



AEROSPACE INFORMATION REPORT

AIR7502™

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Aircraft Electrical Voltage Level Definitions

RATIONALE

Future aircraft programs will become more electric, with possibly hybrid or electrical propulsion, resulting in higher electrical loads. This will require other voltage ranges. New candidate supply voltages could be 0 to 270 VDC, ± 135 VDC, ± 270 VDC, 0 to 540 VDC, or even higher. This report shall set forth the voltage level definitions as discussed and agreed to in the AE-7 committee.

INTRODUCTION

The motivation in creating voltage levels helps to delineate magnitudes in the term "high voltage" as it applies to an aerospace application. These voltage levels should not be associated with voltage standards for electrical power systems (EPS), nor particularly with the "system" voltage. Although there is no physical basis for these levels, these demarcations of voltage levels are to facilitate the different regions for insulation system, material, and device design.

1. SCOPE

The scope of this report will document the various voltage levels and provide a rational for each level as discussed and agreed to in the AE-7 committee.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 60950-1 Information technology equipment - Safety

2.2 Abbreviations

AC	Alternating Current
DC	Direct Current
EPS	Electrical Power System

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Documents

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L-L	Line-to-Line
rms	Root-Mean-Square
SELV	Safety Extra-Low Voltage
VAC	Volts AC
VDC	Volts DC

2.3 Definitions

AIRCRAFT: An airplane, helicopter, or lighter-than-air vehicle.

3. VOLTAGE LEVEL RANGE DEFINITIONS

Table 1 delineates voltage level ranges, which can be used to designate AC and DC electrical rating in forthcoming aerospace applications.

Table 1 - Voltage level range definitions

Voltage Level Type	AC, Volt rms	Abnormal Surge Voltage Based on L-L, rms	DC, Volt (Based on Maximum Voltage Amplitude*)	Normal Transients* Surge Voltage (Based on Maximum Voltage Amplitude*)
Voltage Level 1	Up to 42.4 VAC	66 VAC	Up to 60 VDC	86 VDC
Voltage Level 2	42.4 to 213 VAC	332 VAC	60 to 300 VDC	432 VDC
Voltage Level 3	213 to 425 VAC	663 VAC	300 to 600 VDC	864 VDC
Voltage Level 4	425 to 851 VAC	1327 VAC	600 to 1000 VDC	1440 VDC
Voltage Level 5	Up to 3600 VAC	5612 VAC	1000 to 5100 VDC	7344 VDC
Voltage Level 6	Above 3600 VAC	Above 5612 VAC	Above 5100 VDC	Above 7344 VDC

*For example a DC unipolar system voltage level 2 is up to 300 VDC between line to ground, for bipolar 300 VDC is the voltage between the two lines (i.e., 150 VDC between line to ground). For AC, the normal transients are transients due to load variations and not due to failure mode.

3.1 Rationale for Each Voltage Level

Voltage Level 1 - Level for which human body is safe. Based on IEC 60950-1 and UL60950 guidance for safety extra-low voltage (SELV) circuit. SELV circuits shall not exceed 42.4 VAC peak or 60 VDC for longer than 200 ms. An absolute limit of 71 VAC peak or 120 VDC must not be exceeded.

Voltage Level 2 - Based on voltage level lower than Paschen limit under unpressured value (around 330 V).

Voltage Level 3 - 300 to 600 VDC level for which cable is presently qualified, and also matches currently available high power components (IGBT, SiC, or MOSFET), used for industry.

Voltage Level 4 - 600 to 1000 VDC is the present limit for dielectric insulation materials which do not need any significant design constraints or which are very rare in terms of variety and production rate.