2: When testing in accordance with the Exception to 45.2.5, as shown in Figure 45.1(B), the ground fuse is able to be connected between the enclosure and “S”.

Exception No. 3: The ground fuse connection is able to be made with 12 or 14 AWG (2.05 or 1.63 mm) copper wire when the main input power wiring is either 12 or 14 AWG (2.05 or 1.63 mm) respectively.

46

Info

Group Installation (Optional)

46.4

Info

Short circuit test – group installation for high fault currents

46.4.1

A drive having short circuit ratings in excess of the levels specified in Table 45.1 shall comply with the requirements of Section 48, Short Circuit Test – High Fault Currents, with the following modifications:

e) In 48.4(h), the single-phase power factor shall comply with Table 46.1.

48

Info

Short Circuit Test – High Fault Currents

The requirements for conducting the high fault current short circuit test shall be in accordance with 45.1.5 except for the following differences:

48.4

h) When testing in accordance with the Exception to 45.2.5, the test circuit shall also be able to deliver not less than 90% of the rated high fault current into a single-phase short circuit between each phase and “S”. The single-phase power factor shall comply with 20.1.2.

51

Info

Breakdown of Components Test



There shall be no emission of flame or molten metal nor ignition of cotton, when capacitors, diodes, or other solid state components are short- or open-circuited.

Exception: The test is not required:

- 51.1
- a) When circuit analysis indicates that no other component or portion of the circuit is overloaded as a result of the assumed open circuiting or short circuiting of another component.
 - b) For components located entirely in Class 2 circuits as defined in 32.2.
 - c) For components located on the load side of the isolating source that supplies a limited voltage/current secondary circuit as defined in 32.3 or on the load side of a limiting impedance as defined in 32.7.
 - d) On power semiconductor devices when equivalent testing is accomplished during short circuit tests.
 - e) For components complying with requirements applicable to the component.

New clause added;

51.5

The test circuit for a drive controller with a 3-phase input shall comply with 41.1.2.

52 Info **Breakdown of Components Test – Group Installation for Standard Fault Currents**

A drive having short circuit ratings at the standard available levels specified in Table 45.1 shall be tested in accordance with Section 51, Breakdown of Components Test, with the following additional requirements:

- 52.1
- e) In 51.5, 45.2.5 replaces 41.1.2.
 - f) In 51.6, Figure 45.2(A) replaces Figure 41.1(A).
 - g) In the Exception to 51.6, 45.2.5 replaces 41.1.2 and Figure 45.2(B) replaces Figure 41.1(B).
 - h) The drive shall be tested on a circuit that is calibrated as described in Section 54, Calibration of Test Circuits, of the Standard for Industrial Control Equipment, UL 508. The available short circuit current of the test circuit shall be the standard fault current value according to Table 45.1. When testing in accordance with the Exception to 45.2.5, the test circuit shall also be able to deliver not less than 90% of this current into a single-phase short circuit between each phase and “S”.

53 Info **Breakdown of Components Test – Group Installation for High Fault Currents**



A drive having short circuit ratings in excess of the levels specified in Table 45.1 shall additionally be tested in accordance with Section 51, Breakdown of Components Test, with the following modifications:

- 53.2
- a) The requirements of Section 51 are amended by (a) – (g) of 52.1.
 - b) The branch-circuit protective device(s) shall also comply with 48.4 (a) – (g).
 - c) The drive shall be tested on a circuit that is calibrated as described in Section 54, Calibration of Test Circuits, of the Standard for Industrial Control Equipment, UL 508. The available short circuit current of the test circuit shall be the maximum value for which the drive is rated. The high fault current values for which a drive is able to be tested are not required to be one of the same values detailed in Table 45.1. When testing in accordance with the Exception to 45.2.5, the test circuit shall also be able to deliver not less than 90% of this current into a single-phase short circuit between each phase and “S”.

59 Info **Rating**

New clause added;

Power conversion equipment shall have one or more of the following input voltage ratings:

- 59.6
- a) Straight voltage rating – The rating shall be the line-to-line voltage, for example, 460 or 480 volts.
 - b) Slash voltage rating – The rating shall have two values, the line-to-line voltage and the line-to-ground voltage, for example, 460Y/267 or 480Y/277 volts.

Info **DEVICE MARKING**

60 Info **General**

60.4 The optional markings, “Suitable for Installation in a Compartment Handling Conditioned Air” or “Suitable for Use in Other Environmental Air Space in Accordance with Section 300.22 (C) of the National Electrical Code” shall only be marked on power conversion equipment that has been evaluated in accordance with requirements for plenum rated drives.

61 Info **Overload, Over-Current, and Over-Speed Protection**

61.6 Drives complying with 20.1.10(b) or 20.1.10(c) shall be marked to indicate that motor overtemperature sensing is ~~required~~ not provided by the drive.

67 Info **Cautionary Markings**

New clause added;

67.1 A marking on the product or in the instruction manual that is intended to inform the user of a risk of injury to persons or property damage shall comply with 67.2 through 67.6.



New clause added;

67.2 The marking shall be prefixed by a signal word “CAUTION,” “WARNING,” “DANGER,” or “NOTICE.” The signal word shall be in letters not less than 1/8 inch (3.2 mm) high. The remaining letters of such marking, unless specified otherwise in individual marking requirements, shall not be less than 1/16 inch (1.6 mm) high. The signal word shall be more prominent than any other required marking on the product.

New clause added;

Unless specified otherwise in individual marking requirements, when deciding which signal word to use, the following definitions apply:

- 67.3
- DANGER – Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 - WARNING – Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 - CAUTION – Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.
 - NOTICE – Indicates a potentially hazardous situation which, if not avoided, could result in property damage or other situation not related to personal injury.

67.9 When more than one disconnect switch is required to disconnect all power within a control assembly or compartment, the assembly or compartment shall be marked with the word ~~“CAUTION”~~ “WARNING” or “DANGER” and the following or the equivalent, “Risk of Electric Shock – More than one disconnect switch is required to de-energize the equipment before servicing.”

67.11 A live heat sink or other part mistaken as dead metal and exposed to persons shall be marked with the word ~~“CAUTION”~~ “WARNING” or “DANGER” and the following or equivalent, “Risk of Electric Shock – Plates (or other word describing the type of part) are live – Disconnect Power Supply Before Servicing.” The marking shall be located on the live part.

67.12 The marking required for enclosures that are intended for field assembly of the bonding means in accordance with 6.6.1 shall:

a) Be located where visible during installation, such as inside the cover; and
b) Consist of the word ~~“CAUTION”~~ “WARNING” or “DANGER” and the following or the equivalent, “Bonding between conduit connections is not automatic and must be provided as a part of the installation”; or the word ~~“CAUTION”~~ “WARNING” or “DANGER” and the following or equivalent, “Nonmetallic enclosure does not provide grounding between conduit connection. Use grounding bushings and jumper wires.”

69 Info **Marking Location**



Marking location for power conversion equipment

Table 69.1

Marking reference	Required marking	Location	
		Enclosed	Open
Overload, Over-current, Over-speed, and Overtemperature protection			
61.1	Degree of protection level	B or H	F or H
61.2	Equipment used with motors having thermal protectors	B or H	F or H
61.3	Equipment employing ventilation in accordance with 6.10.1, 6.10.3, 6.10.4 and 6.10.5	B or H	F or H
61.4	Equipment connected to supply source with specific overcurrent protective device as referred in 41.6.1	B or H	F or H
<u>61.5</u>	<u>Equipment not incorporating internal overload protection for the motor load and intended to be used with external or remote overload protection</u>	<u>B or H</u>	<u>F or H</u>
61.6	<u>Drives complying with 20.1.10(b) or 20.1.10(c)</u>	<u>B or H</u>	<u>F or H</u>

Info **COOLING SYSTEMS**

77 Info **Plenum Rated Drives**

77.2 Enclosure surfaces which are exposed in a compartment handling conditioned air for circulation through a duct system shall have a flame spread rating of not more than 25, and a smoke developed rating of not more than 50, when tested as specified in Surface Burning Characteristics of Building Materials and Assemblies, CAN/ULC-S102, and in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723. Drives with enclosures that are either whole or in part non-metallic and intended to be installed in air-handling spaces shall additionally comply with the requirements in the Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043.



The requirements in 77.2 do not apply to the following:

- 77.3
- a) Air filters, drive belts, wire insulation, paint applied for corrosion protection, or tubing of material equivalent to one of the types of wire insulation permitted by this standard;
 - b) Gaskets forming air or water seals between metal parts;
 - c) Miscellaneous small parts such as refrigerant line bushings or insulating bushings, resilient or vibration mounts, wire ties, clamps, labels, or drain line fittings having a total exposed surface area not exceeding 25 in² (161.29 cm²);
 - d) An adhesive that, when tested in combination with the specific insulating material, complies with the requirement.
 - e) ~~Moulded or formed components (not liners) of polymeric materials in such quantities that their total exposed surface area within the compartment does not exceed 10 square feet (0.93 m²); or~~

~~Exception: Polymeric materials shall have a flame spread rating of not more than 25, or shall comply with the requirements of the vertical burning test for classifying materials 5V in accordance with Tests for Flammability of Plastic Materials in Devices and Appliances, UL 94, and Test 5V (500 W) of Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17 with a flammability rating of 5VA.~~

New clause added;

- 77.4
- Metallic enclosure surfaces, including those which are ventilated, are suitable for use in air handling ducts and plenums without further investigation.

CUSTOMERS PLEASE NOTE: This Table and column “Verdict” can be used in determining how your current or future production is or will be in compliance with new/revised requirements.
