INCH-POUND
MIL-PRF-7115G
11 July 2012
SUPERSEDING
MIL-C-7115F
18 September 1992

PERFORMANCE SPECIFICATION

CONVERTERS, AIRCRAFT, GENERAL SPECIFICATION FOR

1. SCOPE

1.1 Scope. This specification establishes the general requirements for converters that convert electrical power in aircraft from nominal 115/200 volts alternating current (AC), 400 Hertz (Hz), AC three-phase, (see 6.7.1) aircraft electrical systems power to nominal 28 volt regulated and non-regulated direct current (DC) (see 6.7.4) power.

1.2 Classification. Converters are of the following types and classes, as specified (see 3.5.2.1 and 6.2):

1.2.1 Converter type.

Type I - Regulated converter designed to provide regulated DC output within a narrow voltage range (28.0 +/- 0.5 VDC) with provisions for parallel operation, when parallel operation is identified in the specification sheet.

Type II - Non-regulated converter designed for a nominal 28 VDC output with provisions for parallel operation.

Comments, suggestions, or questions on this document should be addressed to the Naval Air Systems Command (Commander, Naval Air Warfare Center Aircraft Division, Code 4L8000B120-3, Highway 547, Lakehurst, NJ 08733-5100) or by e-mail to michael.sikora@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST online database at https://assist.dla.mil.

AMSC N/A FSC 6130

1.2.2 Converter class.

Class A - Converters that are self-cooled and are designed to meet the temperature-altitude requirements of Figure 1, Class A.

Class B - Converters that are self-cooled and are designed to meet the temperature-altitude requirements of Figure 1, Class B.

Class C - Converters that are blast-cooled and are designed to meet the temperature-altitude requirements and inlet airflow requirements specified in the applicable specification sheet, and converters that are self-cooled and are designed to meet the temperature-altitude requirements of Figure 1, Class C.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 or 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARD

FED-STD-595/37038	-	Miscellaneous, Flat or Lusterless

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-15024	-	Plates, Tags, and Bands for Identification of Equipment, General Specification for
MIL-PRF-7115/2	-	Converter, Aircraft, AC to DC, 200 Ampere, Type II, Class A
MIL-C-7115/3	-	Converter, Aircraft, 150 Ampere, Type II, Blast Cooled, Class C
MIL-PRF-7115/4		Converter, Aircraft, 300 Ampere, Type II, Class A, Fan Cooled

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	-	Identification Marking of U.S. Military Property
MIL-STD-202	-	Electronic and Electrical Component Parts
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-464	-	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-704	-	Aircraft Electric Power Characteristics
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-889	-	Dissimilar Metals
MIL-STD-1285	-	Marking of Electrical and Electronic Parts

(Copies of these documents are available online at https://assist.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

NASM14151	-	Washer, Flat, Round, Corrosion Resisting Steel (for Electrical applications
NASM35338	-	Washer, Lock-Spring, Helical, Regular (Medium) Series
NASM35650	-	Nut, Plain, Hexagon, Machine Screw, UNF-2B.
NASM90415	-	Nut, Self-Locking, Steel, 160 KSI, 450 Degrees F, 12 Point, Captive Washer

(Copies of these documents are available from http://www.aia-aerospace.org or Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928.)

JOINT ELECTRON DEVICE ENGINEERING COUNCIL (JEDEC)

JESD471	-	Symbol and Label for Electrostatic Sensitive Devices

(Copies of this document are available from http://www.jedec.org or JEDEC, 3103 North 10th Street, Suite 240-S, Arlington, VA 22201-2107.)

RTCA, INCORPORATED

DO-160G	-	Environmental Conditions and Test Procedures for Airborne Equipment

(Applications for copies should be addressed to the RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036-5133, http://www.rtca.org/.)

SAE INTERNATIONAL

SAE-AMS2175	-	Castings, Classification and Inspection of
SAE-AMS-M-3171	-	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on
SAE-AS7928	-	Terminals, Lug: Splices, Conductor: Crimp Style, Copper, General Specification for
SAE-AS8879	-	Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter
SAE-AMS-A-21180	-	Aluminum-Alloy Castings, High Strength
SAE-AS50881	-	Wiring, Aerospace Vehicle

(Copies of this document are available from www.sae.org or SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

2.4 Order of precedence. Unless noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet (see 6.11). In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Converters furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.2 and 6.3).

3.3 Materials.

3.3.1 Selection of materials, parts, and processes. The materials used shall enable the converter to meet all of the operational and environmental performance requirements of this specification and the applicable specification sheet (see 6.4.2 and 6.4.3). Castings shall be in accordance with SAE-AMS2175, or equivalent. Aluminum alloy castings shall be in accordance with SAE-AMS-A-21180. Defects not materially affecting the suitability of the castings may be repaired at the foundry or during machining by peening, impregnating, welding, or other methods acceptable to the qualifying activity.

3.3.2 Moisture resistance. Non-metal materials, including plastics, ceramics, fabrics, and protective finishes, shall be moisture resistant. Non-metal materials and parts may be treated to conform to this requirement. Electrical connector selection shall be environment resistant for 500 hour salt spray environment (see 4.6.3).

3.3.3 Corrosion resistance. All metals used in the converter construction shall be processed and protected to resist corrosion (see 6.4.2.4). The use of magnesium is prohibited unless specifically approved for each application by the qualifying activity. Where approved, magnesium alloy parts shall be surface treated for protection against corrosion in accordance with SAE-AMS-M-3171. Dissimilar metals, when used in contact with each other, shall be protected against electrolytic corrosion in accordance with MIL-STD-889. Corrosion protection applied to dissimilar materials, such as plating and coatings, shall withstand the environmental tests herein.

3.3.4 Contamination by fluids. The converter shall show no deterioration at normal operating temperatures due to wetting from aviation fuel (JP-4/JP-5), fire extinguishing compounds, de-ice fluids, aircraft washing fluids, hydraulic fluids, and lubricating oils (see 4.6.3.12 and 6.8).

3.3.5 Toxicity and fire resistance. Materials used shall be flame-resistant, shall not support combustion, and shall be non-toxic when exposed to flame as well as when used under all operating and environmental conditions herein (see 4.6.3.13).

3.3.6 Recycled, recovered, or environmentally preferable materials. The use of toxic chemicals, hazardous substances, and ozone depleting chemicals shall be avoided in the preparation and production of equipment (see 6.4.2.1). Recycled, recovered, or environmentally preferable materials shall be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.7 Color. The converter shall be finished in 37038 black in accordance with FED-STD-595 or as identified in the specification sheet.

3.4 Design and construction. The converter shall be a single package. Dynamic protective devices (fuses, circuit breakers, and thermally actuated switches) shall not be used. Deviations from this specification or from the applicable specification sheet must be specifically approved by the qualifying activity (see 6.3.2).

3.4.1 General mechanical and electrical design. The converter shall be constructed with parts and materials to provide the specified performance, reliability and service life under all environmental and operating conditions specified herein. Electronics parts shall be selected to enable the converter to provide the specified performance, reliability, and service life (see 6.4.3). Static discharge control shall be provided for protection of electronic devices during assembly and handling (see 6.4.3.4). Dielectrics used for electrical isolation shall be adequate to prevent breakdown under all specified environmental conditions for the life of the equipment. Equipment shall be free from irregularities or defects that could degrade performance or durability. Standard design practices shall be followed (see 6.4).

3.4.2 Electrical design.

3.4.2.1 Electric connections.

3.4.2.1.1 External electric connections. The equipment shall be designed so that external connections and wiring can be made in accordance with the wiring installation, ground return, and connector requirements of SAE-AS50881. The equipment structure shall not be used as a current path except for electromagnetic (radio noise) shielding.

3.4.2.1.1.1 Terminal block design. Where terminals are used for the external connection to converters, they shall be of the stud-type, and shall be designed so that the current is conducted by means of surface-to-surface contact, and not through the stud threads. All studs shall be steel, corrosion resistant, C-34 Rockwell minimum hardness, and shall be of sufficient length to accommodate two SAE-AS7928 lugs. Nuts used on terminals shall conform to NASM35650, NASM35338 for lock-spring washers, and NASM14151 for flat washers. There shall be no dielectric material in the compression build-up. The terminal block shall be so designed that it can be removed and replaced on the converter without the necessity of rebrazing or soldering. Barriers affording a positive separation of leads and terminals shall be provided on the terminal block. Durable, reusable, non-conductive terminal covers shall be provided. Terminal designations shall be durably, legibly, and prominently marked on the terminal block.

3.4.2.1.2 Internal electric connections. Internal wiring and connections shall enable the converter to meet all of the operational and environmental performance requirements of this specification and the applicable specification sheet (see 6.4.3.2).

3.4.2.2 Adjustments.

3.4.2.2.1 Voltage setting and adjustments. No provisions for external adjustments shall be provided and no internal adjustments or alignments shall be required during installation or during the life of the converter. All mechanical and electrical adjustments, such as voltage setting, voltage regulation settings, protection trip and reset settings, shall be made at the time of manufacture or depot repair overhaul. If device-setting adjustments are provided, they shall be locked and sealed. No adjustment shall be required during aircraft installation or between overhauls.

3.4.3 Mechanical design.

3.4.3.1 Shock mounts. Shock mounts or vibration isolators shall not be used.

3.4.3.2 Interchangeability. All parts having the same manufacturer's part number shall be directly and completely interchangeable with respect to installation and performance.

3.4.3.3 Mechanical connections, fasteners, inserts, and hardware retention. Screw threads shall be unified inch standard series UN, UNR, and UNJ (see 6.4.2.3). UNJ screw threads shall conform to the requirements of SAE-AS8879. All internal and external threaded parts shall be positively locked (self-locking nuts, safety wiring, or acceptable alternative methods used to prevent loosening of threaded parts). Staking shall not be used. Internal devices with mechanical adjustment provisions shall be locked and sealed during production. Stud nuts shall be self-locking steel nuts with captive washer in accordance with NASM90415.

3.4.3.4 Cooling. The converter shall be self-cooled. No conduction cooling to the converter environment shall be allowed. Converters that are cooled by an external blast air supply shall meet the requirements of this specification and the applicable specification sheet when supplied with cooling air flow and temperature as required by the applicable specification sheet. Pressure drop through the unit shall be as required by the applicable specification sheet. Safe-operating equilibrium temperature shall be maintained for the converter over the specified range of operating conditions, and the rated temperature of individual converter components shall not be exceeded. For fan-cooled converters, the direction of air flow shall be as required by the applicable specification sheet and depicted by an arrow that is visible on the converter exterior.

3.4.3.5 Ventilation openings. All ventilation openings shall be designed to prevent passage of foreign objects, and shall be of such size to prevent passage of objects of ¼-inch diameter or larger.

3.4.3.6 Operating position. The converter shall operate in any position, unless otherwise specified in the applicable specification sheet.

3.4.3.7 Size and weight. The dimensions and weight shall be as required by the applicable specification sheet. The weight and dimensions shown on the applicable specification sheet shall include the weights and dimensions of all auxiliary apparatus necessary to make the converter conform to this specification and the applicable specification sheet. Where only maximum and minimum dimensions are shown, the part, including all protrusions, shall be contained within the outline shown.

3.5 Performance characteristics. The converter shall deliver power in accordance with the requirements specified herein, MIL-STD-704, and the applicable specification sheet.

3.5.1 Electrical.

3.5.1.1 Input power. The converter shall meet the requirements of this specification and the applicable specification sheet when supplied with power as defined herein, as it applies to an aircraft electrical system. The nominal input voltage is three-phase, 4-wire wye-connected, 115 volts alternating voltage (see 6.7.2) at 400 Hz input, phase rotation in the order A, B, C, phase displacement of 120 degrees ±4 degrees with a waveform and input voltage unbalance defined in 3.5.1.1.1.1c, d, and e.

3.5.1.1.1 Steady state input voltage.

3.5.1.1.1.1 Full performance. The converter shall meet full performance output requirements (see 3.5.1.2.1.1) with any combination of the following input characteristics:

a. Steady state input voltage between 108 VAC and 118 VAC, unless otherwise specified by the applicable specification sheet.

b. Steady state input frequency between 380 Hz and 420 Hz, unless otherwise specified by the applicable specification sheet.

c. Input waveform total distortion of 8 percent of the fundamental or less, with individual harmonic frequency components below 5 percent individual. Individual frequency components not included under the harmonic requirements (including modulated sidebands) shall be defined by the limits of Figure 2, Curve A.

d. Input voltage unbalance of 3.0 volts or less between phase voltages.

e. Input voltage amplitude modulation of 2.5 volts root mean square (RMS).

3.5.1.1.1.2 Limited performance. The converter shall meet limited performance output requirements (see 3.5.1.2.1.2) when each of the following characteristics is separately substituted for the corresponding characteristic listed for full performance listed in 3.5.1.1.1.1:

a. Steady state input voltage between 100 VAC and 108 VAC, unless otherwise specified by the applicable specification sheet.

b. Steady state input voltage between 118 VAC and 125 VAC, unless otherwise specified by the applicable specification sheet.

c. Non-harmonic frequency components (including modulated sidebands) shall be defined by the limits of Figure 2, Curve B.

3.5.1.1.2 Transient input voltage.

3.5.1.1.2.1 Transient surge susceptibility.

3.5.1.1.2.1.1 Full performance. The converter output shall remain within the limits of Figure 3, Curves A and D for Type II (unregulated) and Curves B and C for Type I (regulated), when subjected to transient input voltages within the limits of Figure 4 (see 4.6.2.16.4.1.1).

3.5.1.1.2.1.2 Limited performance. The converter shall not be damaged by power interrupts or abnormal input surge voltages as defined by the limits of Table VII (see 4.6.2.16.4.1.2).

3.5.1.1.3 Transient input frequency. The converter shall withstand without damage and shall recover full performance after application of the following transients (see 4.6.2.16.5):

480 Hz for 7 seconds
320 Hz for 7 seconds

The converter output voltage shall remain at 28.0 ±0.5 volts (Type I), or between 22.5 volts and 28.75 volts (Type II) during application of the following frequency transients.

450 Hz for 2 seconds
440 Hz for 15 seconds
360 Hz for 15 seconds
350 Hz for 2 seconds

3.5.1.1.4 Input power factor. The converter input power factor shall be no less than 0.9 lagging when operated from 50 percent to 100 percent rated load (see 4.6.2.6).

3.5.1.1.5 Input current balance. The current input to each phase of the converter shall remain within 5 percent of the average of the three-phase currents from 25 percent rated load to 100 percent rated load (see 4.6.2.7).

3.5.1.1.6 Input starting current. Peak input starting current shall not exceed 500 percent of its rated input current as computed under full rated load and accounting for efficiencies as specified in 3.5.1.3. The peak current shall return to and stay within 150 percent load value within 0.1 second after first application of input voltage (see 4.6.2.8).

3.5.1.1.7 Total harmonic distortion. When operating from minimum to full rated load, the converter shall not drive the total harmonic distortion of the input voltage above 5 percent when powered by a source with total harmonic distortion of 3.5 percent or less into a purely resistive load (see 4.6.2.9).

3.5.1.1.7.1 Input current waveform. The converter shall not cause single harmonic line currents that are greater than 3 percent of the converter's full rated load fundamental current from the second to the thirty-second harmonic. Currents with frequencies from the thirty-second to the fiftieth harmonic shall not exceed 100/n percent of the converter's full rated load fundamental current, where n is the harmonic multiple number (see 4.6.2.9).

3.5.1.2 Output power.

3.5.1.2.1 Steady state output voltage. The following output characteristics shall apply from minimum to full rated output load current throughout the ambient temperature-altitude range defined by the equipment class.

3.5.1.2.1.1 Full performance. Steady state output voltage characteristics shall be as follows under the conditions listed in 3.5.1.1.1.1:

a. For Type I Regulated Converters, the steady state output voltage shall be within 27.5V and 28.5VDC unless otherwise specified within the applicable specification sheet.

b. For Type II Unregulated Converters, the steady state output voltage shall be within 24V and 29VDC, unless otherwise specified within the applicable specification sheet.

c. Peak to mean ripple voltage for either polarity shall not exceed 1.0V.

d. Output distortion factor shall not exceed .025 (see 6.7.6).

e. Output ripple component frequencies shall not exceed the limits of Figure 8, Curve A.

3.5.1.2.1.2 Limited performance. Steady state output voltage characteristics shall be as follows under the conditions listed in 3.5.1.1.1.2:

a. With the input specified in 3.5.1.1.1.2, the output voltage shall remain between 22.5V and 30VDC, unless otherwise specified within the applicable specification sheet.

b. With input waveform specified in 3.5.1.1.1.2c, peak to mean output ripple voltage for either polarity shall not exceed 2.0 volts and output ripple component frequencies shall not exceed the limits of Figure 8, Curve B.

3.5.1.2.2 Shock load recovery. When the following loads are applied and removed, output voltage transients shall remain within the limits of figure 5 for 100 percent rated load current, and figure 6 for 200 percent rated load current, and short circuit (see 4.6.2.10).

3.5.1.2.3 Input power application. The output voltage when the converter is initially energized shall be within steady state limits (see 3.5.1.2.1.1) within one second after application of the input voltage. During the one-second starting period, output voltage transients shall be within the limits of Figure 7 (see 4.6.2.11).

3.5.1.2.4 Overload and short circuit capacity. Over an input voltage range of 108 to 118 volts and input frequency range of 380 Hz to 420 Hz, the converter shall have the following performance (see 4.6.2.12).

3.5.1.2.4.1 Type I, regulated converters. The converter shall be capable of delivering current, without damage, into any passive load impedance (including short circuit). After delivering required current within the specified voltage range for the specified duration below, the converter shall be capable of operating 30 additional minutes without damage with the overload or short circuit connected. The output voltage and/or current may drop to any level during the additional 30-minute period. Normal output voltage shall be automatically restored within five seconds after removal of the overload or short circuit and restoration of normal rated loading. Required output currents, output voltage ranges, and durations are as follows:

Load	Duration	Required Output Voltage Range (volts)	
120 percent rated current	2 minutes	25.85	28.75
150 percent rated current	5 seconds	23.0	28.75
150 percent rated current	15 seconds	23.5	28.75
Short circuit (300 percent)	5 seconds	> 18.0 (see Figure 10)	

3.5.1.2.4.2 Type II, non-regulated converters. The converter shall deliver overload and short circuit current, without damage, for the duration specified on Figure 9. With loads of 500 percent rated current or less, the converter shall maintain the minimum output voltage specified on Figure 10. Normal output voltage shall be automatically restored within five seconds after removal of the overload or short circuit and restoration of normal rated loading.

3.5.1.2.5 Parallel operation (see 4.6.2.13).

3.5.1.2.5.1 Type I, regulated converters. The converter shall operate with its output connected in parallel with one to three other converters of the same manufacturer's part number when each unit is being supplied from a separate power source or the same power source having full performance specified 3.5.1.1.1.1 for parallel operation as required by the applicable specification sheet. The load carried by each converter shall not differ from another by more than 10 percent of the unit's rating with system loads from 25 percent to rated system load. Any interconnections between units shall be as required by the applicable specification sheet. Required output power characteristics shall be the same as for a single converter.

3.5.1.2.5.2 Type II, non-regulated converters. The converter shall operate with its output connected in parallel with one to three other converters of the same manufacturer's part number when each unit is being supplied from the same power source having full performance characteristics specified in 3.5.1.1.1.1. The load carried by each converter shall not differ from another by more than 10 percent of the unit's rating with system loads from 10 percent to rated system load. Required output power characteristics shall be the same as for a single converter.

3.5.1.2.6 Output overvoltage protection (Type I, regulated converters only). The converter shall have protective circuitry to remove output voltage exceeding the limits of figure 3 curve A, or a steady state value of 31.5 volts, in the event that an internal failure results in overvoltage. Output voltage shall be restored, in the event of a failure to self-correct, after removal and reapplication of input voltage (see 4.6.2.14).

3.5.1.3 Efficiency. When supplied from an input power source having full performance characteristics specified in 3.5.1.1.1.1, converter efficiency shall be 80 percent minimum from 25 percent to 50 percent load and 85 percent minimum from 51 percent load to 100 percent load. See 4.6.2.4.

3.5.1.4 Electromagnetic compatibility (see 4.6.2.15). The converter shall be in accordance with the general interface requirements of MIL-STD-461 and with the CE102, CS101, CS114, CS115, CS116, RE102 and RS103 emissions and susceptibility requirements of MIL-STD-461. The converter shall not interfere with the performance of other aircraft equipment as a result of radiated or conducted electromagnetic interference. In addition, the converter performance shall not be degraded as a result of electromagnetic interference from other aircraft equipment.

3.5.1.5 Acoustical noise. Acoustical noise level requirements shall be as required by the applicable specification sheet. When the applicable specification sheet specifies acoustical noise level limits, the maximum sound level measured at any point shall not exceed the specified limits (see 4.6.3.2).

3.5.1.6 Pressure drop (blast-cooled converters only). Pressure drop through blast-cooled converters shall not exceed the values specified in the specification sheet under the conditions defined therein (see 4.6.3.3).

3.5.2 Environmental. The converter shall conform to the requirements specified herein when subjected to the environmental conditions, as specified by the tests herein.

3.5.2.1 Temperature-altitude. The converter shall meet all performance requirements specified herein throughout the temperature-altitude range specified in 1.2.2 for the class specified in the specification sheet (see 4.6.2.1.2, 4.6.2.1.3, and Tables III and IV).

3.5.2.2 Acceleration. The converter shall withstand the inertial loads induced by aircraft operation (acceleration, deceleration and maneuvers) and provide specified performance when subjected to the acceleration test of 4.6.3.4. The output voltage characteristics of the converter shall remain within the limits in 3.5.1.2.1.1 while operating during the acceleration test. There shall be no evidence of physical damage, and the voltage regulation after the test shall be within the limits specified in 3.5.1.2.1.1.

3.5.2.3 Humidity. The converter shall withstand the humidity effects of operation and storage, in tropical and maritime environments, as simulated in 4.6.3.5. As a result of the humidity test there shall be no evidence of corrosion, peeling, pitting, blistering, or cracking of the finish. At the conclusion of the test, the voltage regulation shall be within the limits specified in 3.5.1.2.1.1.

3.5.2.4 Shock. The converter shall withstand the effects of mechanical shock from handling, transport, and aircraft operations, as simulated by the tests of 4.6.3.6.

a. Functional. The output voltage shall not exceed the limits of figure 3 while operating during the functional shock test. There shall be no evidence of mechanical damage, loosening of parts or hardware, or physical distortion of the enclosure. At the conclusion of the test, the voltage regulation shall be within the limits specified in 3.5.1.2.1.1 (see 4.6.3.6.1).

b. Crash hazard. The converter shall remain in place and not create a safety hazard during the crash hazard shock test (see 4.6.3.6.2).

3.5.2.5 Vibration. The converter shall withstand the vibration environment specified herein (see 4.6.3.7 and 6.5). The output voltage modulation of the converter measured during the test shall not exceed two percent (see 4.6.3.7). The output voltage measured during the test shall remain within the limits specified in 3.5.1.2.1.1. There shall be no evidence of mechanical damage, loosening of parts or hardware, or physical distortion of the enclosure. At the conclusion of the test, the voltage regulation shall be within the limits specified in 3.5.1.2.1.1.

3.5.2.6 Fungus. The converter shall be constructed of non-nutrient materials that do not support the growth of fungus in aircraft operating environments (see 4.6.3.8).

3.5.2.7 Salt fog. The converter shall withstand the effects of operation and storage in maritime salt fog environments when subjected to the test of 4.6.3.9. As a result of the salt fog test, there shall be no evidence of corrosion, peeling, pitting, blistering, or cracking of the finish. At the conclusion of the test, the voltage regulation shall be within the limits specified in 3.5.1.2.1.1.

3.5.2.8 Dust. The converter shall withstand the effects of dust from world-wide operation, as simulated by the dust test of 4.6.3.10. The converter shall be capable of operating within the limits specified in 3.5.1.2.1.1 during the dust test. At the conclusion of the test, the voltage regulation shall be within the limits specified in 3.5.1.2.1.1.

3.5.2.9 Explosive atmosphere. The converter shall not cause ignition of surrounding explosive mixture when tested as specified in 4.6.3.11. Seals and coatings providing ignition hazard protection shall not be damaged by the tests in 4.6.3.11.

3.5.2.10 Electrostatic discharge (ESD). The converter shall be unharmed by electrostatic discharge through contact with personnel up to 15kV air discharge as required in MIL-STD-464 for Electrical and Electronic Subsystems (see 4.6.3.14).

3.6 Reliability. Converters shall have a minimum observed Mean Time Between Failure (MTBF) of 10,000 hours when operated under conditions specified herein, unless otherwise specified in the specification sheet (see 6.4.4).

3.6.1 Reliability demonstration. The reliability of the converter shall be demonstrated by a test, analyze, and fix (TAAF) test program (see 4.6.4), if it is required by the specification sheet.

3.7 Markings.

3.7.1 Terminals. Markings of external electrical connections shall be as required by the applicable specification sheet (see 4.6.1).

3.7.2 Identification of product. Equipment, assemblies, and parts shall be marked in accordance with MIL-STD-130 and MIL-STD-1285. Safety warnings shall be in accordance with MIL-STD-130.

3.7.3 Nameplate. A nameplate conforming to MIL-DTL-15024, Type A, B, C, G, or H, with the following markings, in addition to the requirements of MIL-STD-130, shall be securely attached to the converter. The location of the nameplate shall be as required by the specification sheet. The markings shall remain legible after exposure to the environmental testing specified herein (see 4.6.3). The nameplate shall contain the following information:

Converter _____ Ampere
Input: _____ Volts AC _______Amperes/Phase AC ______ Frequency Range
Output _____ Volts DC _______ Amperes DC

Military Part No.
National Stock No.
Manufacturer's Serial No.
Date of Manufacture
Contract or Order No.
Manufacturer's name or trademark
Inspector's stamp

3.7.4 Airflow. When a blast-cooled or fan-cooled converter is used, the direction of airflow shall be plainly and permanently marked on the outside of the housing in the direction as required by the specification sheet. When the direction of the airflow is marked on the cover, provision shall be made to ensure that the cover cannot be installed to indicate a false airflow direction.

3.7.5 ESD marking. ESD sensitive assemblies and equipment shall be marked as follows:

3.7.5.1 ESD sensitive assemblies. ESD sensitive assemblies shall be marked with the JESD471 symbol as illustrated below. The symbol shall be located in a position readily visible to personnel when the assembly is incorporated in its next higher assembly.

3.7.5.2 ESD sensitive equipment. Converters containing ESD sensitive parts and assemblies shall be marked with the JESD471 symbol. The symbol shall be located on the exterior surface of the converter and readily visible to personnel prior to gaining access to ESD sensitive parts and assemblies within the converter. The ESD caution statement shown below shall be placed adjacent to the ESD sensitive symbol.

CAUTION:

CONTAINS PARTS AND ASSEMBLIES
SUSCEPTIBLE TO DAMAGE BY
ELECTROSTATIC DISCHARGE

3.8 Workmanship. The converter manufactured and assembled shall be free from irregularities that could degrade performance or durability (see 6.4.9).

3.9 Burn-in (Type I regulated converters only). Manufacturing screening of each converter shall be provided by the random vibration and temperature cycling of the burn-in test (see 4.6.6).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).
b. Conformance inspection (see 4.3).

4.2 Qualification inspection.

4.2.1 Qualification sample submittal. The qualifying activity will acquire converters for qualification or unsolicited samples may be submitted to the qualifying activity by manufacturer's seeking qualification (see 6.2 and 6.3). Qualification may require up to four converters. The qualification test schedule matrix is shown in table I and may be modified by the qualifying activity.

4.2.2 Qualification inspections and tests. Qualification inspection shall consist of the examinations and tests required by this specification and the applicable specification sheet. The manufacturer or an independent laboratory may conduct qualification testing with approval from the qualifying activity.

a. Laboratory qualification test - The examinations and tests listed in table I shall be conducted on the converters submitted for qualification. In addition, the qualifying activity shall have the following options:

(1) the qualification test matrix listed in table I is subject to alteration such that any test may be conducted on any sample submitted for qualification;

(2) inspections may be conducted to verify conformance to any of the requirements that were qualified by similarity;

4.2.3 Qualification retention. Inspection requirements for qualification retention samples shall consist of the examinations and tests listed in table I in accordance with the specification and applicable specification sheet. Samples shall be randomly selected from a production run and submitted to the qualifying activity. Products may be removed from the Qualified Products List (QPL) if:

(1) the manufacturer has not provided the requested certification;

(2) the manufacturer has requested that the product be removed from the list; or

(3) the qualifying activity has removed the product pending the results of re-qualification testing.

a. The qualifying activity may conduct an evaluation to determine if requalification test is necessary when any of the following conditions occur:

(1) change in manufacturer's product design, materials, or processes;

(2) change in performance levels or functional requirements due to specification revision;

(3) production facility relocation;

(4) company sale or transfer to new ownership.

4.2.4 Rejection, resubmittal, and retest. Requirements for resubmittal or retest of repaired or reworked test samples will be covered in the contract or purchase order.

4.3 Conformance inspection. Conformance inspection tests shall consist of examinations and tests listed in table II and the applicable specification sheet. The qualifying activity may conduct conformance inspection on any production components. Unless otherwise directed by the Government contracting officer, delivery of production components should not be delayed pending:

a. results of any test inspection; or

b. correction of failures/defects disclosed during conformance inspection.

Production lot samples will be selected at random under the contract provisions. Production samples forwarded to the qualifying activity will be subjected to conformance inspections in accordance with this specification.

4.4 Standard test conditions. Unless otherwise specified by the individual tests of 4.6, MIL-STD-810, or the specification sheet, the following standard inspection conditions shall apply:

a. Ambient temperature: 23° ± 10° C (73° ± 18° F)
b. Relative humidity: 50 ±30 percent
c. Atmospheric pressure: 25.5 to 30.5 inches of Mercury (650 to 775 mm of Mercury)
d. Coolant temperature: Coolant supply at the inlet shall be maintained at 80 percent of the maximum continuous coolant temperature, °C as required by the specification sheet.

4.4.1 Tolerances for controlled test environment. Unless otherwise specified by the tests of 4.6, the limits for test condition tolerances shall be as follows:

a. Ambient temperature: ±2° C of specified value (±3.6° F)
b. Air flow: ±5 percent of specified value
c. Temperature of coolant (liquids and forced air): ±2° C of specified value (±3.6° F)
d. Pressure altitude: ±5 percent of specified value

e. Relative humidity: ±5 percent
f. Vibration Amplitude: Sinusoidal: ±10 percent (+3.0dB -1.5dB)
Random : <500 Hz (-1.5dB)
>500 Hz (+3.0dB)
g. Vibration Frequency: ±2 percent, or ±1/2 Hz below 25 Hz
h. Acceleration: ±10 percent

4.4.2 Ambient temperature measurement. When tests are required to be conducted at reduced or elevated temperatures, the ambient temperature shall be determined by measurements of the air at several points surrounding, but not above, the converter, and through averaging the results. For converters without fans, air temperature measurements shall be taken as close to the surface of the converter as possible, but not so the airstream temperature is affected by the converter surface temperature. For converters with an internal fan, air temperature measurements taken 1¼ inch from the fan inlet shall be considered the ambient temperature.

4.4.3 Airflow. For all maximum temperature-altitude tests below 20,000 feet conducted on converters without integral cooling fans, the airflow velocity over the converter within the test chamber shall be adjusted to approximate natural convection conditions and shall not exceed 100 feet/minute, but shall be adjusted to the minimum velocity consistent with maintaining the required ambient temperature within specified tolerance. For tests above 20,000 feet altitude, the airflow may exceed 100 feet/minute, but shall be adjusted to the minimum velocity consistent with maintaining the required ambient temperature within specified tolerance in 4.4.1. Inlet airflow during blast-cooled converter tests shall be maintained at nominal conditions as required by the applicable specification sheet.

4.4.4 Warm-up and stabilization. Prior to testing, the converter shall be operated, delivering full rated load specified in the applicable specification sheet for sufficient time for the converter's temperature and output voltage to stabilize (see 6.7.5). The converter shall be considered to have stabilized when the change over a ten-minute period is measured to be less than:

a. Output voltage: 0.05 volt
b. Converter critical component temperature: 1.0° C (1.8° F)

4.4.5 voltage measurement. The input and output voltage shall be measured at the terminals of the converter. For three wire input converters with no neutral connection to the converter, the neutral measurement connection is made at the power source.

4.4.6 Position. The converter shall be mounted base down.

4.4.7 Electrical loading. Prior to testing, the converter shall be operated at full rated load (see 6.7.5) until stabilized. Unless otherwise specified, the test shall be performed with the converter operating at full rated load.

4.4.8 Input voltage. Nominal rated input voltage shall be applied (see 3.5.1.1).

4.5 Test equipment and inspection facilities. The inspection facility shall maintain test and measuring equipment of sufficient accuracy, quality and quantity to permit performance of the required inspections and testing.

4.6 Methods of inspection.

4.6.1 Examination of product. The converter envelope, geometry, mounting interface, and weight shall be examined for conformance to the applicable specification sheet dimensions and tolerances, as required by 3.4.3 herein and the applicable specification sheet. Visual examinations shall also be conducted to verify that workmanship and construction conform to the specification requirements of 3.4.1 and 3.4.2.

4.6.2 Electrical performance (see 3.5.1).

4.6.2.1 Voltage regulation. The output voltage shall be measured under the conditions specified in 4.6.2.1.1 through 4.6.2.1.3. For each load, input voltage, position, and temperature-altitude condition (and for blast-cooled converters, inlet airflow condition), output voltage shall remain within the limits specified in 3.5.1.2.1.1. During the course of the tests, no components of the converter shall exceed their maximum rated temperatures. Tests may be conducted at any intermediate input voltage, load, or temperature-altitude condition within the range of Figure 1 Class A, B, or C (as applicable) at the option of the qualifying activity.

4.6.2.1.1 Voltage regulation at room ambient temperature. Immediately upon energizing the converter (see 3.5.1.1.1.1), full performance shall be verified by conducting the following tests, (a) through (e) below. These tests shall be conducted immediately upon energizing the converter, and then repeated after operating the converter at nominal input (see 3.5.1.1), and full rated load, until the output voltage is completely stabilized (see 4.4.4).

a. With nominal input voltage specified in 3.5.1.1, the load shall be varied from minimum load (10 percent of rated load) to full rated load in steps of 25 percent rating. When a load between minimum and 25 percent is required as defined by the applicable specification sheet, the converter shall also be tested at this load. Type I (regulated) converters shall be de-energized and re-energized at each load condition to demonstrate their ability to start. For only blast-cooled converters, during this portion of the test at full rated load, the input airflow (see 3.4.3.4) conditions shall be varied from nominal conditions throughout the entire range as required by the applicable specification sheet to establish the airflow conditions which result in maximum and then minimum internal component temperatures of the converter when stabilized at full rated load.

b. The test specified in 4.6.2.1.1a shall be repeated at the maximum input voltage as required by the specification sheet, and at 118 volts RMS (see 3.5.1.1.1.1a).

c. The test specified in 4.6.2.1.1a shall be repeated at the minimum input voltage as required by the applicable specification sheet, and at 108 volts RMS (see 3.5.1.1.1.1a).

d. The tests specified in 4.6.2.1.1a, b, c shall be repeated at the maximum input frequency as defined in 3.5.1.1.1.1b or in the applicable specification sheet.

e. The tests specified in 4.6.2.1.1a, b, and c shall be repeated at the minimum input frequency as defined in 3.5.1.1.1.1b or in the applicable specification sheet.

4.6.2.1.2 Voltage regulation at maximum temperature-altitude conditions. The converter shall be tested under each of the temperature-altitude conditions listed in table III. Prior to being energized, the converter shall be soaked at the initial maximum temperature, sea level condition for at least one-half hour. The tests specified in 4.6.2.1.1 shall be conducted. Inlet conditions for blast-cooled converters shall be those determined to result in the highest internal component temperatures of the converter during the test of 4.6.2.1.1a.

4.6.2.1.3 Voltage regulation at minimum temperature-altitude conditions. The test specified in 4.6.2.1.2 shall be repeated substituting the temperature-altitude conditions listed in table IV and increasing the soak time at the initial -55° C sea level condition to two hours. Inlet airflow conditions for blast-cooled converters shall be those determined to result in the lowest internal component temperatures of the converter during the test of 4.6.2.1.1a.

4.6.2.2 Operating position. The converter shall be operated at nominal input voltage, full rated load in the normal base down position until output voltage and critical component temperatures stabilize (see 3.5.1.1 and 4.4.4). Output voltage and critical component temperatures shall be measured as the converter is rotated by increments of 90 degrees from the normal base down position, 360 degrees about each major axis except the vertical axis. Each position shall be held until output voltage and critical component temperatures stabilize.

4.6.2.3 Worst condition. The converter shall be operated at the worst indicated conditions determined from the tests specified in 4.6.2.1 through 4.6.2.2. The conditions from each of these tests resulting in highest output voltage shall be simultaneously applied. Prior to the test, the converter shall be soaked at the applicable ambient temperature for a minimum of two hours prior to energizing the converter. The converter shall be operated until voltage and critical component temperatures stabilize. The above test shall be repeated for minimum output voltage and maximum critical component temperature conditions.

4.6.2.4 Efficiency. In conjunction with the test of 4.6.2.1.1, the input and output power of the unit shall be measured. The efficiency shall be calculated under these conditions and shall not be less than specified in 3.5 1.3 under stabilized test conditions as defined in 4.4.4.

4.6.2.5 Output ripple. The output peak to mean ripple voltage shall be measured for both the positive and negative polarities during all tests of 4.6.2.1, and shall not exceed the limits specified in 3.5.1.2.1.1. The output ripple voltage component frequencies and distortion factor shall be measured during the test of 4.6.2.1 and shall not exceed the limits specified in 3.5.1.2.1.1.

4.6.2.6 Input power factor. In conjunction with the tests of 4.6.2.1, the input power factor at half load or greater shall be determined for each condition and shall be as specified in 3.5.1.1.4.

4.6.2.7 Input current balance. In conjunction with the test of 4.6.2.1, the input current balance at 25 percent load or greater shall be determined for each condition and shall be as specified in 3.5.1.1.5.

4.6.2.8 Input starting current. The converter shall be tested to verify compliance with 3.5.1.1.6 at minimum, half and full rated load at nominal input with minimum and maximum input voltages as defined in 3.5.1.1.1.1.

4.6.2.9 Total harmonic distortion. The converter shall be tested at minimum, half and full rated load to verify compliance of the harmonic distortion of the input voltage requirement of 3.5.1.1.7. At full rated load, the converter shall be tested to verify compliance of the input current waveform requirement of 3.5.1.1.7.1.

4.6.2.10 Shock load recovery. The converter shall be tested to verify compliance with 3.5.1.2.2 at maximum, minimum, and room ambient temperatures for the applicable class converter at sea level altitude. For 100 percent load application and removal, tests shall be conducted at nominal input and maximum input voltages as defined in 3.5.1.1 and 3.5.1.1.1.1 respectively. For 200 percent load and short circuit application and removal, tests shall be conducted at nominal input voltage, 112.5 volts RMS input, and 117.5 volts RMS input.

4.6.2.11 Input power application. The converter shall be tested to demonstrate compliance with the input power application requirements of 3.5.1.2.3 at minimum, half, and full rated load at nominal input with maximum and minimum input voltages as defined in 3.5.1.1.1.1. Tests shall be conducted at maximum, minimum, and room ambient temperature for the applicable class converter at sea level altitude.

4.6.2.12 Overload and short circuit capacity. The converter shall be tested to demonstrate compliance with the overload and short circuit capacity requirements specified in 3.5.1.2.4 at maximum, minimum, and ambient temperatures at sea level altitude for the applicable class converter. Tests shall be conducted at nominal input voltage and at the extremes of input voltage and frequency in 3.5.1.1 and 3.5.1.1.1.1. Tests on Type II converters shall be conducted at the tests points indicated on Figure 9. Should the 1200 percent rated current test point not be obtainable because of converter output impedance limitations, a test at the highest current obtainable shall be conducted for the corresponding duration indicated on Figure 9.

4.6.2.12.1 Conformance inspection test conditions. When conducting converter conformance inspection tests shown in table II, the overload and short circuit capacity requirements defined in 3.5.1.2.4 shall be performed at the room ambient condition, with nominal input voltage and frequency only. During the conformance inspection testing the converters shall be tested at the 200 percent and 500 percent test points only, and for the corresponding duration indicated on Figure 9.

4.6.2.13 Parallel operation. Two, three and four identical converters shall have their outputs connected in parallel and the load varied from 10 percent of the total rated capacity to 100 percent of rated capacity in steps of 10 percent. Type I converters shall be tested with paralleled converters operating from separate input power sources adjusted to provide all possible combinations of nominal input with maximum and minimum input voltages and maximum and minimum input frequencies as required by the applicable specification sheet (see 3.5.1.1.1.1). Type II converters shall be tested at nominal input with maximum and minimum input voltages and maximum and minimum input frequencies as defined in 3.5.1.1.1.1 when supplied by the same input power source. The parallel units shall meet the requirements of 3.5.1.2.5.

4.6.2.14 Output overvoltage protection (Type I, regulated converters only). Protection for failure modes of the converter which could result in an uncontrolled increase in output voltage shall be as required by the applicable specification sheet. These failure modes shall be artificially introduced with the converter operating at the maximum input voltage as defined in 3.5.1.1.1.1 at minimum and full rated load. The converter shall meet the requirements of 3.5.1.2.6. Following the test, the converter shall pass the test of 4.6.2.1.1a.

4.6.2.15 Electromagnetic compatibility. The converter shall be tested in accordance with MIL-STD-461 requirements of CE102, CS101, CS114, CS115, CS116, RE102, and RS103. CE102 shall be performed on converter power output leads as well as power input leads, including neutral and returns. Converters intended for use on Army aircraft or Navy antisubmarine aircraft (including land based aircraft) shall also be in accordance with the requirements of MIL-STD-461: CE101, RE101, and RS101. The test shall be conducted at full rated load and half load with minimum and maximum input voltage. The output voltage shall remain within the normal limits of 3.5.1.2.1.1. During electromagnetic susceptibility test for Type I, regulated converters, the converter shall pass the test of 4.6.3.1. All testing shall be conducted by National Association of Radio and Telecommunications Engineers (NARTE) certified personnel at a National Voluntary Accreditation Program (NVLAP) accredited laboratory.

4.6.2.16 Input power susceptibility.

4.6.2.16.1 Abnormal steady state input voltage. The converter shall be operated at the no load and the impedance equivalent of full rated load at 28 VDC output with input voltages ranging from 100 to 125 volts in 5 volt steps. The converter shall be operated for five minutes under each input voltage/load combination and shall meet the requirements of 3.5.1.1.1.2. Following this test the converter shall pass the test of 4.6.3.1.

4.6.2.16.2 Input voltage unbalance. The test of 4.6.2.1.1a shall be conducted substituting each of the six input voltage combinations for nominal input voltage (see 3.5.1.1) as indicated in table V. During the test, output voltage, peak to mean ripple voltage, output distortion factor and output ripple component frequencies shall meet the requirements of 3.5.1.2.1.1.

4.6.2.16.3 Input waveform distortion. The test of 4.6.2.1.1a shall be conducted at half- and full-rated load under the following conditions:

a. Using an AC power source that normally provides 3.0 percent total distortion or less while supplying the converter at full rated load, sufficient input inductance shall be added equally in each line (except the neutral line if utilized) between the power source and the converter to increase input waveform distortion to the maximum allowed by 3.5.1.1.1.1c. During this test, output voltage, peak to mean ripple voltage, output distortion factor and output ripple component frequencies shall meet the requirements of 3.5.1.2.1.1. Input inductance shall then be further increased to obtain the maximum distortion allowed by 3.5.1.1.1.2c. During this test, output voltage, peak to mean ripple voltage, and output ripple component frequencies shall meet the requirements of 3.5.1.2.1.2b.

b. Using a variable waveform AC power source, input waveform distortion shall be adjusted to the maximum allowed by 3.5.1.1.1.1c while maintaining a crest factor (see 6.7.3) of 1.31 to 1.40. This test shall be repeated while maintaining a crest factor of 1.42 to 1.51. During these tests, output voltage, peak to mean ripple voltage, output distortion factor and output ripple component frequencies shall meet the requirements of 3.5.1.2.1.1. Distortion shall then be adjusted to the maximum allowed by 3.5.1.1.1.2c while maintaining a crest factor of 1.26 to 1.38. This test shall be repeated while maintaining a crest factor of 1.44 to 1.56 during these tests, output voltage, peak to mean ripple voltage, and ripple component frequencies shall meet the requirements of 3.5.1.2.1.2.

4.6.2.16.4 Transient input voltage.

4.6.2.16.4.1 Transient surge susceptibility.

4.6.2.16.4.1.1 Full performance. With the converter operating at minimum load (10 percent of rated load) and full rated load with nominal input, the positive step voltages indicated in table VI shall be applied to the converter input terminals four times for each condition (see 3.5.1.1). The converter shall meet the requirements of 3.5.1.1.2.1.1. Following the test, the converter shall pass the test of 4.6.3.1.

4.6.2.16.4.1.2 Limited performance. With the converter operating at minimum load (10 percent of rated load) and full rated load with nominal input, the positive step voltages indicated in table VII shall be applied to the converter input terminals four times for each condition (see 3.5.1.1). The converter shall be observed for evidence of flashover or insulation breakdown, and shall meet the requirement of 3.5.1.1.2.1.2. Following the test, the converter shall pass the test of 4.6.3.1.

4.6.2.16.5 Transient input frequency. The transient input frequencies of 3.5.1.1.3 shall be applied to the input of the converter using a transient generator. Following the test, the converter shall pass the test of 4.6.3.1.

4.6.3 Operating environment performance.

4.6.3.1 Performance verification. Unless otherwise specified, satisfactory converter operation shall be verified during and after the following environmental tests. The tests of 4.6.2.1.1a shall be conducted to verify converter performance except that both positive and negative peak to mean ripple voltages shall also be measured at each condition. Blast-cooled converters shall be tested with nominal inlet airflow conditions. Output voltage and ripple voltage shall meet the requirements of 3.5.1.2.1.1.

4.6.3.2 Acoustical noise. The acoustical noise of the converter shall be measured in planes one foot from each of the six sides. In each plane, measurements shall be made opposite the center of the converter surface to determine the sound level. The maximum sound level at all points shall be measured using the A-weighted scale of exponentially averaging sound level meter. The acoustical noise level shall meet the requirements of 3.5.1.5. The calibrating devices or standards used shall be directly traceable to the National Institute of Science and Technology. Measurements shall be made under anechoic conditions with the converter supported in a manner to minimize acoustic transmission and reflection by the support structure. Following the test, the converter shall pass the test of 4.6.3.1.

4.6.3.3 Pressure drop (blast-cooled converters only). During the testing of 4.6.2.1.1, 4.6.2.1.2 and 4.6.2.1.3 the pressure drop across the converter shall be measured. The converter shall meet the pressure drop requirements of 3.4.3.4 and 3.5.1.6.

4.6.3.4 Acceleration. The converter shall be tested in accordance with the acceleration test of MIL-STD-810 Method 513.6, Procedures I and II (see 3.5.2.2). The test level for all directions in Procedure I (Structural Test – Non Operating) shall be accomplished using an acceleration level of 13.5g. The g level shall be applied along three mutually perpendicular axes in two opposite directions along each axis. The test time duration in each direction shall be at least one minute following centrifuge stabilization. At the conclusion of the test, the converter shall be examined for evidence of structural damage. For Procedure II (Operational Test), the required acceleration level for all directions shall be 9.0g, and shall be applied along three mutually perpendicular axes in two opposite directions along each axis. The test time duration in each direction shall be at least one minute following centrifuge stabilization and the converter shall be operated continuously at nominal input (see 3.5.1.1) and one-fourth load, and the output voltage and ripple voltage shall be monitored during the test to determine compliance with 3.5.1.2.1.1. At the conclusion of the test, the converter shall be examined for evidence of structural damage, permanent deformation and broken fasteners. See "Procedure selection considerations" of MIL-STD-810 test method 513.6.

4.6.3.5 Humidity. The converter shall be tested in accordance with MIL-STD-810, test method 507.5, Procedure II (see 3.5.2.3). The humidity test shall consist of a 24-hour conditioning cycle and a minimum of ten 24-hour humidity test cycles. The converter shall be operated for the last 15 minutes of each 24-hour cycle. Following the completion of the ten 24-hour humidity test cycles the converter shall be removed from the chamber and excess moisture may be removed by turning the converter upside down or by shaking. There shall be no evidence chemical or electrochemical breakdown of organic or inorganic surface coatings, swelling of materials due to absorption effects or electrical shorts. See "Effects of warm, humid environments" paragraph of MIL-STD-810, test method 507.5 for negative effects of humidity.

4.6.3.6 Shock. The converter shall be subjected to shock testing in accordance with those methods described in 4.6.3.6.1 and 4.6.3.6.2.

4.6.3.6.1 Functional. The converter shall be subjected to shock response spectrum (SRS) testing per MIL-STD-810, Method 516.6, Procedure I (functional shock) using the reference profile shown in Figure 516.6-8 (functional test for flight equipment). The converter shall be subjected to three shocks in both directions along each of three mutually perpendicular axes for a total of 18 shocks at the functional level. The converter shall be operating during the functional shock test at full rated load and nominal input (see 3.5.1.1). A functional check shall be performed after each axis functional test is completed. At the conclusion of the functional shock test, the converter shall be inspected for evidence of damage, and shall pass the test of 4.6.3.1.

4.6.3.6.2 Crash hazard. The converter shall be subjected to shock response spectrum (SRS) testing per MIL-STD-810, Method 516.6, Procedure V (crash hazard shock) using the reference profile shown on Figure 516.6-8 (crash hazard test for flight equipment). The converter shall be subjected to two shocks in both directions along each of three mutually perpendicular axes for a total of 12 shocks at the crash hazard level. The converter is not required to demonstrate specific performance during the crash hazard test, however, it shall remain securely attached to the fixture and pose no missile hazard to personnel or equipment. Bending and distortion of the converter shall be permitted.

4.6.3.7 Vibration. The converter shall withstand the vibration environment induced by aircraft operations, as simulated by the vibration tests herein. Vibration testing shall be performed according to the general vibration guidelines of MIL-STD-810, Method 514.6, Procedure I (general vibration) or the profile identified in the specific converter specification requirements sheet document for a particular aircraft application. Sinusoidal dwell vibration shall be applied along each of three mutually perpendicular axes of the converter. The input levels specified by the vibration reference profile defined in 4.6.3.7.2 shall be maintained at the equipment mounting locations. Upon completion of the vibration tests, component electrical performance shall be within specified limits. All component parts, connections, and mounting hardware shall exhibit no evidence of cracking, rupture, or operational degradation, and the converter shall meet the requirements of 3.5.2.5.

4.6.3.7.1 Resonance search. Resonant frequencies of the equipment shall be determined by performing a sinusoidal sweep from 5 – 2000 Hz. Time for sweep (5 Hz to 2000 Hz to 5 Hz) shall be 20 minutes. The applicable reference profile defined in 4.6.3.7.2 shall be used. A resonance shall be defined as a frequency at which the response of the test article is greater than or equal to two times the input vibration magnitude.

4.6.3.7.2 Sinusoidal Vibration Test. The converter shall be subjected to 3 hours of sinusoidal vibration testing comprising both dwell testing and cycling. The reference profile shall be defined as follows: 5-2000 Hz, 0.036 inch double amplitude, 10 g maximum (see Figure 11). Sinusoidal dwells shall be performed for 30 minutes at each of the four highest resonance frequencies. Sinusoidal cycling testing at a sweep rate of 1.0 octave/minute shall be performed for 1.0 hour. If less than four resonant frequencies are identified, the allocated dwell time shall be added to the cycling portion of the test. For equipment weighing 80 lbs or more, the maximum input vibration level may be reduced by 1.0 g for every 20 lbs increment over 80 lbs. Following the vibration test the converter shall pass the test of 4.6.3.1, and shall be thoroughly inspected for cracking or rupture of any components, solder connections, or of the mounting assembly itself. The presence of such damage shall be cause for rejection.

4.6.3.8 Fungus. The converter and installation instructions shall be tested in accordance with MIL-STD-810, test method 508.6 to determine compliance with 3.5.2.6. At the conclusion of the test, the converter shall be removed from the test chamber, and excess moisture may be removed by turning the test item upside down or by shaking. No washing or wiping of the test item is permitted. The converter shall be inspected for fungus growth and shall pass the test of 4.6.3.1. Fungus testing is not required if all the parts and materials are certified as non-nutrient supporting. A certificate signed by an individual authorized to speak for the manufacturer may by submitted in lieu of fungus testing with the approval of the qualifying activity. The certificate shall state that the converter is constructed of non-nutrient materials and does not use any organic material (see 6.2.e(8)).

4.6.3.9 Salt fog. The converter and mounting hardware shall be tested in accordance with MIL-STD-810, test method 509.5 to determine compliance with 3.5.2.7. The converter shall be oriented base down. The duration of the exposure shall be 48-hours and 48 hours of drying with the converter non-operating. The test cycle shall consist of 24 hours of a 5% +/- 1% salt solution concentration exposure followed by 24 hours of drying. Two test cycles shall be conducted. At the completion of the second 24 hours of drying, a functional test shall be conducted and shall pass the test of 4.6.3.1. The converter shall then be physically inspected both inside and out. There shall be no evidence of: (1) material degradation such as corrosion; or (2) blistering of paint or degradation of electrical insulation. Metal parts shall be examined for corrosion, moving parts for clogging or binding, and paint for blistering.

4.6.3.10 Dust. The converter shall be tested in accordance with the blowing dust test (procedure I) of MIL-STD-810, test method 510.5 and as tailored in 4.6.3.10a, b, c below (see 3.5.2.8). The converter shall be oriented with the cooling air intake oriented toward the dust stream.

a. Dust composition shall be silica flour.

b. For step 3 of Procedure I, the converter shall be operated at no load with nominal input voltage (see 3.5.1.1) for six hours at standard ambient temperature (dust concentration of 0.3 +0.2 gram per cubic foot and air velocity of 1,750 +250 feet per minute). The chamber temperature shall be increased to 63° C or the high operating temperature identified in the specific converter specification requirements sheet document during step 4. For step 7, the converter shall be operated at no load for six hours at 63° C or the high operating temperature identified in the specific converter specification requirements sheet document (same blowing dust conditions as step 3).

c. At the conclusion of the test, the converter shall be removed from the chamber and allowed to cool to room temperature. Accumulated dust shall be removed from the converter by brushing, wiping or shaking, with care taken not to introduce additional dust into the specimen. Under no circumstances shall either blast or vacuum cleaning be used to remove dust. The converter shall pass the test of 4.6.3.1.

4.6.3.11 Explosive atmosphere. The converter shall be tested in accordance with MIL-STD-810, test method 511.5, Explosion atmosphere - Procedure I (see 3.5.2.9). The test altitude shall be 40,000 feet or the high altitude specified in the specific converter specification requirements sheet document. The test temperature shall be the 71° C or the high temperature at sea level specified in the specific converter specification requirements sheet document.

4.6.3.12 Contamination by fluids. Determine conformance to the requirements of 3.3.4 by test or by similarity (see 6.2e(8)). The converter shall be tested in accordance with MIL-STD-810, test method 504.1, Procedure I (see 6.8 for additional fluids if not listed in method 504.1).

4.6.3.13 Toxicity and fire resistance. Determine conformance of component materials to the requirements of 3.3.5 by test or by similarity (see 6.2e(8)). If testing is required, components shall be subjected to a flammability test in accordance with MIL-STD-202, method 111A.

4.6.3.14 Electrostatic discharge. The electrostatic discharge requirement of 3.5.2.10 shall be verified by the electrostatic discharge test of section 25 of RTCA/DO-160G. Test points shall be the top of the converter case and the outside of each connector.

4.6.4 Reliability demonstration. Reliability demonstration testing shall be conducted (see 3.6.1). The test shall be structured as a test, analyze and fix (TAAF) program wherein any failure (any operation outside of specified limits) which occurs is analyzed and corrective action implemented by the manufacturer to prevent recurrence of the failure. For Type I converters, a minimum of 4,000 hours total converter operating time on two samples is required with two or less failures under the test profile of figure 13 to successfully complete the test. For Type II converters, a minimum of 6,000 hours total converter operating time on two samples is required with one or less failures under the test profile conditions of figure 13 in order to successfully complete the test. In the event more than two failures of the Type I converter, or more than one failure of the Type II converter occur, additional converter operating time shall be accumulated until the total converter operating hours divided by the number of failures (cumulative mean time between failures) equals 2,000 (Type I) or 6,000 (Type II) or higher. When a corrective action has resolved a failure to the satisfaction of the qualifying activity all but the first occurrence of the resolved failure shall be dropped from consideration. No single converter of the two samples shall accumulate less than 25 percent of the total test time. During the test, output voltage and ripple shall be monitored for compliance with 3.5.1.2.1.1. The test shall be conducted at full rated load except at 500 ± 50 hour intervals when at such times the output load of each type II test sample shall be increased to 400 percent rated load for 7 seconds during the 71^{o} portion of the cycle. Type I test samples shall have the output load increased to 150 percent rated load for 5 seconds at the same interval. During these overloads, the converters shall meet the requirements of 3.5.1.2.4. Following the complete test, the converters shall pass the test of 4.6.3.1.

4.6.5 Disassembly and inspection. At the conclusion of the test program, each sample shall be disassembled, as necessary, to inspect for evidence of deleterious effects of qualification testing; examples of these effects include wear, defects, overheating, etc. The presence of such evidence is cause for rejection.

4.6.6 Burn-in (Type I, regulated converters only). The converter shall be subjected to one or more cycles of testing conforming to Figure 13. The number of cycles shall be determined by referencing table VIII. The heating and cooling temperature ramps on Figure 14 shall be performed at a minimum of 5° C/minute. The converter shall be turned off during the cool down period (cooling ramp) and turned on for the balance of each cycle. The equipment shall be vibrated in one axis with amplitude of 0.02g^2/Hz over a frequency range of 20 - 2,000 Hz during the last 20 minutes of each four hour stabilized temperature condition. Failures may occur and be corrected in any cycle prior to the final cycle. The burn-in is considered acceptable if there is no failure during the final cycle. If a failure occurs in the final cycle, the equipment failure may be corrected, subject to approval by the qualifying agency and a failure-free cycle run.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The items described herein are intended for use on aircraft to convert three-phase, 115/200 volts, 400 Hz AC power to nominal 28 volt Regulated/Non-regulated DC power. Converters typically are used to provide DC power on aircraft with main electrical generating systems that provide AC power. The military operating environment and electrical performance requirements of this specification exceed the requirements used for commercial aircraft converters.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Type and Class converter desired (see 1.2).

c. Military part number.

d. Packaging (see 5.1).

e. Contract provisions for acquisition of manufacturer's data may include:

(1) Schedules for component design, development, and delivery;
(2) Wiring diagrams, schematics, outline drawings;
(3) List of parts, list of materials, functional descriptions, operating instructions,
(4) Installation instructions, and servicing requirements;
(5) Temperature, altitude, and coolant flow rate criteria correlated with converter output capacity (see Figure 1);

(6) Contractor analyses of sneak circuits, failure modes and effects, parts stress, parts failure rate modeling, and reliability prediction (see 3.6, 6.4.3.5, 6.4.4, and 6.4.6,);
(7) Stress screening test procedures, acceptance test procedures, manufacturer's test data, and qualification by similarity data (see 4.6.3.8, 4.6.3.12, and 4.6.3.13);
(8) Verification data, manufacturing process controls, inspection criteria, configuration management data, engineering change processes, and parts traceability (see 3.8).
(9) Re-inspection date marking and any special marking (see 3.7).
(10) Handbooks or manuals, when required.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List (QPL)-7115 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Naval Air Systems Command (AIR-4.4.5.2), 48298 Shaw Road, Patuxent River, Maryland 20670-1900 or steven.fagan@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Provisions governing qualification. Qualification will be conducted in accordance with the provisions and guidelines of SD-6, "Provisions Governing Qualification." Copies of this document are available online at https://assist.dla.mil/quicksearch/ or https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

6.3.2 Qualification sample submittal. Qualification submissions should be submitted to the qualifying activity. The qualifying activity may acquire up to four converters to conduct qualification tests. Each converter will be acquired with installation hardware and a mating connector plug for each receptacle.

6.3.3 Aircraft demonstration (ground and flight). Prior to flight, the converter will be subjected to an aircraft ground demonstration for safety of flight. Converter conformance to specification requirements will be demonstrated throughout all aircraft operations and the cumulative operating flight time for the converter should be not less than 50 hours.

6.4 Standard design practices. The following paragraphs contain design guidelines based on actual experience that should be considered by the manufacturer when a converter is to be developed to meet the performance requirements of this specification.

6.4.1 Verification and configuration management. As required by the contract, verification and failure analysis/reporting should be in accordance with industry standards, such as ISO 9000. Product identification, parts traceability, product configuration control and documentation data control should be in accordance with industry standards for configuration management, such as TechAmerica/ANSI/EIA-649 or ISO 10007. MIL-HDBK-61 also provides information on configuration management. Copies of ISO 9000 and ISO 10007 are available from info@ansi.org or American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, New York, 10036. Copies of TechAmerica/ANSI EIA-64 are available from TechAmerica, 601 Pennsylvania Avenue, NW, North Building, Suite 600, Washington, DC 20004 or http://www.techamerica.org. Copies of MIL-HDBK-61 are available from https://assist.dla.mil/quicksearch/ or https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

6.4.2 Materials and structural design. Military standard parts are desired. Commercial industry parts, such as screws, bolts, nuts and washers, may be used provided that performance requirements are met under all specified operating conditions and environments. Design characteristics and limitations should be observed for the materials and components selected for use in the converter.

6.4.2.1 Recycled, recovered, or environmentally preferable materials. The use of toxic chemicals, hazardous substances, and ozone depleting chemicals should be avoided in the preparation and production of equipment. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs. Information regarding toxic chemicals, hazardous substances, and ozone depleting substances can be found at the Environmental Protection Agency website at http://www.epa.gov.

6.4.2.3 Fasteners, inserts and retention. Screws, fasteners, inserts should be selected using industry standard NASM1515 for guidance.

6.4.2.4 Corrosion. Corrosion resistance treatments for aluminum alloy materials are provided in MIL-A-8625. Corrosion protection methods for magnesium alloy materials are provided in SAE-AMS-M-3171.

6.4.2.5 Bearing installation and lubrication. Steel sleeve bearing inserts are recommended when the bearing support structure is made of non-ferrous material. The outer ring for each shaft bearing should be retained axially and should have a locking method to prevent rotation. Bearing inner rings should rotate with the drive shaft. The locking methods for the inner and outer bearing rings should allow for thermal expansion differentials. The grease type selected for bearing lubrication should be capable of a minimum of 100 hours, and withstand continuous operation at bearing temperatures from -40° C to +205° C.

6.4.2.6 Cooling fan. Converters for which an internally mounted, integral cooling fan is permitted (see 3.4.3.4) the fan should be rated for operation at 100° C ambient or higher.

6.4.3 Electrical and electronics design.

6.4.3.1 Wiring and distribution. External electrical wiring for power distribution, component interconnection and system control should conform to SAE-AS50881. Load contactor relays should conform to MIL-PRF-6106. Power feeder sizes should be selected using SAE-AS50881 guidelines for conductor current-carrying capacity.

6.4.3.2 Electronics internal wiring and electric connections. Printed circuit board design and performance criteria guidance is provided in MIL-PRF-31032, MIL-HDBK-1547, MIL-HDBK-1861, and industry standards IPC-2221. Guidelines 1, 10, 17, 19, 20, and 69 of MIL-HDBK-454 provide guidance on Safety Design Criteria – Personnel Hazards, Electrical Connectors, Printed Wiring, Internal Wire Hookup and Internal Wiring Practices. Copies of IPC 2221 are available from http://www.ipc.org/ or IPC - Association Connecting Electronics Industries, 3000 Lakeside Drive Suite 309 S, Bannockburn, Illinois, 60015-1249.

6.4.3.3 Semi-conductors, resistors, and capacitors. MIL-STD-750 and MIL-PRF-19500 provide guidance on the design and test of semi-conductor devices. Adjustable resistors should conform to MIL-PRF-39015. MIL-HDBK-198 provides guidance on capacitor selection. MIL-HDBK-199 provides guidance on resistor selection. The use of silver case wet slug tantalum capacitors should not be used.

6.4.3.4 Microelectronic devices. Microelectronic devices should be selected in accordance with Guideline 64 of MIL-HDBK-454. Microelectronic devices qualified to MIL-STD-883, and listed in MIL-PRF-38535, are preferred. Static discharge control should be in accordance with MIL-STD-1686 or an equivalent industry standard (such as JESD625).

6.4.3.5 Parts de-rating. DoD standard practices for electrical and electronic parts de-rating are documented in SD-18 available at http://www.navsea.navy.mil/nwsc/crane/sd18/ or via e-mail at: sd18webmaster@navy.mil or Commander, Bldg. 3334 Code GXMQ, NAVSURFWARCENDIV, 300 Highway 361, Crane, IN 47522-5001.

6.4.4 Reliability. Reliability should be considered in each phase of the converter design process. MIL-STD-790, MIL-HDBK-217 and MIL-HDBK-251 provide guidance on established reliability and reliability prediction.

6.4.5 Maintainability. The converter should be designed to facilitate assembly, disassembly, location of trouble sources, and maintenance without the aid of special tools. All functional parts should be readily identifiable, accessible, and removable for replacement. When printed circuit boards are utilized, only clear transparent conformal coating should be used in order to permit identification, location, removal, and replacement of functional parts.

6.4.6 Failure mode and effects analysis (FMEA). A failure mode and effects analysis should be performed. Converter protective functions should be independent of the control functions, and no single fault or failure should result in converter operation outside the output power requirements specified herein (see 3.5.1.2).

6.4.7 Identification markings. MIL-STD-130, MIL-STD-1285, and MIL-HDBK-1812 provide guidelines for identification marking of equipment and parts.

6.4.8 Calibration system. ANSI/NCSL Z540-1 and ISO 10012-1 provide guidance for the establishment and maintenance of a calibration system to control accuracy of the measuring and test equipment.

6.4.9 Workmanship. Guideline 9 of MIL-HDBK-454 provides guidance on workmanship practices.

6.4.10 Installation. The aircraft manufacturer should allow clearance of at least one inch at each end of the converter in addition to the maximum dimensions shown on the applicable specification sheet for installation and ventilation.

6.5 Vibration. Converters meeting the vibration requirements specified herein are suitable for use in jet, propeller, and helicopter applications. Specific aircraft platform requirements identified in a converter specification requirements sheet document may limit the suitable use to the specific platform.

6.6 Packaging. The converters should be packaged in accordance with MIL-STD-2073-1 level A or B, as specified in the contract. Interior and exterior containers should be marked in accordance with MIL-STD-2073-1 (see 5.1).

6.7 Definitions. The definitions in MIL-STD-704, MIL-STD-810, and MIL-STD-461 will apply in addition to those cited herein. Normal operation and abnormal operation characteristics for aircraft electrical systems are defined in MIL-STD-704, including definitions of transient and steady state conditions for voltage and frequency.

6.7.1 Alternating current. Alternating currents used in this specification are root mean square (RMS) values (see MIL-STD-704).

6.7.2 Alternating voltage. Alternating voltages used in this specification are considered line-to-neutral root mean square (RMS) values for both 3 wire and 4 wire input connections (see MIL-STD-704).

6.7.3 Crest factor. The crest factor is the absolute value of the ratio of the peak to the root mean square (RMS) value for each half cycle of the voltage waveform.

6.7.4 Direct voltage and current. Direct voltages and currents used in this specification are mean (average) values (see MIL-STD-704).

6.7.5 Full rated load (full load). Full rated load used in this specification is the maximum continuous converter output load specified in the applicable specification sheet for a given temperature-altitude condition.

6.7.6 Output distortion factor. Output distortion factor is the ratio of the root mean square (RMS) value of the ripple to the average DC voltage (see MIL-STD-704).

6.8 Aviation fuel and hydraulic fluids. Testing for resistance to the effects of oil, fuel and hydraulic fluids should also include those listed in MIL-PRF-23699, MIL-PRF-7808, DoD-PRF-85734 and MIL-DTL-5624 (JP-4/JP-5), MIL-PRF-8188, MIL-PRF-5606, and MIL-PRF-87257.

6.9 Subject term (key word) listing.

Electrical
Non-regulated
Power supply
Regulated
Transformer-rectifier

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.11 Specification sheet requirements. Specification sheets define the performance, design, interface, test, qualification, etc. requirements for a specific converter and its components. The paragraphs and tables in this specification that are identified in table IX, require information to be provided in the specification sheet and provide the minimum requirements to define the specific converter. The following applies: Paragraphs with an X in the "As Required By" column will either have a default value given in this specification or must have a value or requirement given in the specification sheet. Paragraphs with an X in the "Unless Otherwise Specified" column will have the requirement or value given only in the specification sheet, if it is required.

TABLE I. Qualification inspections (see 4.2.1, 4.2.2a, and 4.2.3).

Inspection title (Examination or test)	Requirement paragraph	Test method paragraph	Qualification (sample no.)			
			1	2	3	4
Visual and mechanical inspection	3.3, 3.4, 3.7, 3.8	4.6.1	X	X	X	X
Voltage regulation	3.5.1.2.1.1, 3.5.1.2.1.2,	4.6.2.1				
At room ambient temperature conditions		4.6.2.1.1	X	X	X	X
At maximum temperature-altitude conditions		4.6.2.1.2	X	X		
At minimum temperature-altitude conditions		4.6.2.1.3	X	X		
Operating position		4.6.2.2	X	X		
Worst condition		4.6.2.3	X	X		
Efficiency	3.5.1.3	4.6.2.4	X	X	X	X
Output ripple	3.5.1.2.1.1, 3.5.1.2.1.2	4.6.2.5	X	X	X	X
Input power factor	3.5.1.1.4	4.6.2.6	X	X	X	X
Input current balance	3.5.1.1.5	4..6.2.7	X	X	X	X
Input starting current (type I regulated converters only)	3.5.1.1.6	4.6.2.8	X			
Total harmonic distortion	3.5.1.1.7	4.6.2.9	X	X	X	X
Input current waveform	3.5.1.1.7.1	4.6.2.9	X	X	X	X
Shock load recovery	3.5.1.2.2	4.6.2.10	X		X	
Input power application	3.5.1.2.3	4.6.2.11	X		X	
Overload and short circuit capacity	3.5.1.2.4	4.6.2.12		X	X	
Parallel operation	3.5.1.2.5	4.6.2.13	X	X	X	X
Output overvoltage protection (type I regulated converters only)	3.5.1.2.6	4.6.2.14	X			
Electromagnetic compatibility	3.5.1.4	4.6.2.15	X		X	
Input power susceptibility	3.5.1.1.2, 3.5.1.1.3	4.6.2.16		X		
Acoustical noise	3.5.1.5	4.6.3.2	X			
Pressure drop (blast-cooled converters only)	3.5.1.6	4.6.3.3	X			
Acceleration	3.5.2.2	4.6.3.4	X			
Humidity	3.5.2.3	4.6.3.5	X			
Shock	3.5.2.4	4.6.3.6	X			
Vibration	3.5.2.5	4.6.3.7		X		X
Fungus	3.5.2.6	4.6.3.8				X
Salt fog	3.5.2.7	4.6.3.9		X		
Dust	3.5.2.8	4.6.3.10				X
Explosive atmosphere	3.5.2.9	4.6.3.11		X		
Contamination by fluids	3.3.4	4.6.3.12			X	
Reliability demonstration	3.6.1	4.6.4			X	X
Toxicity and fire resistant	3.3.5	4.6.4.13			X	
Disassembly and inspection	-----	4.6.5			X	X

TABLE II. Conformance inspections (see 4.3 and 4.6.2.12.1).

Inspection title (examination or test)	Requirement paragraph	Test method paragraph
Visual and mechanical inspection	3.3, 3.4, 3.7, 3.8	4.6.1
Burn-in (type I, regulated converters only)	3.8.1	4.6.6
Overload and short circuit capacity	3.5.1.2.4	4.6.2.12
voltage regulation at temperature-altitude	3.5.1.2.1.1	4.6.2.1
Efficiency	3.5.1.3	4.6.2.4
Output ripple	3.5.1.2.1.1, 3.5.1.2.1.2	4.6.2.5
Input power factor	3.5.1.1.4	4.6.2.6
Input current balance	3.5.1.1.5	4.6.2.7
Input starting current (type I, regulated converters only)	3.5.1.1.6	4.6.2.8
Total harmonic distortion	3.5.1.1.7	4.6.2.9
Input current waveform	3.5.1.1.7.1	4.6.2.9

TABLE III. Maximum temperature-altitude conditions (see 4.6.2.1.2).

<table>
<tr><th colspan="2">Class A converters</th><th colspan="2">Class B converters 1/</th><th colspan="2">Class C converters (blast-cooled)</th><th colspan="2">Class C converters (self-cooled)</th></tr>
<tr><th>Ambient temperature (°C)</th><th>Altitude (feet)</th><th>Ambient temperature (°C)</th><th>Altitude (feet)</th><th>Ambient temperature (°C)</th><th>Altitude (Feet)</th><th>Ambient temperature (°C)</th><th>Altitude (Feet)</th></tr>
<tr><td>71</td><td>Sea level</td><td>85</td><td>Sea level</td><td rowspan="5">Maximum specified on the applicable specification sheet</td><td>Sea level</td><td>120</td><td>Sea level</td></tr>
<tr><td>25</td><td>15,000</td><td>85</td><td>17,500</td><td>25,000</td><td>80</td><td>25,000</td></tr>
<tr><td>8</td><td>25,000</td><td>50</td><td>35,000</td><td>37,000</td><td>60</td><td>37,000</td></tr>
<tr><td>-10</td><td>35,000</td><td>20</td><td>50,000</td><td>50,000</td><td>40</td><td>50,000</td></tr>
<tr><td>-10</td><td>50,000</td><td>20</td><td>65,000</td><td>65,000</td><td>-12</td><td>65,000</td></tr>
</table>

1/ Class B power rating lowered 50 percent above 50,000 feet.

TABLE IV. Minimum temperature-altitude conditions (see 4.6.2.1.3).

Classes A, B, and C converters 1/	
Ambient Temperature (°C)	Altitude (Feet)
-55	Sea level
-55	10,000
-55	25,000
-55	50,000
-55	65,000

1/ Class B power rating lowered 50 percent above 50,000 feet

TABLE V. Input voltage unbalance (see 4.6.2.16.2).

Combination Number	Phase A (volts, RMS)	Phase B (volts, RMS)	Phase C (volts)
1	113	116	116
2	116	113	116
3	116	116	113
4	113	113	116
5	113	116	113
6	116	113	113

TABLE VI. Full performance transient surge susceptibility (see 4.6.2.16.4.1.1).

Volts RMS	Duration (seconds)
180	0.010
165	0.029
145	0.054
130	0.073
95	0.048
80	0.010

TABLE VII. Limited performance transient surge susceptibility (see 4.6.2.16.4.1.2).

Volts RMS	Duration (seconds)
180	0.010
162	0.500
124	25.00
102	25.00
64	0.010
5	0.050
0	0.050

TABLE VIII. Number of burn-in cycles (see 4.6.6).

Number of electronic parts	Number of cycles
0 – 100	1
101 – 500	3
501 – 2000	6
2001+	10

TABLE IX. Specification sheet requirements (see 6.11).

Paragraph	As required by	Unless otherwise specified
1.2.2 Converter class - Class C	X	
3.4.3.4 Cooling	X	
3.4.3.6 Operating position.	X	
3.4.3.7 Size and weight		X
3.5.1.1.1.1 a and b Full performance	X	
3.5.1.1.1.2 a and b Limited performance	X	
3.5.1.2.1.1 a and b Full Performance		X
3.5.1.2.1.2 a Limited performance		X
3.5.1.2.4.1 Type I, regulated converters (Overload and short circuit capacity)		X
3.5.1.2.5.1 Type I, regulated converters (Parallel operation)	X	
3.5.1.5 Acoustical noise	X	
3.5.1.6 Pressure drop (blast cooled converters only)	X	
3.5.2.1 Temperature-altitude	X	
3.6 Reliability		X
3.6.1 Reliability demonstration	X	
3.7.1 Terminals	X	
3.7.3 Nameplate	X	
3.7.4 Airflow	X	
4.4 Standard test conditions		X
4.4d Coolant temperature	X	
4.4.3 Airflow	X	
4.4.4 Warm-up and stabilization	X	
4.6.1 Examination of product	X	
4.6.2.1.1(a,b,c,d,e) Voltage regulation at room ambient temperature	X	
4.6.2.13 Parallel operation	X	
4.6.2.14 Output overvoltage protection (Type I, regulated converters only)	X	
4.6.4 Reliability demonstration	X	

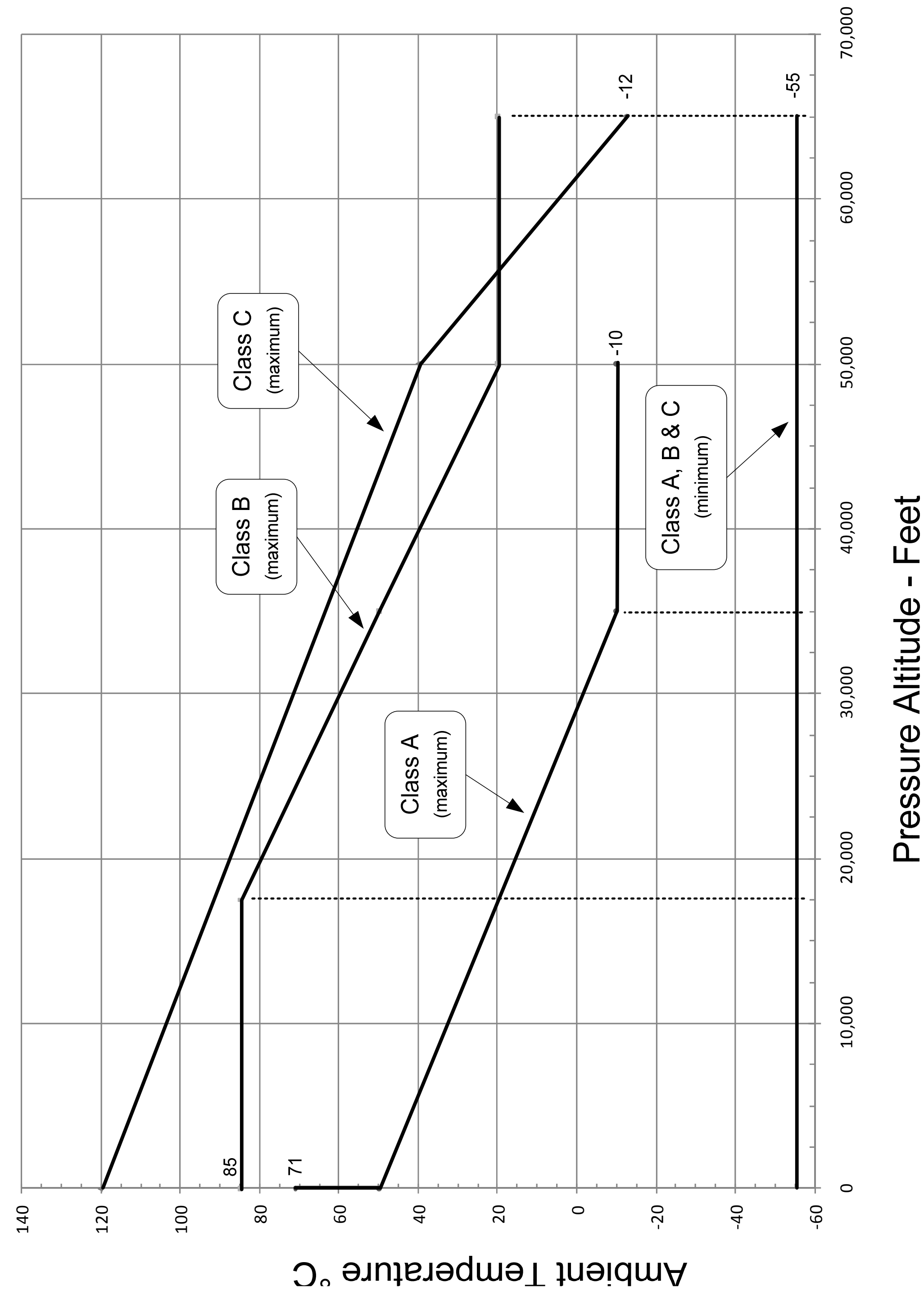

FIGURE 1. Temperature – altitude (see 1.2.2, 4.6.2.1, and 6.2e(5)).

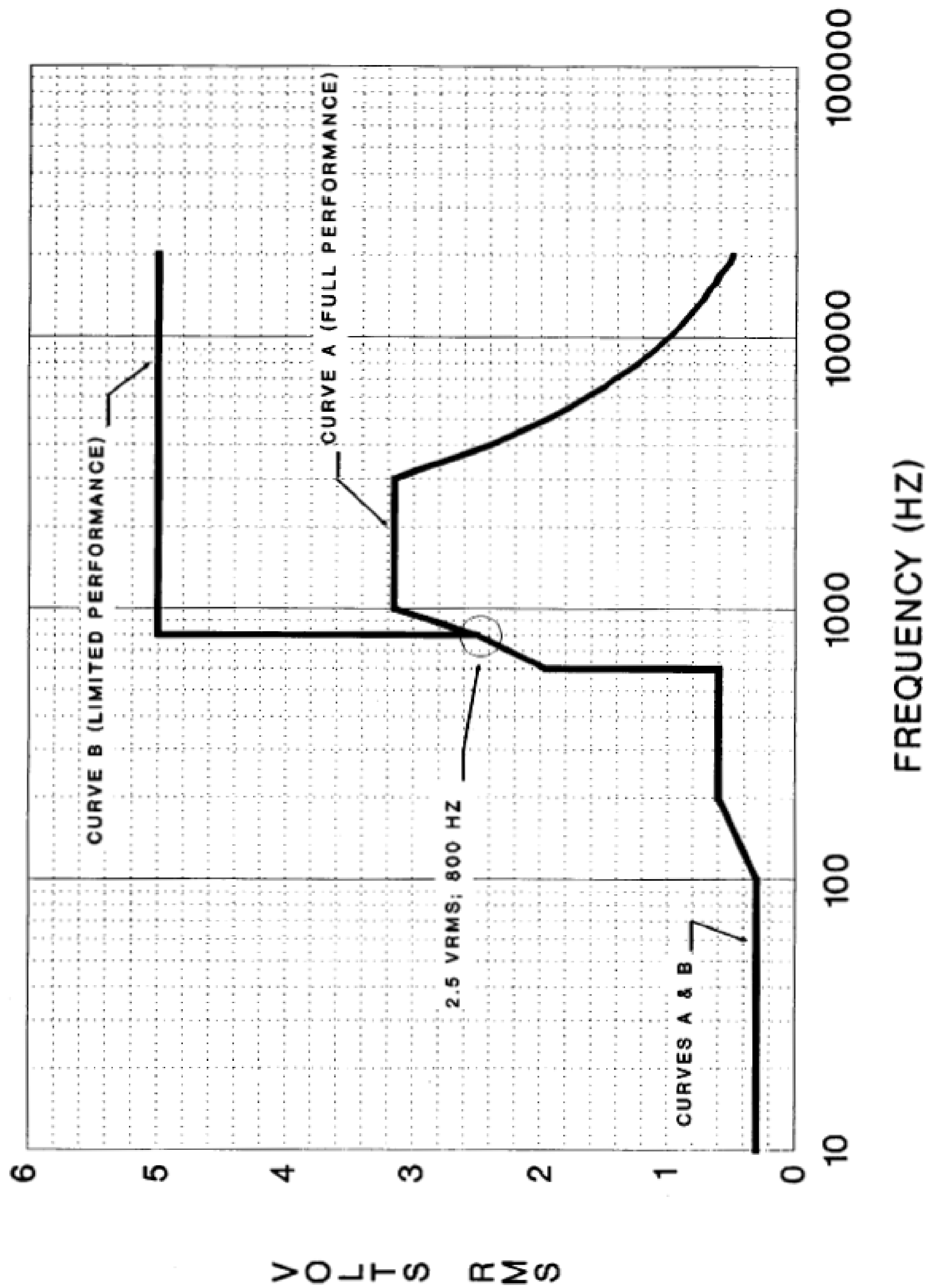

FIGURE 2. Input waveform distortion (see 3.5.1.1.1.1c and 3.5.1.1.1.2c).

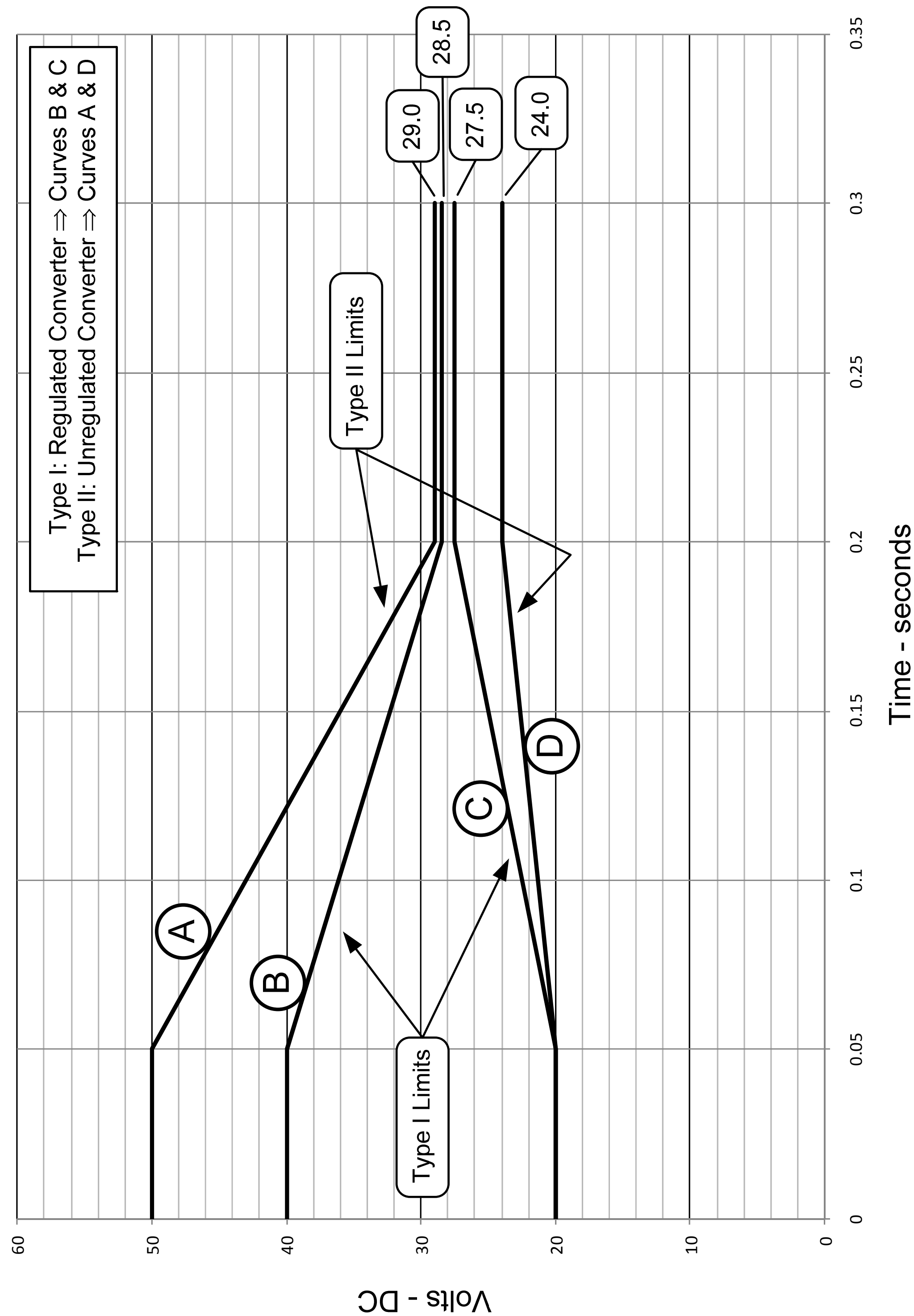

FIGURE 3. Output voltage transient limits (see 3.5.1.1.2.1).

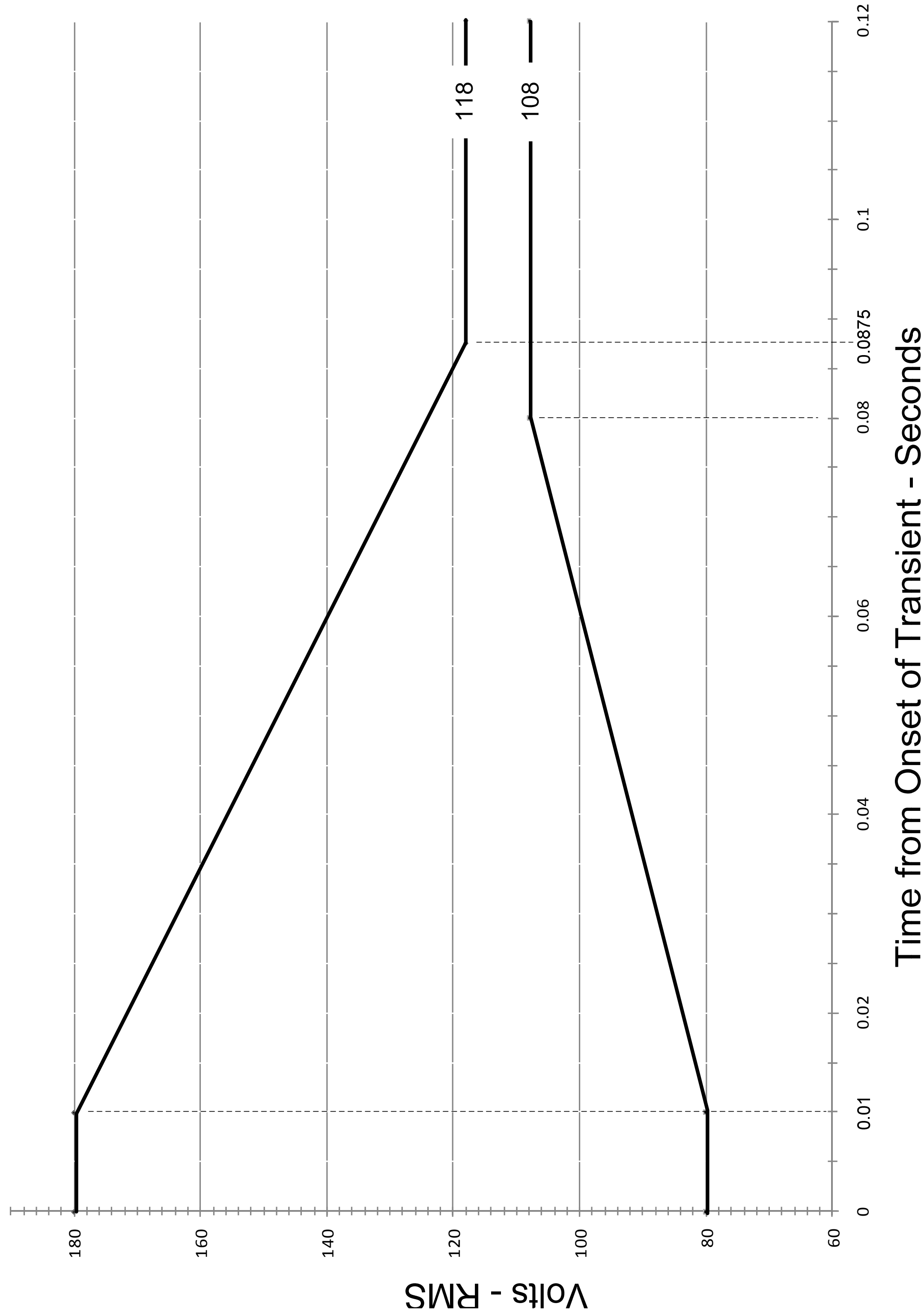

FIGURE 4. Input voltage transient limits (see 3.5.1.1.2.1.1).

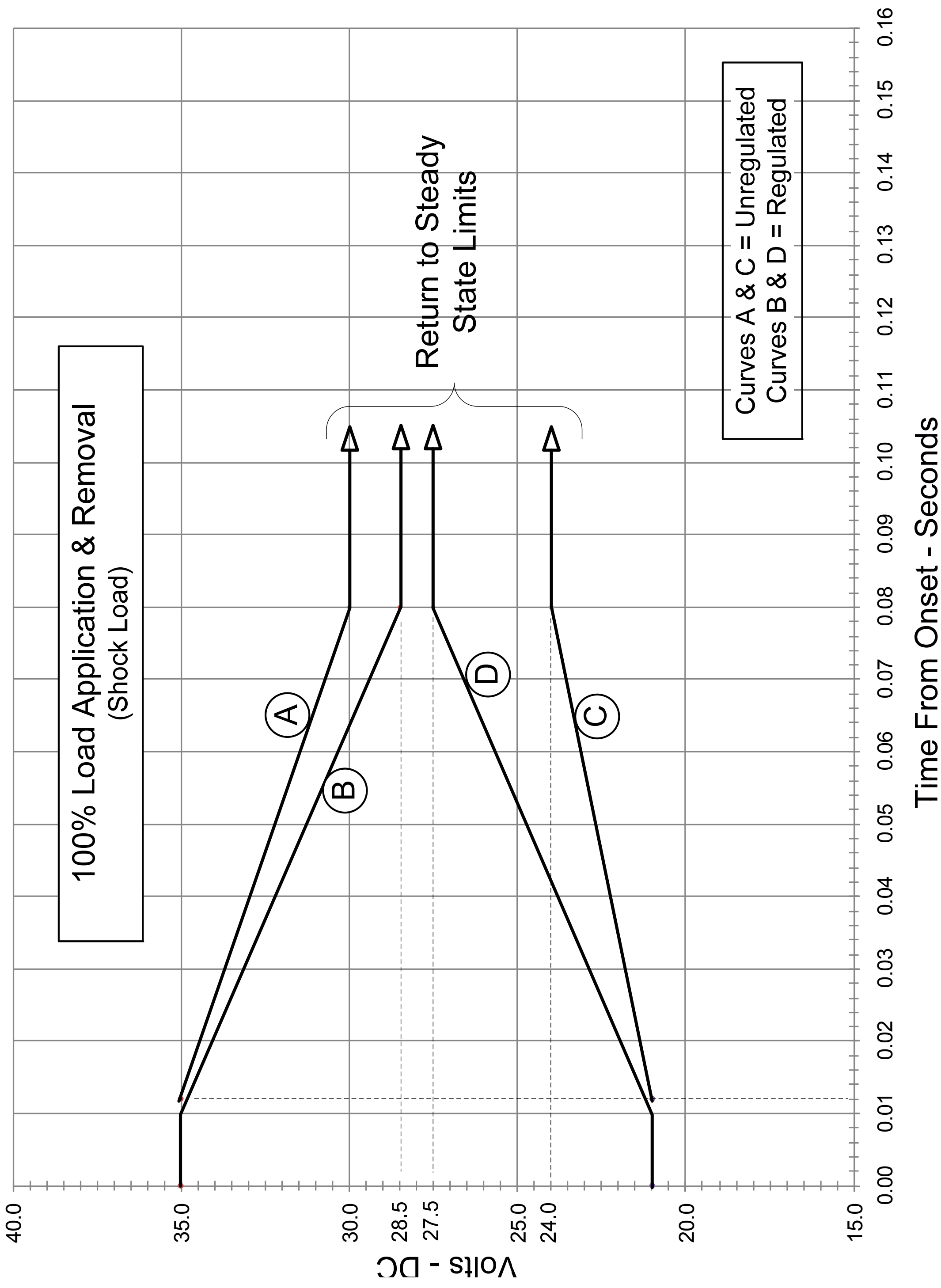

FIGURE 5. 100% load application and removal (see 3.5.1.2.2).

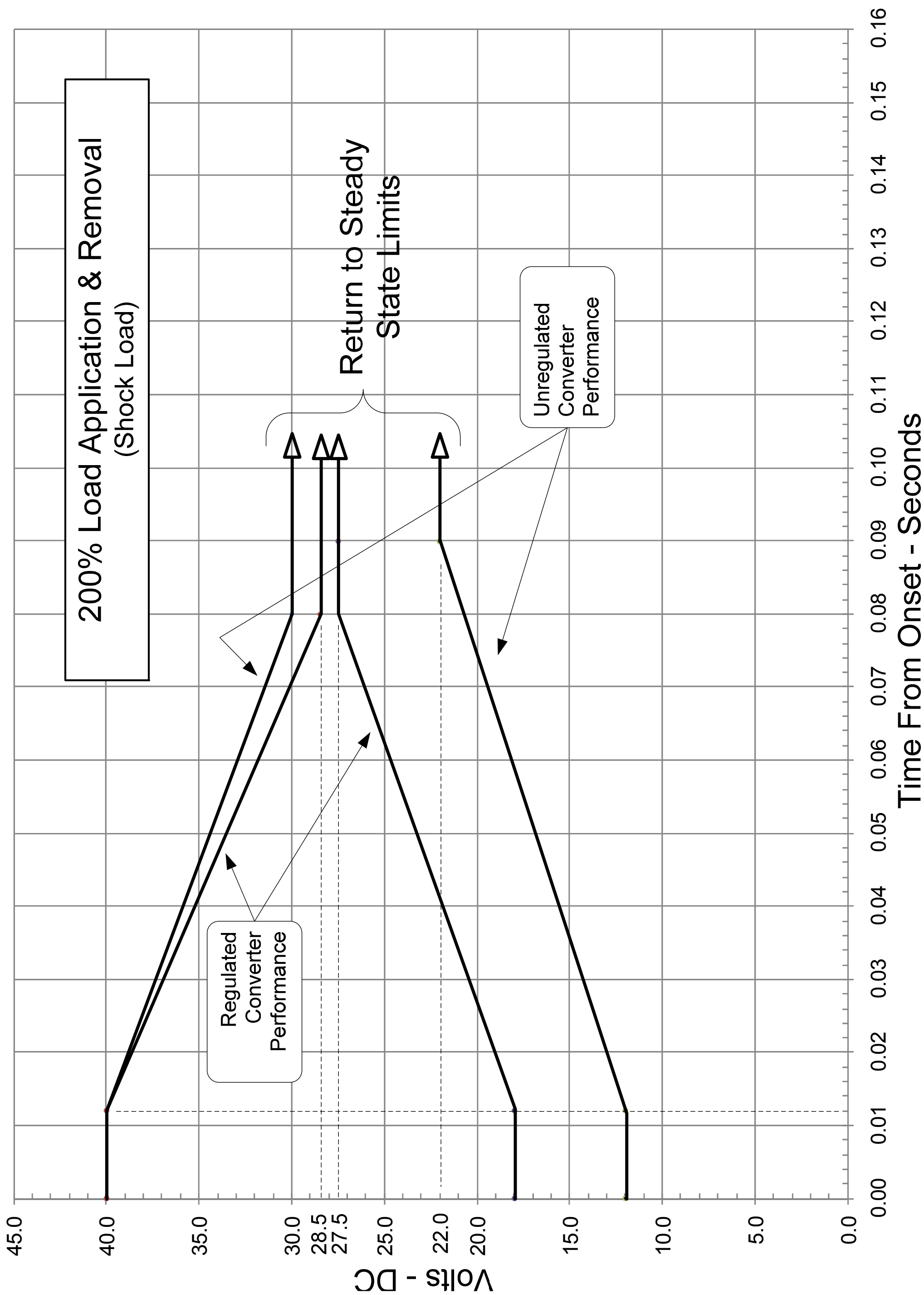

FIGURE 6. 200% load application and removal and short circuit (see 3.5.1.2.2).

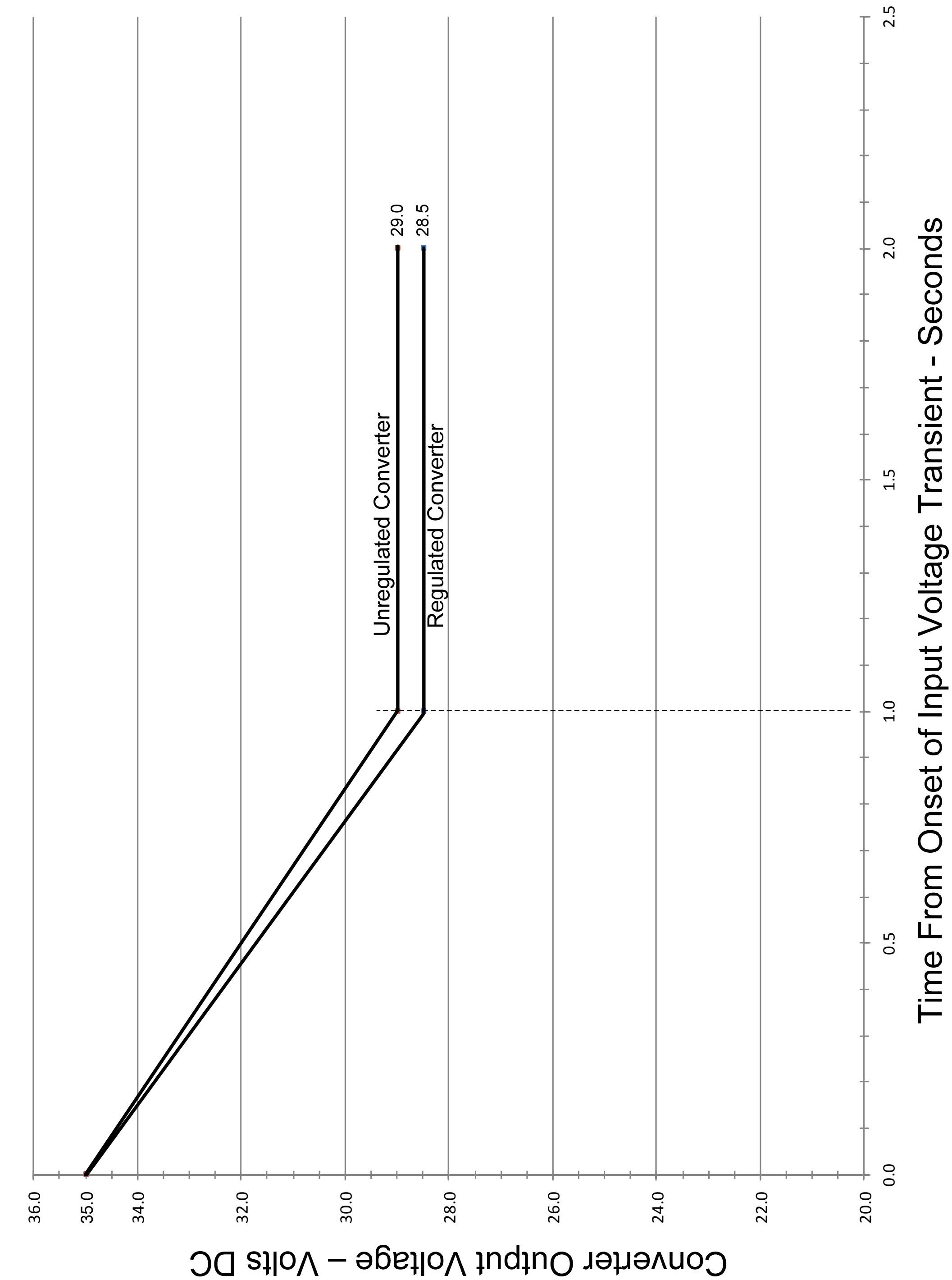

FIGURE 7. Input power application (see 3.5.1.2.3).

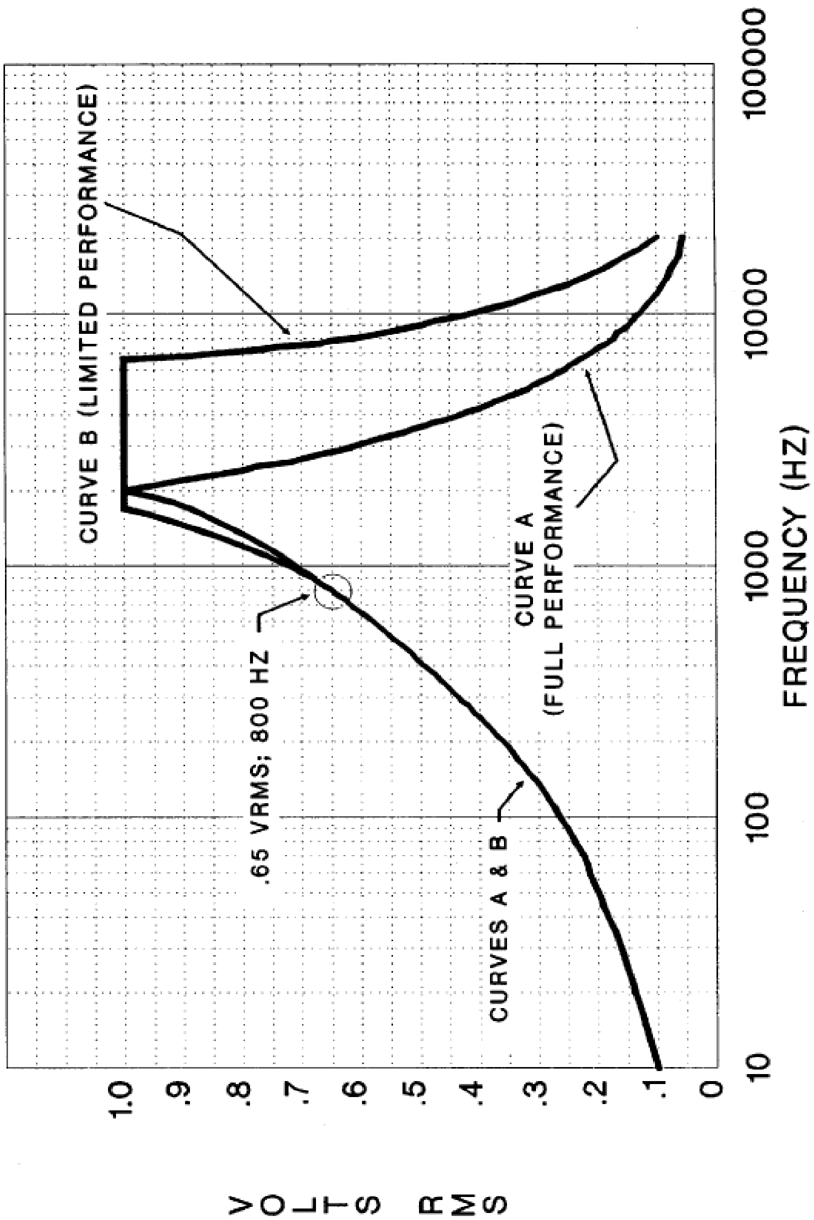

FIGURE 8. Output ripple frequency spectrum (see 3.5.1.2.1.1 and 3.5.1.2.1.2b).

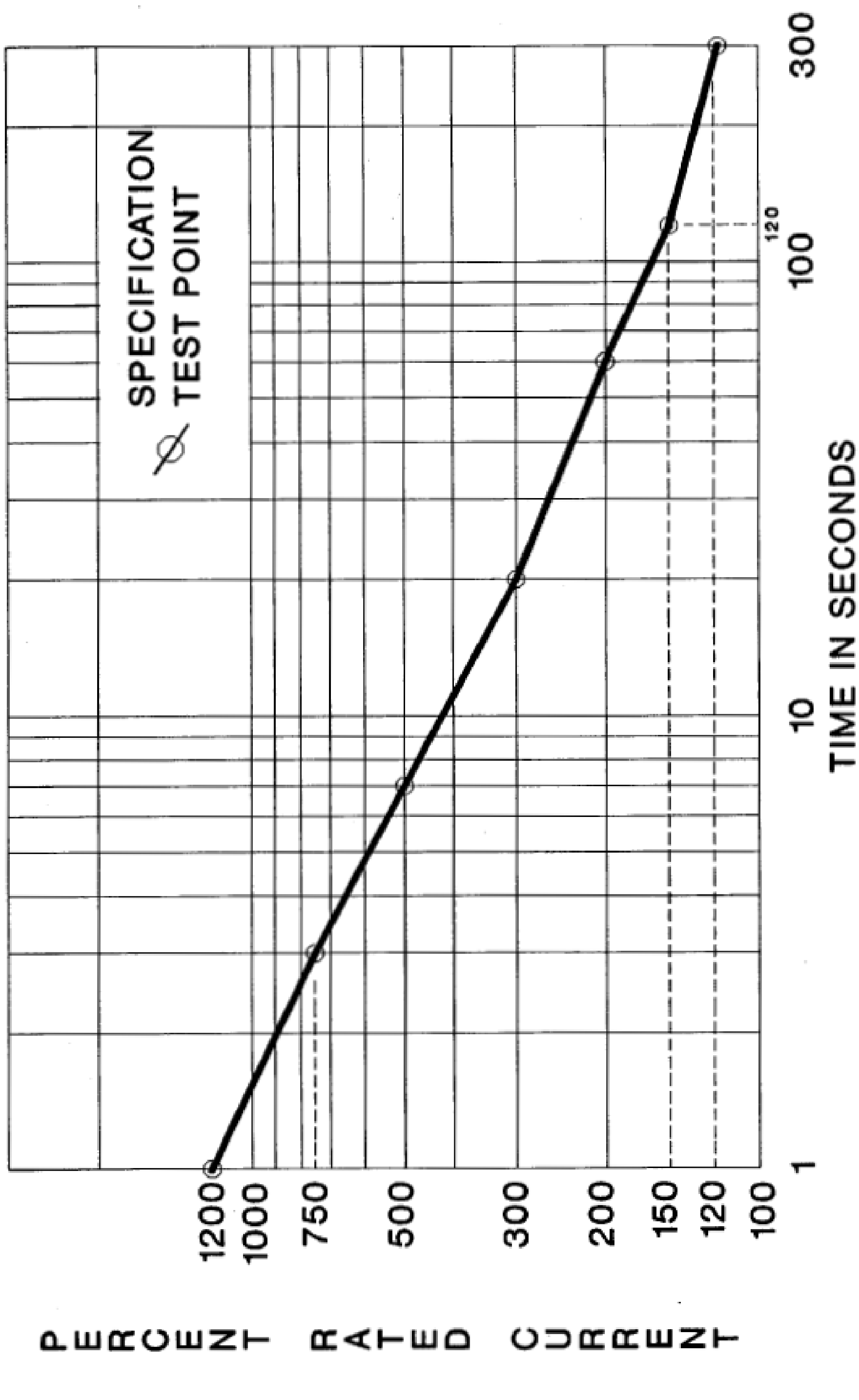

FIGURE 9. Converter current carrying capacity (see 3.5.1.2.4.2 and 4.6.2.12).

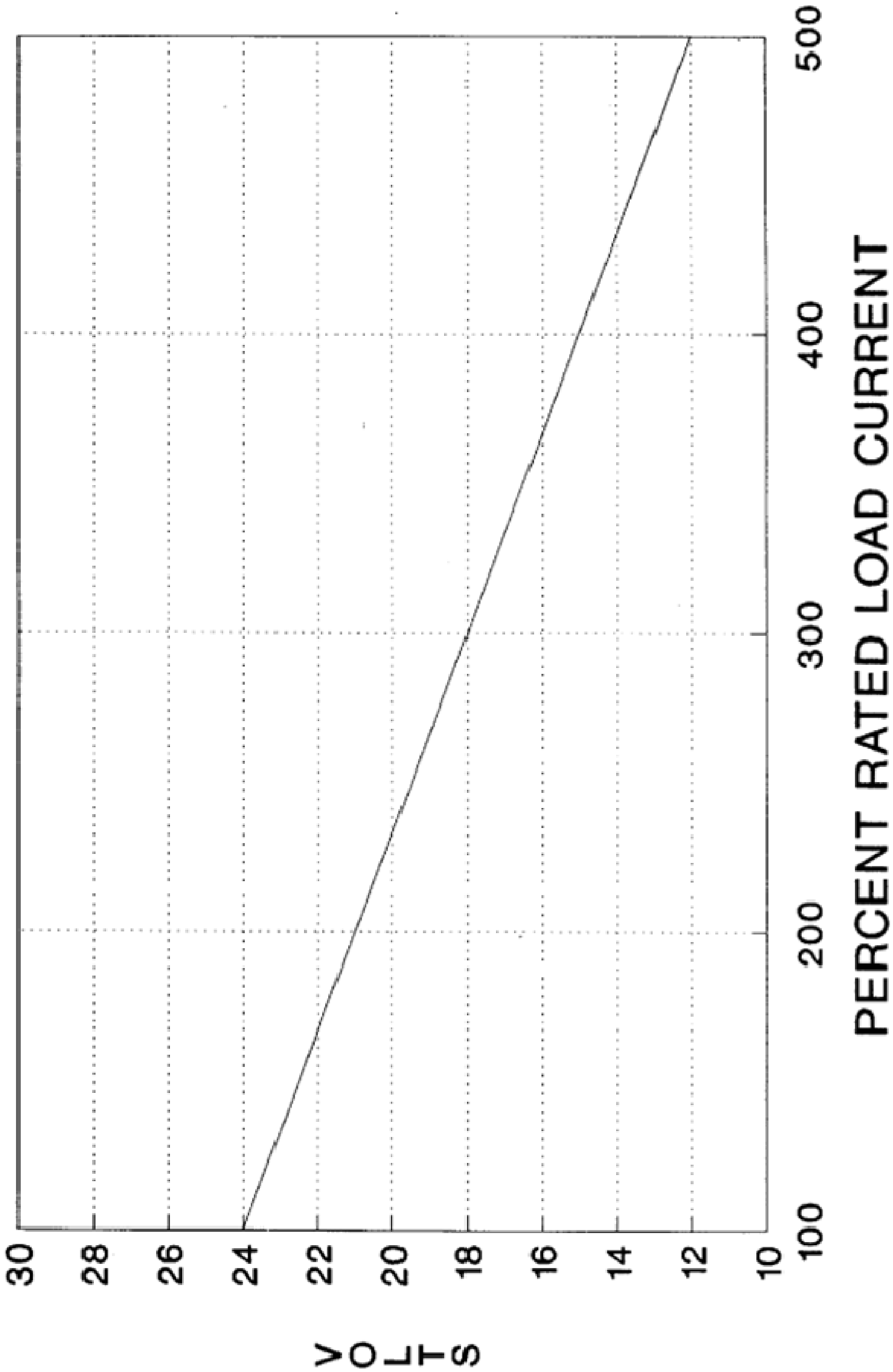

FIGURE 10. Minimum output voltage vs load (see 3.5.1.2.4.2).

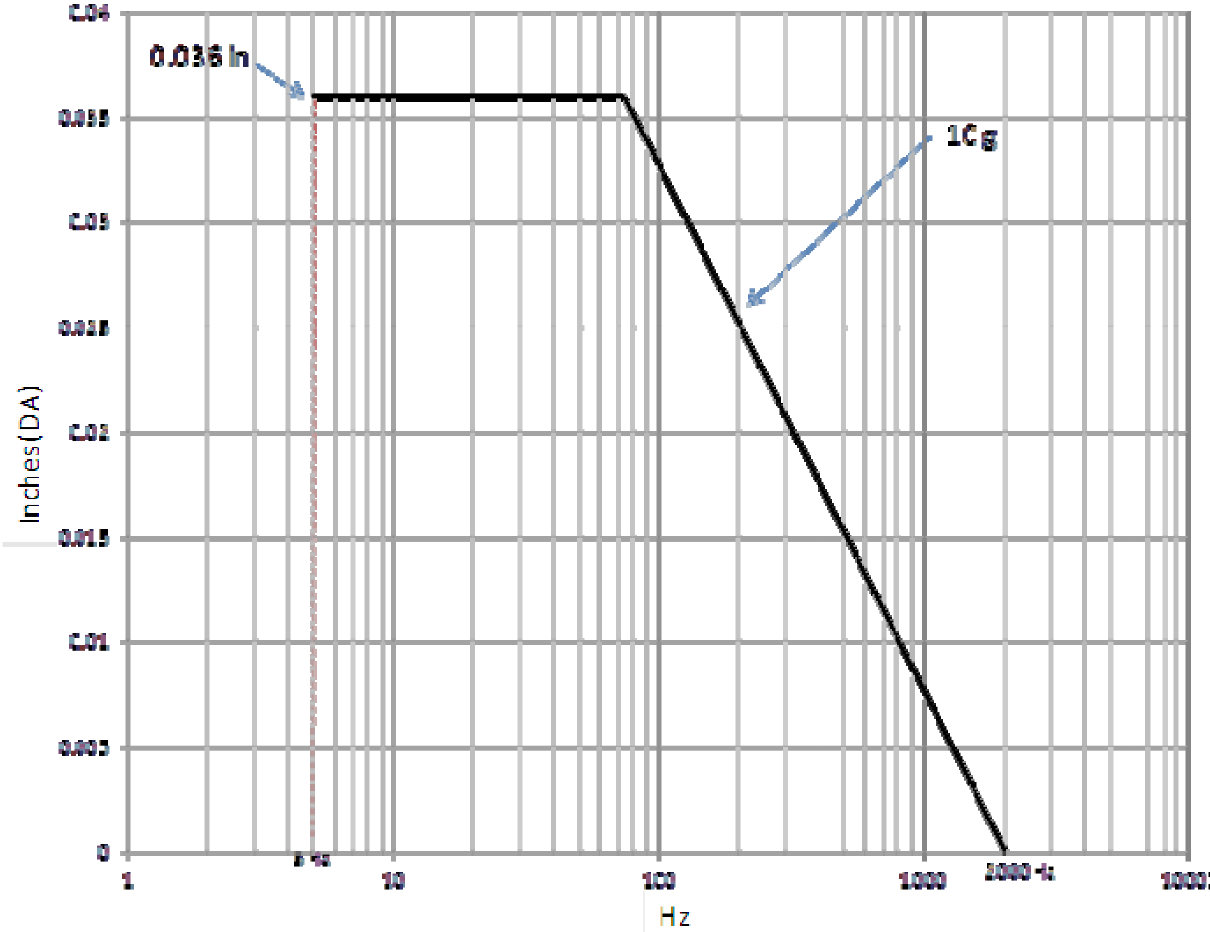

FIGURE 11. Sinusoidal vibration reference profile (see 4.6.3.7.3).

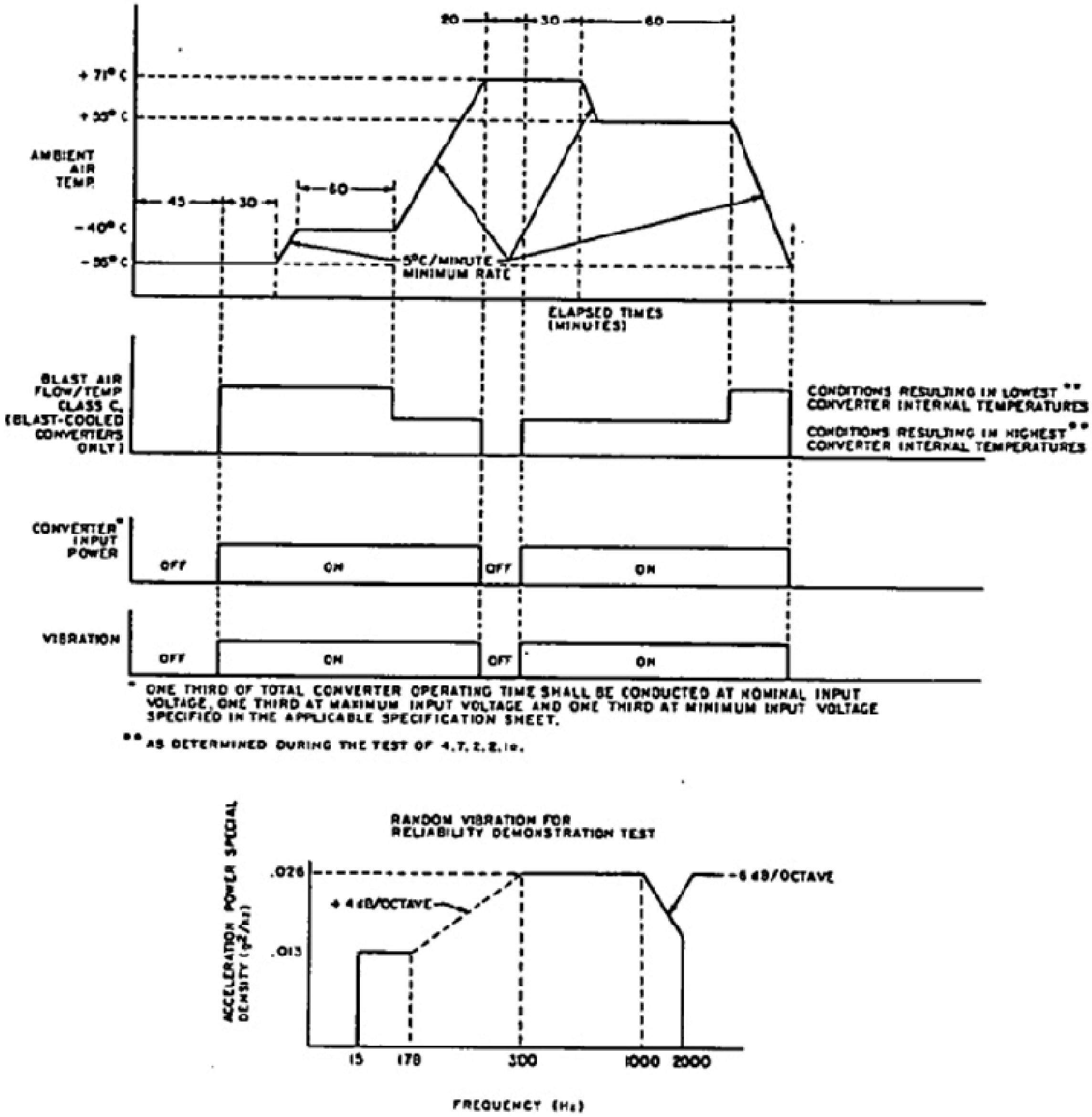

FIGURE 12. Reliability demonstration test profile (see 4.6.4).

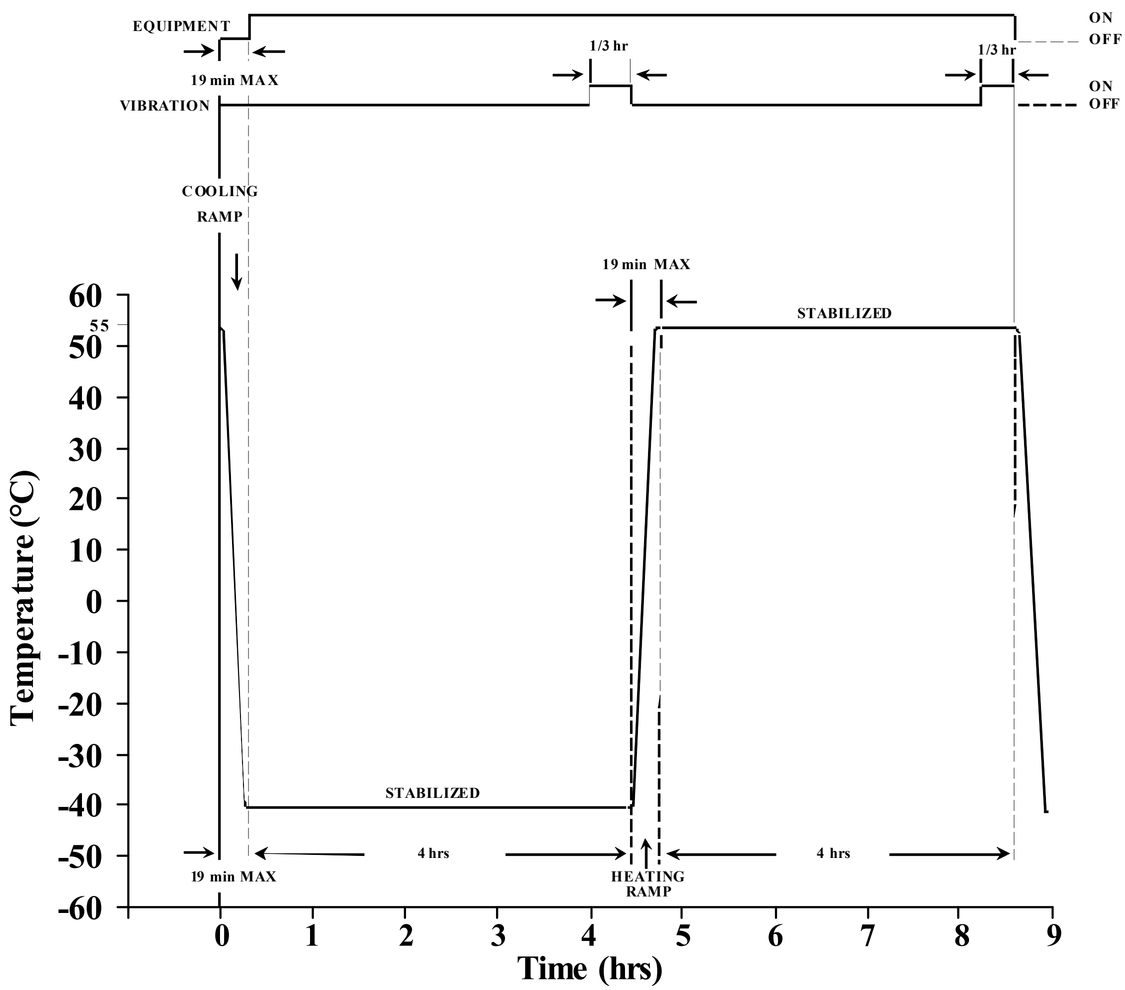

FIGURE 13. Typical burn-in test cycle (see 4.6.6).

CONCLUDING MATERIAL

Custodians:
Navy – AS
Air Force – 99
DLA – GS

Preparing activity:
Navy - AS
(Project 6130-2010-004)

NOTE: The activities listing above were interested in this document as of the date of the document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST online database at https://assist.dla.mil.