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Practical Application Guidelines for

The Third Edition of the Standard for Safety for Information Technology Equipment, UL 1950

PAG 1950

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UL Practical Application Guidelines (PAG)
for
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PAG 1950

Practical Application Guidelines (PAG) for The Third Edition of the Standard for Safety for Information Technology Equipment, UL 1950

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FOREWORD

A. UL's Practical Application Guidelines are intended to be used as reference documentation and are designed to provide assistance in understanding the application of requirements contained in the corresponding UL Standard, provide assistance in addressing the use and applications of the respective products covered by the associated UL Standard(s), or both. These guidelines are based upon sound engineering principles, research, record of tests and field experience, installation, and use. They are subject to revision as further experience and investigation may show is necessary or desirable.

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INTRODUCTION

1 Scope

1.1 These practical application guidelines are intended to provide a source of reference for understanding and applying the requirements of the Third Edition of the Standard for Safety for Information Technology Equipment, UL 1950.

1.2 These guidelines are not intended to take the place of the requirements in the corresponding UL Standard and are not intended to establish additional requirements.

1.3 These guidelines do not contain any construction or performance requirements for information technology equipment. Information technology equipment is investigated in accordance with the Standard for Safety for Information Technology Equipment, UL 1950.

1.4 This printed version of the Practical Application Guidelines is derived from an electronic Practical Applications On-Line System (PAGOS). It is intended that the PAGOS will be updated frequently and therefore, only the on-line version of the Practical Application Guidelines are considered most current. The on-line version of the Practical Application Guidelines may be found at **http://www.ul.com/pag.**

2 Application Guidelines

2.1 Each application guideline is numbered as follows:

a) The designation to the left of the colon indicates the related sub-clause of the third edition of UL 1950 and

b) The designation to the right of the colon indicates the number (001, 002, etc.) of the specific guideline related to that sub-clause.

For example, an application guideline identified as 1.5.6:001 is the first guideline for sub-clause 1.5.6.

2.2 The following table provides a summary of the application guidelines contained in these practical application guidelines.

SUMMARY OF APPLICATION GUIDELINES		
Application Guideline	**Issued Date**	**Issued Addressed**
1.1.1:001	June 24, 1994	"Listing" versus "Accessory Listing" of accessory-like devices.
1.1.2:001	May 28, 1993	Equipment intended to be powered by an automobile battery source.
1.2.3.2:001	May 28, 1993	Lap-top and notebook computers not considered hand-held equipment.
1.2.5.1:001	November 19, 1993	Pluggable equipment type designation for multiple voltage rated equipment using detachable power supply cords and/or appliance inlets.
1.2.8.7:001	May 28, 1993	Methods for measuring hazardous energy levels.
1.2.8.7:002	May 28, 1993	Application of Hazardous Energy "continuous power level" limits.
1.2.14.7:001	December 3, 1993	Data communication circuits subject to evaluation to Clause 6.
1.3.1:001		Unassembled and Disassembled Equipment.
1.3.1:002	November 19, 1993	Disassembled, nondetachable power supply cords intended for field assembly.
1.3.3:001	June 24, 1994	ITE marked as Class II equipment, shipped with a Class I power supply.
1.4:001	June 24, 1994	Test suites for families of power supplies.
1.4:002	January 24, 1996	Ferrite cores considered conductive.
1.4:003	May 28, 1993	End product testing of Listed accessory personal computer plug-in cards.
1.4.7:001	May 28, 1993	"Bench" versus "oven testing" to evaluate maximum temperatures or maximum temperature rises.
1.5:001	November 22, 1995	Accessible LEDs located in Hazardous Voltage circuits
1.5.2:001	May 28, 1993	Recognized Components used outside their ratings.
1.5.3:001	January 24, 1996	Foil transformer windings
1.5.3:002	May 28, 1993	Insulating tapes in transformers
1.5.3:003	May 28, 1993	Transformer bobbins in Class 105 (A) insulation systems.
1.5.4:001	May 28, 1993	Applicability of 2.2.2 to high voltage components.
1.5.4:002	May 28, 1993	Report descriptions of alternate materials for high voltage components.
1.5.6:001	November 22, 1995	UL component requirements for mains capacitors.
1.5.6:002	November 22, 1995	Generic acceptance of (FOKY2)/(FOWX2) capacitors.
1.5.6:003	October 14, 1994	Assumed casing insulation levels for (FOKY2)/(FOWX2) capacitors.
1.5.6:004	July 23, 1993	Integral insulation on electrolytic capacitors.

SUMMARY OF APPLICATION GUIDELINES		
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1.7:001	November 22, 1995	"Exclamation point within a triangle" (ISO 3864, No. B.3.1) may not be substituted for required markings.
1.7:002	May 28, 1993	Accessory Listing Mark placed on product packaging.
1.7:003	May 28, 1993	Correlation markings for Listed accessory plug-in cards.
1.7.1:001	May 28, 1993	Power rating marking requirements for ITE intended for use with a Listed Direct Plug-In Transformer Unit (EPBU).
1.7.1:002	June 24, 1994	Conflicts between voltage rating declarations in markings and manuals.
1.7.1:003	May 28, 1993	Equipment not intended for direct connection to the mains, but marked with a current rating.
1.7.2:001	May 28, 1993	Class III products shipped without Direct Plug-In Transformer Units (EPBU).
1.7.2:002	May 28, 1993	Instructions which refer to after-market, field installable upgrades.
1.7.3:001	May 28, 1993	Operating/Rest Time markings that might reasonably be assumed to be ignored.
1.7.4:001	May 28, 1993	Instructions/markings for voltage adjustment switches.
1.7.6:001	May 28, 1993	Marking for fuses in sealed compartments.
1.7.6:002	June 24, 1994	Fuses required to be marked.
1.7.8.3:001	October 14, 1994	Working definition of "stand-by" condition.
1.7.8.3:002	October 14, 1994	Use/Restriction on use of "stand-by" condition symbol (IEC 417, No. 5009).
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1.7.15:001	May 28, 1993	Requirements for Non-Recognized Marking and Labeling.
1.7.17:001	May 28, 1993	Replacement markings for Recognized Component Lithium Batteries (BBCV2).
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1.7.18:001	October 14, 1994	Power supplies with removable covers in user access areas.
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2.1.4.2:001	May 28, 1993	Special accessibility considerations only allowed for RALS.
2.1.10:001	May 28, 1993	Placement of overcurrent devices affecting compliance with capacitive discharge requirements.

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2.2.2:002	May 28, 1993	"Grandfathered" materials.
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2.2.2:004	May 28, 1993	Humidity test considerations.
2.2.5:001	November 22, 1995	End product spacings considerations based on component working voltages.
2.2.7:001	May 28, 1993	Fault conditions not considered into working voltage determinations.
2.2.7:002	October 14, 1994	Circuit references and affect on working voltage measurements
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2.3.3:001	July 23, 1993	Supply tolerances not used for SELV reliability testing.
2.3.3.1:001	May 28, 1993	Tandem transformers used to comply with SELV Method I.
2.3.3.1:002	May 28, 1993	SELV and hazardous voltage wiring routed together.
2.3.3.3:001	October 14, 1994	SELV Method 3 considerations
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2.5:002	June 24, 1994	Inductors in the protective earthing path.
2.5:003	June 24, 1994	Evaluations of unsoldered quick-connect connectors and tabs in the protective earthing path.
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2.5.1:002	May 28, 1993	Performance requirements for earthing paths through PWB traces in Class I equipment.
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2.7:001	May 28, 1993	Single-pole supplementary overcurrent protective devices in primary circuitry of 125/250 V equipment.
2.7:002	November 22, 1995	AC rated fuses used in DC circuits.
2.7.3:001	May 28, 1993	Interrupting ratings for branch circuit overcurrent protective devices.
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2.9.3:001	May 28, 1993	Measurement of peak and nonsinusoidal working voltages for creepage distance determinations.

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Application Guideline	**Issued Date**	**Issued Addressed**
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2.9.4.1:001	May 28, 1993	Minimum distance through insulation requirements for Basic insulation.
2.9.7:001	May 28, 1993	Cemented/uncemented joints.
2.9.7:002	May 28, 1993	Adhesive tape not cemented joint.
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2.9.7:004	May 28, 1993	Generic epoxy as an encapsulant.
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4.2:001	May 28, 1993	Mechanical Strength Testing of platen glass
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4.3.9:002	November 19, 1993	Securement of wires bridging Operational or Basic insulation.
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4.3.17:001	May 28, 1993	Misconnection of modular jacks and plugs.
4.3.18:001	November 19, 1993	Certification options for direct plug-in units.
4.3.21:001	May 28, 1993	Nickel-cadmium batteries.
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4.3.21:003	July 23, 1993	Performance requirements for battery chargers.
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4.4:002	January 24, 1996	Recognized Plastics outside of their RTI.
4.4.3:001	May 28, 1993	Flammability requirements for disposable parts (toner, dispersant and ink containers).
4.4.4:001	May 28, 1993	Flammability of ordinary glass.
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4.4.4:003	November 22, 1995	Mass of disposable parts not considered into overall equipment mass.
4.4.4:004	November 22, 1995	Mass of accessories not considered into overall equipment mass.
4.4.5:001	June 24, 1994	Fault condition testing to determine compliance with fire enclosure requirements.
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4.4.6:005	October 14, 1994	Front bezels on disk drives.
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5.4.6:002	May 28, 1993	Waiving repetition of component fault tests (three times total rule).
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6.2.2.1:002	May 28, 1993	TNV-3 circuits on PC plug-in modem cards.
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6.4.1:002	November 22, 1995	Application of test to telephone keypads.
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B.6:001	May 28, 1993	Running Overload Test waived on spindle motors in disk drives.
B.7:001	May 28, 1993	Locked Rotor Test waived on spindle motors in hard disk drives.
C.1:001	May 28, 1993	Practical Overload testing of switching type transformers.
C.1:002	May 28, 1993	Annex C applies to transformers supplying a Limited Power Source.
C.1:003	May 28, 1993	Waiving Transformer Overload testing.
C.1:004	May 28, 1993	Overload testing of linear transformers.
C.1:005	May 28, 1993	Alternative to Overload testing of switch mode transformers.
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C.1:007	July 23, 1993	Electric Strength Testing after the Overload Test.
C.2:001	May 28, 1993	Meaning of "Positive means of retention".
C.2:002	October 14, 1994	Positive retention of metal (foil) windings.
H:001	June 24, 1994	"Abnormal" Operation X-radiation tests.
H:002	June 24, 1994	Abnormal X-radiation Test considerations.
L:001	May 28, 1993	Effect of photocopier paper tray capacity on rest period.
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L:003	June 24, 1994	Normal load conditions for paper shredders.
P(1.5.2):001	November 22, 1995	Battery chargers.
P(1.5.2):002	May 28, 1993	TVSS devices.
P(1.5.2):003	May 28, 1993	Telephone handsets.
P(1.5.2):004	May 28, 1993	Flexible PWBs.
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P(1.5.2):006	November 19, 1993	Internal wiring.
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SUMMARY OF APPLICATION GUIDELINES		
Application Guideline	**Issued Date**	**Issued Addressed**
P(1.5.2):008	November 22, 1995	End product descriptions of R/C Insulation Systems (OBJY2).
P(1.5.2):009	May 28, 1993	Class 2 power supply outputs considered SELV.
P(1.5.2):010	October 14, 1994	Output requirements for Listed (QQGQ) power supplies.
P(1.5.2):011	December 3, 1993	TNV connectors, modular jacks and plugs.
NAE(2.7.1):001	May 28, 1993	Working definition of "Standard supply outlet."
NAE(2.11):001	May 28, 1993	Working definition of "NEC Class 2".
NAE(3.2.4):001	November 19, 1993	Detachable power supply cords and ITE used outside of U.S./Canada.
NAE(3.2.4):002	May 28, 1993	Detachable power supply cords for multiple-voltage rated products.

PAG No. 1.1.1:001

(Sub)CLAUSE/ANNEX NUMBER: 1.1.1

(Sub)CLAUSE/ANNEX HEADING: Equipment Covered by this Standard

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When are accessory-like products for use with host ITE systems required to be Accessory Listed and when may they be Listed?

APPLICATION GUIDELINE:

As a general rule, if the accessory-like product (a) is located externally to the host product, (b) has its own power source and (c) relies on a signal level interface with the host product to function, the product may be Listed.

If the accessory-like product is mounted internal to the host product, or receives power from the host product (5 V, 12 V, 120 V, etc.), the product should be Accessory Listed, as required in the past.

RATIONALE:

Products, such as small accessory-like label makers and scanners, which have their own power source, but which will not function without a signal from a host computing device, usually do not introduce any unique safety related concerns into a product investigation. These types of devices are eligible for Listing.

On the other hand, a modem card or similar device which is mounted inside a computer, or an external copier collator which receives power from the host copier, usually requires the electrical and/or fire enclosure to be opened for installation of the accessory and there are concerns raised regarding the correct and safe interconnection of the accessory and host device. Therefore, these types of devices should continue to be Listed Accessories.

OTHER:

SEE RELATED PAG:

PAG No. 1.1.2:001

(Sub)CLAUSE/ANNEX NUMBER: 1.1.2

(Sub)CLAUSE/ANNEX HEADING: Additional Requirements

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Sub-clause 1.1.2 states that equipment intended to be used in vehicles (automobiles) may need to be subjected to additional requirements other than this Standard. For ITE that can be powered by an automobile battery source (e.g. portable facsimile machines), are there any special considerations beyond those already contained in this Standard?

APPLICATION GUIDELINE:

Equipment evaluated for use in an automobile and powered by a car battery should be considered operating in a Pollution Degree 3 environment, and this Pollution Degree is applicable for both ac and dc circuits.

The cable/connector assembly for connection to the automobile power source should be evaluated under the category Adapters, Vehicle Battery (AATX) to UL 2089, Vehicle Battery Adapters.

The following abnormal operation testing should be considered while the unit is connected to a simulated dc supply: Reverse polarity input, simultaneous ac and dc operation, and dc circuit component faults. All tests should be performed while the equipment is connected to a dc source with enough supply capability to simulate a car battery.

RATIONALE:

An automobile interior is not a controlled environment and may be subject to conductive pollution or dry non-conductive pollution, e.g. dust, which could become conductive due to expected condensation. Both ac and dc circuits should be considered operating in a Pollution Degree 3 environment if the equipment has ac/dc capability since the product may be used in an automobile with a dc source for a period of time and then operated indoors with an ac source.

The ANSI Standard for Plugs/Cords for Connection Between Equipment and Cigarette Lighter Receptacles is UL 2089.

OTHER:

SEE RELATED PAG:

PAG No. 1.2.3.2:001

(Sub)CLAUSE/ANNEX NUMBER: 1.2.3.2

(Sub)CLAUSE/ANNEX HEADING: Hand-Held Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Should lap-top and notebook computers be considered hand-held equipment and, therefore, be subjected to the requirements for hand-held equipment?

APPLICATION GUIDELINE:

Lap-top and notebook computers that are marketed as portable personal computers, and which do not involve operation while being held in the hand should not be considered hand-held equipment.

Engineering judgment should be used to distinguish these types of computers from other types of hand-held computers (e.g. pen based, remote data entry, etc.) that are becoming more and more prevalent, and which should be considered hand-held equipment.

RATIONALE:

Typical lap-top and notebook computers do not meet the definition of hand-held equipment. They are not to be "held in the hand during normal use."

OTHER:

SEE RELATED PAG:

PAG No. 1.2.5.1:001

(Sub)CLAUSE/ANNEX NUMBER: 1.2.5.1

(Sub)CLAUSE/ANNEX HEADING: Pluggable Equipment Type A

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.5.2, 1.7.11, 2.1.10, 2.7.3, 5.2, 6.3

DESCRIPTION OF ISSUE:

For equipment rated 125 V/250 V or 125 V — 250 V, capable of being used on either a 125 V or 250 V supply, and supplied with a detachable power supply cord and/or an appliance inlet, may the equipment be classified either Pluggable Equipment Type A or B, or must the equipment be classified as both Pluggable Equipment Types A and B?

APPLICATION GUIDELINE:

Unless supplied with a plug type specified in the note to Sub-clause 1.2.5.1, or instructions restricting use of a cord with such a plug type, the equipment must be classified as both Pluggable Equipment Type A and B.

Worst case requirements applicable to Pluggable Equipment Type A or B should be applied to such constructions. Requirements that are based on pluggable equipment classification include Sub-clause 1.7.11, Marking and Instructions, Protection in building installation; Sub-clause 2.1.10, Capacitor Discharge; Sub-clause 2.7.3, Short Circuit Protection; Sub-clause 5.2, Earth Leakage Current; and Sub-clause 6.3, Protection of Telecommunication Network Personnel.

RATIONALE:

The Standard defines ITE as Pluggable Equipment Type A or B for purposes of applying different levels of requirements (e.g. leakage current limits).

Equipment having multiple ratings that is supplied with a detachable power supply cord and/or an appliance inlet may be used on multiple supply sources and, therefore, should be classified as both Pluggable Equipment Types A and B.

The more stringent of the applicable Pluggable Equipment Type A or B requirements should be applied to individual constructions.

OTHER:

Some European Countries base the definition on the plug ampere rating and the ampere ratings associated with the earth fault protection provided in the building installation.

SEE RELATED PAG:

PAG No. 1.2.8.7:001

(Sub)CLAUSE/ANNEX NUMBER: 1.2.8.7

(Sub)CLAUSE/ANNEX HEADING: Hazardous Energy Level

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1.4, 2.1.5

DESCRIPTION OF ISSUE:

When measuring stored energy or continuous power associated with hazardous energy levels:

a) Should component open/shorts be considered when determining maximum energy levels?

b) Should voltage tolerances of +6, -10% be used at the input power source?

APPLICATION GUIDELINE:

a) When determining maximum energy levels, component faults should not be considered.

b) Input power source voltage tolerances only should be considered when test results are borderline pass/fail.

RATIONALE:

a) This Standard offers no basis for conducting hazardous energy measurements under abnormal operating conditions.

b) Sound engineering judgment.

OTHER:

SEE RELATED PAG: 1.2.8.7:002

PAG No. 1.2.8.7:002

(Sub)CLAUSE/ANNEX NUMBER: 1.2.8.7

(Sub)CLAUSE/ANNEX HEADING: Hazardous Energy Level

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1.4, 2.1.5

DESCRIPTION OF ISSUE:

Part of the definition of a hazardous energy level is "an available continuous power level of 240 VA or more at a potential of 2 V or more." When taking a measurement to determine a "continuous power level," how long is considered continuous?

APPLICATION GUIDELINE:

To be considered a "continuous" hazardous energy level, 240 VA shall be available for 1 minute.

RATIONALE:

"Continuous" implies a sustained ability to supply power. Measuring the power level for 1 minute is considered reasonable and practical.

Additionally, Article 725 and Chapter 9, Tables 11(a) and 11(b) of the NEC define VA after 1 minute of operation.

OTHER:

SEE RELATED PAG: 1.2.8.7:001

PAG No. 1.2.14.7:001

(Sub)CLAUSE/ANNEX NUMBER: 1.2.14.7

(Sub)CLAUSE/ANNEX HEADING: Telecommunication Network

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 6.2.1.2

DESCRIPTION OF ISSUE:

What common "ISDN" and "public data" protocols generally can be expected to be used on networks meeting the telecommunication network definition and, therefore, be subjected to the requirements of Clause 6 of this Standard?

APPLICATION GUIDELINE:

The following types of digital/data communication protocols generally meet the definition of a telecommunication signal and will be used on networks meeting the telecommunication network definition because the network will have circuits with exposed plant leads:

a) ISDN (broadband/narrowband; BRI/PRI)
b) T1/T2/T3
c) DS1/DS2/DS3

These networks are associated with the TNV-1 definition.

Excluded are networks using fiber optics, because they are not metallically terminated.

This list is not all inclusive and some of the protocols may be designed into specific equipment which is not intended to have exposed plant leads. When considering transmission protocols, the installation practice specified by the manufacturer may be considered.

For example, it is possible that a manufacturer may specify that a T1 protocol is to be used on a network without exposed plant leads. Therefore, the equipment would not be subjected to Clause 6 requirements. Conversely, equipment with traditional non-telecommunication signals, such as the RS-232 signaling protocol, may include specifications to allow it to be connected to a network with exposed plant leads. Therefore, it would be subjected to Clause 6 requirements.

Equipment manufacturers will be consulted to determine the type of networks to which their equipment will be connected and a decision to apply Clause 6 should be made accordingly. Any decision made to apply or not to apply Clause 6 will be documented in the UL Report for future reference.

RATIONALE:

The definition of a telecommunication network states that it includes metallically terminated circuits intended to carry telecommunication signals for data or other communication, and that such networks may be subjected to overvoltages due to atmospheric discharges and power line failures.

The protocols specified above in the Application Guideline meet the telecommunication signal definition and, generally, are installed using installation practices meeting the telecommunication network definition.

However, these protocols may also be utilized in non-telecommunication network installations, i.e. no exposed plant leads, and therefore, at times, they may also be considered ordinary SELV circuits.

OTHER:

SEE RELATED PAG:

PAG No. 1.3.1:001

(Sub)CLAUSE/ANNEX NUMBER: 1.3.1

(Sub)CLAUSE/ANNEX HEADING: Equipment Design and Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When may equipment be shipped from a factory unassembled or disassembled to facilitate shipment?

APPLICATION GUIDELINE:

Equipment may be shipped from the factory unassembled or disassembled to facilitate shipment provided it meets all of the following conditions:

- All of the parts are furnished;
- Earthing continuity is maintained where required between the field-assembled components;
- The equipment is constructed so that field assembly can be accomplished without drilling, cutting, threading or any other alteration other than the attachment of field-installed electrical conduit or raceway; and
- The relationship between separate parts is established at the time of manufacture and shall not be dependent upon installation personnel.

RATIONALE:

Due to the size or complexity of some equipment (e.g. mainframe computers), manufacturers often ship equipment unassembled or disassembled. This practice is acceptable as long as the principles of safety associated with the Standard are maintained during and after assembly.

Also, in the BNWG Working Document, under Item 241, although the existing deviation was dropped, it states "The deviation represents present practice which will continue."

OTHER:

SEE RELATED PAG:

PAG No. 1.3.1:002

(Sub)CLAUSE/ANNEX NUMBER: 1.3.1

(Sub)CLAUSE/ANNEX HEADING: Equipment Design and Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Equipment is allowed to be shipped from a factory unassembled or disassembled to facilitate shipment.

Specifically, may a unit be shipped from a factory with a non-detachable power supply cord disassembled from the equipment, if it is done so to prevent damage to the power cord during shipment?

If yes, do the power cord internal terminations need to meet field wiring requirements (e.g. wire bending space)?

APPLICATION GUIDELINE:

A non-detachable power supply cord may be shipped from a factory disassembled, if:

a) There is a valid reason for doing so (e.g. possible damage to the power supply cord during shipment);

b) The assembly of the disassembled equipment is conducted by qualified service personnel;

c) There are no special tools or complicated assembly steps required (such as assembly of a Heyco strain relief bushing into a D-shaped opening requiring a special tool);

d) Detailed assembly instructions are provided that address all aspects of assembly, including connection of the main earthing connection;

e) The additional conditions of PAG 1.3.1:001 are met.

The power cord internal connections are not required to comply with field wiring requirements.

RATIONALE:

Manufacturers of mainframe computers and similar large equipment often ship power supply cords disassembled from the equipment because the power supply cords are very large, the cord lengths are long, and the cords may be damaged during shipping.

These reasons for shipping power supply cords disassembled from the equipment are considered valid if the other considerations outlined in the Guideline are confirmed.

The power supply cord terminations do not need to meet field wiring requirements because the wire gauge and cord type are known, and it is reasonable to assume that assembly of the power cord to the equipment in the field will be no different than the assembly that would take place at a manufacturing location.

OTHER:

SEE RELATED PAG: 1.3.1:001

PAG No. 1.3.3:001

(Sub)CLAUSE/ANNEX NUMBER: 1.3.3

(Sub)CLAUSE/ANNEX HEADING: Classification of Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.4.1, 1.2.4.2, 1.2.4.3

DESCRIPTION OF ISSUE:

May Class II equipment marked with the Class II (double-insulated) symbol be certified for use, and shipped with a Class I Listed power supply?

[For example, may a (double-insulated) Listed lap top computer with a Class II marking be shipped with a Listed Class I power supply?]

APPLICATION GUIDELINE:

If it can be determined that there are no safety related hazards associated with the Class I power supply being interconnected with a Class II product, and if both devices have individual Listing marks, the Class II symbol may be marked on ITE supplied with a Class I power supply.

RATIONALE:

Sub-clauses 2.5.2 and 2.5.4 permit interconnection of Class I and Class II products provided that there are no hazards associated with such interconnections. This situation, from a safety standpoint, is very similar to a Class II product receiving data from a data port which contains an earthed pin. Generally, there will be no safety related hazards associated with such an interconnection.

OTHER:

SEE RELATED PAG:

PAG No. 1.4:001

(Sub)CLAUSE/ANNEX NUMBER: 1.4

(Sub)CLAUSE/ANNEX HEADING: General Conditions For Tests

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Power supply manufacturers often design families of power supplies which have a basic PWB layout that can accommodate a variety of end use specifications through simple component changes. For example, a family of power supplies may be capable of having different output configurations, based on the number of windings incorporated into the isolation transformer and the addition or subtraction of components on a standard (single layout) PWB.

What considerations are valid for these large power supply families to minimize the amount of testing and to promote cost- and time-efficient power supply evaluations?

APPLICATION GUIDELINE:

The use of representative testing when evaluating families of power supplies which exhibit similar construction features and electrical ratings may be considered. When considering a representative test program, engineering judgment and input from the manufacturer should be used to consider the purpose of any particular test and the effects that representative testing may have on the determination that an entire power supply family complies with this Standard.

Although the number and range of considerations required to determine the extent of representative testing for any one power supply family will vary, there are some general considerations that may apply to most large-family power supply investigations.

For example, when evaluating a series of power supplies with identical primary circuitry and input ratings, the Input, Leakage Current, Earthing, Primary Component Failure, Electric Strength, Ball Pressure and Primary Circuit Working Voltage Measurement tests usually may be conducted on a representative basis with very little repeat testing necessary.

On the other hand, tests such as Heating, Transformer Overload, Secondary Component Failure and Output Overload may be significantly affected by changes in output circuitry and power supply loading and, generally, cannot be as readily accepted as being representative for a family of power supplies.

Summarized below are a number of general considerations that may be applied to a typical power supply family, which has identical primary circuitry and input ratings, but which has output circuits that vary in ratings and number. These general considerations are provided to indicate common considerations that apply to many evaluations of large power supply families, and to promote sound engineering judgment when conducting these investigations.

Input Test, Sub-clause 1.6:

The Input Test is primarily affected by the output ratings of the unit. Selecting a configuration with the greatest output rating and testing at maximum load should represent worst case testing for the series.

Primary Circuit Working Voltage Measurement Test, Sub-clause 2.2.7:

The Working Voltage Measurement Test in primary circuits generally is not affected by secondary circuitry modifications and representative testing may be done for models sharing a common primary circuit design. Some repeat testing may be required for designs with multiple output voltage configurations. Also, the effect of output circuit loading on working voltage measurements should be considered.

Earthing Test, Sub-clause 2.5.11:

If the power supply series uses the same earthing scheme and layout (e.g. main PWB secured by screws through PWB ground plane to metal chassis), a single test may be used to represent the entire series.

Heating Test, Sub-clause 5.1:

Heating test thermal measurements in the primary circuitry generally will be worst case when the configuration with the highest output VA rating is used for testing, typically corresponding to an output rating with the largest current component.

Individual transformer results may be affected by variations in output loading and transformer secondary winding constructions. It may be necessary to test more than one model to obtain transformer heating test results which are representative of the entire series.

Earth Leakage Current Test, Sub-clause 5.2:

The Leakage Current Test is affected by the voltage placed across the primary line-to-earth (Y) capacitance and the size of the capacitance. It is reasonable to test at the highest rated input voltage (with tolerances), the model having the largest Y capacitors as representative of the worst case. In particular, borderline pass/fail results should be given extra consideration due to common capacitor tolerances (up to 20% in some cases).

Electric Strength Test, Sub-clause 5.3:

Electric Strength Tests between primary circuit traces, primary circuits to dead metal and primary to secondary circuits, when the primary to secondary transformer construction is common between all models, may be performed on representative configurations. Tests between individual secondary circuits, and from secondary circuits to dead metal, usually will require individual or case by case evaluation.

Transformer Overload Test, Sub-clause 5.4.3:

The Transformer Overload Test generally is dependent on the transformer secondary winding construction. Variations on both the number and location of the secondary windings within the transformer may adversely affect the results of this test. Winding configurations should be considered when selecting models for representative testing.

Primary Component Failure Test, Sub-clause 5.4.6:

The Primary Component Failure Test is primarily affected by the design of the primary circuit and the input voltage. Generally, test results will not be affected by changes in output circuit configuration or secondary windings of the power transformer, provided that there is not a significant variation in total output VA.

Secondary Component Failure Test, Sub-clause 5.4.6:

The Secondary Component Failure Test is generally dependent on secondary winding construction and output circuit design and ratings. A comparison of secondary circuits can be used to determine the suitability of representative testing.

Output Circuit Overload Test, Sub-clause 5.4.6:

The Output Circuit Overload Test is dependent on secondary winding construction and output circuit design and ratings. A comparison of transformer and secondary circuits can be used to determine the suitability of representative testing.

Ball Pressure Test, Sub-clause 5.4.10:

The result of a Ball Pressure Test is dependent mostly on the temperature of individual components. Because of I5R considerations (i.e. the heating effect due to current being drawn through a component), generally the configurations selected for the Heating Test should be the ones which will demonstrate the worst case results.

* * * * *

When developing a representative test program for large families of power supplies, it is crucial that sound engineering judgement be used, and that basic assumptions and non-obvious engineering considerations are documented.

Furthermore, appropriate Conditions of Acceptability should be included in the corresponding UL Report that alert end-product project handlers to any critical decisions.

RATIONALE:

The intent of this Application Guideline is to allow representative testing of power supplies when such testing can be justified based on engineering judgment and the application of this Standard's requirements.

Sub-clause 1.4 outlines basic conditions for testing and specifies general considerations that apply to all product investigations to this Standard. However, at times it may be appropriate to go beyond the considerations outlined in Sub-clause 1.4 and use additional engineering judgment to limit the amount of representative testing required to determine compliance of a power supply family to this Standard. Certainly, Sub-clause 1.4 does not prohibit these considerations.

The UL position statement outlines basic considerations that may be used to make such judgments. These considerations, if used with sound engineering judgment, will help limit the time, samples and costs associated with evaluations of power supply families. The philosophy communicated in this Decision is justified, because redundant and unnecessary testing is being eliminated while sound engineering judgment is being used to determine that the worst case conditions have been tested.

OTHER:

SEE RELATED PAG:

PAG No. 1.4:002

(Sub)CLAUSE/ANNEX NUMBER: 1.4

(Sub)CLAUSE/ANNEX HEADING: General Conditions For Tests

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9

DESCRIPTION OF ISSUE:

Should ferrite cores used in transformers/inductors be considered conductive or non-conductive for the purpose of applying spacing requirements?

APPLICATION GUIDELINE:

Ferrite cores should be considered conductive for the purpose of applying spacing requirements.

Therefore, if a component is touching the ferrite core of a transformer or inductor, the entire core should be considered operating at the component's working voltage when applying spacing requirements around the core.

RATIONALE:

Because ferrite cores consist of a combination of powdered iron and non-conductive binding materials, they are not pure conductors of electricity. However, since no general assumptions may be made about ferrite cores and their general conductivity, and most ferrite cores begin to conduct electricity at voltages in the 100 — 300 V range, they should be considered conductive for the purposes of applying spacing requirements.

OTHER:

This guideline is compatible with the position taken by most other international safety certification agencies.

SEE RELATED PAG:

PAG No. 1.4:003

(Sub)CLAUSE/ANNEX NUMBER: 1.4

(Sub)CLAUSE/ANNEX HEADING: General Conditions for Tests

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When evaluating low-voltage products (e.g. graphic cards and modem cards) as Listed Accessories which are designed to be installed in multiple models of Listed personal computers and similar products, do the Listed Accessories need to be tested in every model of the Listed equipment that they can be used in?

APPLICATION GUIDELINE:

If the Listed Accessory is a low-voltage product or a modem, i.e. it does not connect directly to the primary supply mains, testing, if required, can typically be performed in a representative end-use piece of equipment.

RATIONALE:

For end-use Listed equipment, since a Heating Test is conducted at maximum load and an Overload Test is conducted on cardcage connectors that supply power to unused card slots, representative testing of the Accessory in a typical end-use product will be adequate in most cases.

OTHER:

SEE RELATED PAG:

PAG No. 1.4.7:001

(Sub)CLAUSE/ANNEX NUMBER: 1.4.7

(Sub)CLAUSE/ANNEX HEADING: Temperature Measurement Conditions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.1, 5.4.6, 5.4.9, B.3, C.1

DESCRIPTION OF ISSUE:

What test environment (e.g. bench or oven) should be used to conduct tests that have pass/fail criteria based on maximum temperatures or maximum temperature rises?

APPLICATION GUIDELINE:

The recommended test environment used to conduct tests that have pass/fail criteria based on maximum temperatures or maximum temperature rises is a laboratory test bench placed in a 10 — 40°C room ambient, i.e. typical laboratory environment.

The tests should be conducted in accordance with the applicable sub-clause test specifications and the results should be adjusted in accordance with Sub-clause 1.4.7.

If requested by a manufacturer (e.g. during factory testing), a simulated operating environment (e.g. oven) may be used to conduct any required testing with pass/fail criteria based on maximum temperatures or maximum temperature rises. In such cases, oven air temperature should be documented. Level of oven air-circulation, oven humidity and sample placement in the oven should not affect results, but need not be documented.

RATIONALE:

The test environment that will provide the most consistent and repeatable results for UL 1950 testing with pass/fail criteria based on maximum temperatures or temperature rises is a test bench located in a typical laboratory ambient. Sub-clause 1.4.7 clearly indicates that temperature results may be adjusted to compensate for anticipated increased ambient temperatures (i.e. Tmra) during actual use.

If standard practice was to conduct any test, such as the Heating Test, in an oven, consideration would have to be given to requiring all tests (e.g. Transformer Overload and Motor Locked Rotor Testing) with similar pass/fail criteria in an oven. Taking this position would be impractical.

Furthermore, conducting tests in an oven adds additional expense and time-delay to projects and does not necessarily provide more valuable or useful data.

OTHER:

SEE RELATED PAG:

PAG No. 1.5:001

(Sub)CLAUSE/ANNEX NUMBER: 1.5

(Sub)CLAUSE/ANNEX HEADING: Components

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.2, 2.9.4, 4.2.2, 4.2.6, 5.3

DESCRIPTION OF ISSUE:

What considerations are applicable to accessible Light Emitting Diodes (LEDs) that are located in Hazardous Voltage circuits, including Primary circuits?

APPLICATION GUIDELINE:

An accessible LED which is located in a Hazardous Voltage circuit shall:

(a) Be rated for its working voltage.
(b) Comply with Solid Insulation requirements per Sub-clause 2.9.4 for Reinforced insulation from the outside of the lens to the internal circuit.
(c) Comply with Electric Strength requirements per Sub-clause 5.3 for Reinforced insulation from the outside of the lens to the internal circuit.
(d) Comply with the Stress Relief test per Sub-clause 4.2.6.
(e) Comply with a 30 N Steady Force test per Sub-clause 4.2.2, modified to apply to an external surface.

The LED does not need to be subjected to a Steel Ball test per Sub-clause 4.2.4 aimed directly at the lens of the LED.

The LED will be controlled by manufacturer and part number. The LED does not need to be subjected to further UL Follow-Up Service, nor do the individual LED materials or construction need to be controlled. However, consideration should be given to controlling any associated circuit components (e.g. limiting resistor) which may be influencing the engineering considerations being applied to the LED.

RATIONALE:

The subject construction is being submitted on a more frequent basis. Rather than reject the construction outright, the above guidelines attempt to permit the construction if the basic principles of this Standard are adhered to.

The Steel Ball test is not necessarily designed to be directed at individual components.

Applying a modified 30 N steady force test rather than the normal 250 N test is more reasonable and practical, considering typical surface area and enclosure opening sizes associated with accessible LEDs.

OTHER:

A CCA Decision (EE(Chm) 1/94 10.10) on the same topic requires compliance with Sub-clause 2.9, but does not require the Steel Ball Test per Sub-clause 4.2.4.

SEE RELATED PAG:

PAG No. 1.5.2:001

(Sub)CLAUSE/ANNEX NUMBER: 1.5.2

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

May a component be used in ITE if it is used outside the range of the component's electrical rating? For example, can a power supply rated only 120 V be used in ITE rated 100 V — 120 V?

APPLICATION GUIDELINE:

Although the use of components within their ratings and compatible with the end-use equipment ratings is encouraged, components used outside of their ratings can be accepted if the level of additional investigation required is practical and if it can be determined that the component used outside of its ratings will not contribute to a hazardous condition. This determination may involve repeating some component testing at the new ratings and/or increasing the amount of end product testing.

Note: Using a component rated 120 V in an end use product rated 100 V — 120 V is considered a reasonable level of investigation that can be adequately done as part of the end-use investigation. However, using a component rated 120 V in an end use product rated 240 V would not be considered a practical (and sound) type of investigation, since there are numerous safety-related issues, most which would have to be addressed directly with the component manufacturer. It would be more practical and sound for the end product to incorporate a suitably rated component, or for the component manufacturer to have the component re-evaluated for the higher rating.

RATIONALE:

The third dashed paragraph of Sub-clause 1.5.2 permits consideration of components used outside of their electrical ratings. If it can be determined through a thorough and sound evaluation that a hazard does not exist when the component is used outside of its electrical rating, the component may be accepted in the end-use product.

OTHER:

SEE RELATED PAG:

PAG No. 1.5.3:001

(Sub)CLAUSE/ANNEX NUMBER: 1.5.3

(Sub)CLAUSE/ANNEX HEADING: Transformers

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex C.2

DESCRIPTION OF ISSUE:

Transformers with metallic foil windings (primary or secondary) are constructed with the external transformer leads either welded or soldered to the metallic foil windings.

For winding applications, are compatibility of foil and lead materials with respect to corrosion, and the placement and securement of the leads to the foil, issues needing special attention?

APPLICATION GUIDELINE:

For winding applications, the compatibility of metallic foil windings and transformer lead terminations with respect to corrosion resistance need not be evaluated.

For winding applications, special consideration to the location and termination of the leads to the foil is not needed as long as general clearance and creepage distance requirements are adhered to. Spot welding and soldering typically are acceptable without further evaluation.

However, for foil used as a metallic shield in transformer protective earthing applications, full compliance with Sub-clause 2.5 is required, including corrosion considerations.

RATIONALE:

The Annex J material compatibility requirements were developed for materials generally found in protective earthing systems. They do not consider material typically found in foil windings of transformers. Since the Standard does not contain specific requirements for transformers with foil windings, the general earthing requirements should not be applied to non-earthing applications. It is assumed that transformer manufacturers address the material compatibility requirements for windings as part of the overall transformer design process.

Additionally, there is no indication through reported field incidents that securement/placement of transformer leads to metallic foil windings is a problem. Furthermore, special considerations have not been applied to transformer magnet wire terminations to external leads. Applying special considerations to foil windings would be inconsistent with the considerations applied to other transformers.

For protective earthing applications, such as windings used for compliance with Method 2 of Sub-clause 2.3.3, concern with corrosion is valid.

OTHER:

SEE RELATED PAG:

PAG No. 1.5.3:002

(Sub)CLAUSE/ANNEX NUMBER: 1.5.3

(Sub)CLAUSE/ANNEX HEADING: Transformers

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2, 2.9.4, 5.3

DESCRIPTION OF ISSUE:

For tape used as interleaved insulation in transformers, what are the material requirements?

APPLICATION GUIDELINE:

Tape is suitable for transformer interleaved insulation provided that:

a) It is made of common generic materials, such as glass cloth, polyester film, PVC, PTFE, aramid paper, polyamide, etc., or any other material meeting the considerations in the first paragraph of 2.2.2;

b) It is not hygroscopic (Sub-clause 2.2.2);

c) It meets required electric strength, creepage distance, clearance, distance through insulation, and heating requirements (Sub-clause 2.2.4); and

d) The generic material and thickness are confirmed during normal Follow-Up Service.

Use of Recognized Component Insulating Tapes (OANZ2) is not required although it may be beneficial when determining Item d) above.

RATIONALE:

Precedence in the Electronic Data Processing Equipment and Office Appliance Business Equipment categories has been to accept generic materials for insulating tape. Absence of documented field problems indicates that this practice continues to be adequate for UL 1950. Placement of the Standard for Insulating Tape, UL 510, in Mandatory Annex P.1 is not intended to apply to transformer constructions.

OTHER:

SEE RELATED PAG:

PAG No. 1.5.3:003

(Sub)CLAUSE/ANNEX NUMBER: 1.5.3

(Sub)CLAUSE/ANNEX HEADING: Transformers

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2, 2.9.4, 5.3, 5.4.10

DESCRIPTION OF ISSUE:

For transformer bobbins that are considered Class A (105) insulation systems, what are the material requirements and are there any special tests required?

APPLICATION GUIDELINE:

A bobbin material does not need to be subjected to any special considerations to determine its insulation properties if it has a minimum thickness of 0.71 mm (per the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C, Section 9) and the bobbin temperature does not exceed a 65°C rise (90°C maximum).

If the material is less than 0.71 mm thick, the material should be subjected to special consideration to determine the adequacy of its insulation properties, such as that outlined in Table 9.1 of UL 746C. Per Section 9 of UL 746C, at its Recognized thickness, the insulating material should have suitable electrical properties, and should not achieve a temperature exceeding it's RTI (electrical).

A bobbin aging test is not required.

The Ball Pressure Test can be waived if the material is used within its RTI.

The V-2 flammability requirement for internal materials can be waived.

RATIONALE:

Most Class A (105) transformer bobbins of adequate thickness may be subjected to a generic test program similar to the one that has been used under UL 114 and UL 478 for the past 30 years, without requiring the use of generic materials. If a bobbin material meets UL 1950 heating and electric strength requirements, and it is not hygroscopic, the generic evaluation outlined above is considered adequate for most basic insulation used in Class (105) applications, as long as it has a minimum thickness of 0.71 mm.

Based on a past history of minimal, if any, failures resulting from bobbin aging testing, this testing is no longer considered necessary, nor is the Ball Pressure Test if the material is used within its Recognized RTI.

Also considered is that many Recognized Component Electrical Insulation Systems are permitted to use HB materials and are common in UL 1950 products. Also, most transformer bobbins would contribute negligible fuel to a fire and established precedence has not shown this position to cause problems in the field.

OTHER:

Most international certification agencies require the Ball Pressure Test on all constructions. Most international certification agencies do not establish criteria for accepting bobbins used as insulators, other than Humidity Conditioning, Distance Through Insulation, Electric Strength and Ball Pressure Testing.

SEE RELATED PAG:

PAG No. 1.5.4:001

(Sub)CLAUSE/ANNEX NUMBER: 1.5.4

(Sub)CLAUSE/ANNEX HEADING: High-Voltage Components

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.2

DESCRIPTION OF ISSUE:

For high voltage components (e.g. flyback transformers, deflection yokes, etc.) used in low power applications, such as monitors, do insulation requirements in Sub-clause 2.2.2 need to be applied in addition to Sub-clause 1.5.4?

APPLICATION GUIDELINE:

Sub-clause 2.2.2 is applicable. However, based on past experience evaluating these components and considering their common electrical characteristics and insulating materials, this Standard's test program, which includes Heating and Electric Strength testing, provides enough information to make a decision as to whether the component and its materials meet Sub-clause 2.2.2.

RATIONALE:

The rationale for Sub-clause 1.5.4 in the Subjects 478 (114) meeting report ("White Book") dated March 15, 1988, which implies additional component requirements other than those contained in the Standard are not required for high-voltage components.

OTHER:

SEE RELATED PAG: 1.5.4:002

PAG No. 1.5.4:002

(Sub)CLAUSE/ANNEX NUMBER: 1.5.4

(Sub)CLAUSE/ANNEX HEADING: High Voltage Components

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.2

DESCRIPTION OF ISSUE:

High voltage components (e.g. flyback transformers) often are evaluated with a number of alternate materials for each component part (e.g. L.V./H.V. bobbin, case, etc). It is often costly and impractical to conduct testing on each alternate material. Is testing always required on alternate materials in high voltage components?

APPLICATION GUIDELINE:

Alternate materials in high voltage components will not always require testing. Generally, the original generic material will always be tested, but alternate materials will not require testing, as long as they are of the same generic material with equal or better electrical and temperature ratings, and the component design does not change.

Plastics in high voltage components will be controlled in the descriptive Reports as:

> R/C (QMFZ2), generic material designation, temperature rating, minimum 94V-2, minimum thickness.

RATIONALE:

Due to the use of common materials with similar characteristics, there is justification for controlling generic properties of high voltage component materials. Based on past experience and no known field problems with interchanging similar materials, testing of alternate materials, if similar, is not deemed necessary.

OTHER:

SEE RELATED PAG: 1.5.4:001

PAG No. 1.5.6:001

(Sub)CLAUSE/ANNEX NUMBER: 1.5.6

(Sub)CLAUSE/ANNEX HEADING: Mains Capacitors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.8.1, Annex P (1.5.6, 2.2.8.1)

DESCRIPTION OF ISSUE:

What are the component requirements for capacitors in the Primary bridging Operational, Basic, Double or Reinforced insulation?

APPLICATION GUIDELINE:

1. Capacitors (X) bridging Operational Insulation (connected between phase-phase or phase-neutral) — Required by Sub-clause 1.5.6 to comply with X-capacitor requirements in IEC 384-14. Alternatively, per Annex P.2, if suitably rated, may comply with Double Protection Requirements in the Standard for Across-the-Line, Antenna-Coupling, and Line-By-Pass Capacitors for Radio- and Television-Type Appliances, UL 1414 (or CSA No. 1).

   Components certified by other agencies may be accepted per the UL component acceptance policy (Subject 1950 Bulletin dated October 25, 1994, and March 16, 1995).

2. Capacitors bridging Reinforced or Double insulation (Pri-SELV) — Required by Sub-clause 2.2.8.1 to comply with Y- (or U-) capacitor requirements in IEC 384-14. Alternatively, per Annex P.2, if suitably rated, may comply with UL 1414 (or CSA No. 1) Double Protection Requirements.

   Components certified by other agencies may be accepted per the UL component acceptance policy (Subject 1950 Bulletin, dated October 25, 1994, and March 16, 1995).

3. Capacitors (Y) bridging Basic insulation — Required to comply with Electric Strength test for Basic insulation.

   Non-recognized capacitors accepted by performance testing may be described by manufacturer, part number and ratings without additional Follow-Up Service.

RATIONALE:

The Standard contains specific requirements for capacitors based on the type of insulation they bridge.

Based on the UL component acceptance policy (outlined in the referenced Bulletins), components determined to meet IEC standards by other safety certification agencies may be accepted by UL if UL has determined that the other agencies have acceptable testing capability (technical) and follow-up surveillance for the components that they certify (Certification).

For basic insulation established precedence since the 1980's permits acceptance of capacitors without UL Recognition or additional UL Follow-Up Service when subjected to end product performance requirements.

OTHER:

SEE RELATED PAG: 1.5.6:002, 1.5.6:003, 1.5.6:004

PAG No. 1.5.6:002

(Sub)CLAUSE/ANNEX NUMBER: 1.5.6

(Sub)CLAUSE/ANNEX HEADING: Mains Capacitors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.8

DESCRIPTION OF ISSUE:

For Y-capacitors connected between line and earth, Sub-clause 1.5.6 does not contain component requirements. May Y-capacitors be accepted generically and be controlled by UL component category and electrical ratings in the UL FUS Procedure?

APPLICATION GUIDELINE:

Typical ITE filter capacitors (X/Y) are Component Recognized Electromagnetic Interference Filters (FOKY2) or Across-The-Line Capacitors, Antenna Coupling and Line-By-Pass Components (FOWX2).

FOKY2 capacitors subjected to working voltages up to 130 Vrms may be controlled generically in UL FUS Procedures by CCN and electrical ratings.

FOKY2 capacitors subjected to working voltages up to 250 Vrms and serving as Operational Insulation also may be controlled generically, if a supplementary protection device (e.g. fuse) is protecting the capacitor in case of a short circuit of the capacitor.

FOKY2 capacitors subjected to working voltages up to 250 Vrms and serving as Basic Insulation also may be controlled generically, if the equipment is subjected to a Production Line Dielectric Voltage Withstand Test between Primary and chassis at 1500 V.

FOWX2 capacitors subjected to working voltages up to 130 Vrms may be controlled generically in UL FUS Procedures by CCN and electrical ratings.

FOWX2 capacitors subjected to working voltages up to 250 Vrms also may be controlled generically, if the casing is not relied upon as Basic or Operational Insulation, or an additional layer of insulation meeting Basic Insulation requirements is sleeved over the capacitor.

RATIONALE:

UL 1283 (FOKY2) requires insulation between live parts and casings to pass a 2Vr+1500V (Vrating $\leq$ 250 V) electric strength test, which is compatible with this Standard.

UL 1283 (FOKY2) only requires a 1250 V (Vrating $\leq$ 250 V) electric strength test between parts of opposite polarity. Although this test value does not meet this Standard's Operational/Basic insulation electric strength requirements for working voltages higher than 130 Vrms, (a) for Operational insulation UL 1950 permits short circuit testing to determine the suitability and it can be assumed a fuse located before a FOKY2 capacitor will open, and (b) for Basic insulation an adequate Primary-Earth Production line test will help assure compliance with Basic insulation requirements. Furthermore, most X and Y Capacitors comply with International component capacitor requirements which are more stringent than UL requirements.

UL 1414 (FOWX2) requires an electric strength test of 1250 V (Vrating ≤ 125 V) or 1500 V (Vrating ≤ 250 V) between parts of opposite polarity. This requirement meets this Standard's Operational and Basic insulation requirements.

However, for ratings above 130 Vrms, UL 1414 (FOWX2) does not subject capacitor casings to an electric strength test that is compatible with this Standard. Therefore, the casings of these capacitors cannot be considered acceptable for operational or basic insulation, unless there is adequate air spacings around the casing or suitable sleeving is placed on the capacitor.

OTHER:

Additional criteria are applicable to X capacitors and capacitors bridging Double or Reinforced insulation. See Sub-clause 1.5.6 and Sub-clause 2.2.8, respectively.

SEE RELATED PAG: 1.5.6:001, 1.5.6:002, 1.5.6:003

PAG No. 1.5.6:003

(Sub)CLAUSE/ANNEX NUMBER: 1.5.6

(Sub)CLAUSE/ANNEX HEADING: Mains Capacitors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2, 2.2.8.1

DESCRIPTION OF ISSUE:

What insulation level may the casing of Certified X1, X2, X3, Y1, Y2, and Y3 capacitors to IEC 384-14, and Recognized Component — Electromagnetic Interference Filters (FOKY2) Across-The-Line Capacitors, Antenna Coupling and Line-By-Pass Components (FOWX2), be relied upon to act as?

APPLICATION GUIDELINE:

Capacitor casings of acceptably Certified X1, X2, X3, Y1, Y2, or Y3 capacitors to IEC 384-14 may be accepted as Operational or Basic insulation when the capacitors are used in circuits compatible with their ratings. Therefore, these capacitors do not need to be provided with an additional, definable insulation level when the capacitor casing is acting as Basic or Operational insulation. (Y1 capacitors may be accepted as Reinforced insulation also.)

Capacitor casings of Recognized Component — Electromagnetic Interference Filters (FOKY2) may be accepted as Operational or Basic Insulation when the capacitors are used in circuits compatible with their ratings. Therefore, these components do not need to be provided with an additional, definable insulation level when the capacitor casing is acting as basic or operational insulation.

Capacitor casings of Across-The-Line Capacitors, Antenna Coupling and Line-By-Pass Components (FOWX2) only may be accepted as Operational or Basic insulation when the circuit working voltage is 130 Vrms or less. If provided in circuits with working voltages above 130 Vrms, these components need to be provided with an additional, definable insulation level, such as Recognized Component — Tubing, when adequate clearances are not provided between the capacitor casing and another component or an earthed dead metal part.

RATIONALE:

Under IEC 384-14, X1, X2, X3, Y2, and Y3 capacitors are subjected to a minimum Electric Strength Test of 2000 V rms between live parts and case. Y1 capacitors are subjected to a 4000 V test. (Y4 are only subjected to a 900 V test).

For Recognized Component (FOKY2) (UL 1283) capacitors, the insulation between live parts and casing is required to pass a 2Vr+1500V (Vrating $\leq$ 250 V) electric strength test. Additionally, the case is required to be 94V-2 or less flammable (or equivalent), and meet UL 746C (or generic) insulation requirements.

For Recognized Component (FOWX2) (UL 1414) capacitors, the insulation between live parts and the case is only required to pass a 1000 V electric strength test. This value meets UL 1950 electric strength test requirements for basic and operational insulation only for working voltages of 130 Vrms and less, but is not compatible with the 1500 V test required for working voltages above 130 Vrms.

OTHER:

Compatible with CCA Decision 97/1 on 1.5.1.

SEE RELATED PAG: 1.5.6:001, 1.5.6:002, 1.5.6:004

PAG No. 1.5.6:004

(Sub)CLAUSE/ANNEX NUMBER: 1.5.6

(Sub)CLAUSE/ANNEX HEADING: Mains Capacitors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2

DESCRIPTION OF ISSUE:

Electrolytic capacitors typically incorporate an aluminum can covered by a layer of insulation (e.g. PVC, mylar).

May the insulation provided on electrolytic capacitors be relied upon as any level of insulation (basic/supplementary/reinforced) against risk of electric shock, or must an additional and separate layer of insulation be added to such constructions?

APPLICATION GUIDELINE:

The integral insulation provided on electrolytic capacitors generally may not be relied upon as a level of insulation against electric shock.

Manufacturers of products with creepage/clearance deficiencies involving the body of electrolytic capacitors have the option of adding an additional and separate insulation level that meets the requirements of Sub-clause 2.2.4 (and related sub-clauses), or having the integral capacitor insulation evaluated to meet the same requirements. The second option would require the capacitor insulation to be subjected to UL Follow-Up Service.

Compliance with creepage/clearance requirements may require an additional level of insulation to be added to the electrolytic capacitor in the form of Recognized Component — Electrical Extruded Tubing (YDPU2), Processed Tubing (YDRY2), or Miscellaneous Tubing (YDTU2).

RATIONALE:

Since the internal construction and insulation of electrolytic capacitors cannot be controlled, the aluminum enclosure is considered a live part. Since electrolytic capacitors are not required to be Component Recognized and the integral insulation is not evaluated as an insulator, any integral insulation provided on electrolytic capacitors cannot be relied upon as an insulator in compliance with the Standard without further consideration.

Manufacturers have the option of either adding an additional level of insulation that is subjected to UL Follow-Up Service, or having the integral insulation investigated for compliance with the Standard's insulation requirements. If the integral insulation is investigated, it should also be subjected to UL Follow-Up Service (e.g. Special Component (C) Procedure Volume).

This position is consistent with the need to assure continued compliance of products after type testing.

OTHER:

CCA Decision 95/8 on 2.9 only allows capacitor insulation to serve as basic insulation if it complies with IEC 384-14.

SEE RELATED PAG: 1.5.6:003

PAG No. 1.6.1:001

(Sub)CLAUSE/ANNEX NUMBER: 1.6.1

(Sub)CLAUSE/ANNEX HEADING: Input Current

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.1

DESCRIPTION OF ISSUE:

Are supply voltage tolerances (e.g. +6,-10%) considered when determining compliance of ITE with power rating marking requirements, in particular input current?

APPLICATION GUIDELINE:

Supply tolerances are not considered when determining compliance with power rating marking requirements.

RATIONALE:

The compliance statement of Sub-clause 1.6.1 specifically indicates that compliance is checked at "each rated voltage" or at "each rated voltage range". Therefore supply tolerances shall not be considered when determining compliance with power rating marking requirements.

OTHER:

SEE RELATED PAG:

PAG No. 1.7:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7

(Sub)CLAUSE/ANNEX HEADING: Markings and Instructions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

May the "exclamation point in a triangle" symbol (ISO 3864, No. B.3.1) be used in place of specific markings required by the Standard if the specific wording is provided in the user's operation manual?

For example, may the symbol "exclamation point in a triangle" be used instead of the marking required by Sub-clause 1.7.9 when two power supply cords are incorporated into the equipment.

APPLICATION GUIDELINE:

Symbols may only replace specific wording indicated in the standard if there is an established symbol (e.g. per IEC 417) already designated for the instruction and the symbol is fully explained in the manual.

The IEC symbol "exclamation point in a triangle" is not acceptable because it does not identify a specific hazard but only refers the user to the operator's manual.

RATIONALE:

The standard includes specific markings and wording to address specific hazards. The ISO 3864 symbol "exclamation point in a triangle" is not considered adequate to replace specific messages conveyed by specific wording or symbols.

OTHER:

SEE RELATED PAG:

PAG No. 1.7:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7

(Sub)CLAUSE/ANNEX HEADING: Marking and Instructions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For Listed Accessories that may be installed within other Listed equipment thus loosing their identity, is a manufacturer's name and product designation allowed to be placed on the accessory equipment packaging, and may the Accessory Listing Mark as described on the Listing Mark Data Page also be included on the accessory packaging?

APPLICATION GUIDELINE:

The Accessory Listing Mark may be located on the accessory equipment packaging if the manufacturer's name and product designation are provided on the packaging (rather than the product).

If the manufacturer and product designation are located on the accessory equipment, the Accessory Listing Mark also shall be on the equipment.

RATIONALE:

The above guidelines establish UL certification requirements. Equipment that looses its identity when installed in other equipment does not need to be easily identifiable as being separately Listed. Equipment which does not loose its identity when installed in/with other equipment shall be easily identifiable as being separately Listed.

OTHER:

SEE RELATED PAG:

PAG No. 1.7:003

(Sub)CLAUSE/ANNEX NUMBER: 1.7

(Sub)CLAUSE/ANNEX HEADING: Marking and Instructions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 6.2.2.1

DESCRIPTION OF ISSUE:

When evaluating low power products (e.g. graphics cards and modem cards) as Listed Accessories which are designed to be installed in multiple models of Listed personal computers, does every end-use Listed equipment need to be specified in the Listed Accessory Installation Instructions, i.e. "For use only with IBM AT Model XXXX, Compaq Model YYYY and Epson Model ZZZZ personal computers?"

APPLICATION GUIDELINE:

If a reasonable level of confidence exists that the Listed Accessory will only be installed in a specific class or configuration of equipment (e.g. personal computer with enclosed power supply), a detailed list of specific computers does not need to be included as part of the Listed Accessory Installation Instructions. However, since the accessory is to be used only with Listed personal computers and since there is a concern with accessibility within the card cage of constructions evaluated to the Standard for Electronic Data Processing Units and Systems, UL 478, 4th Edition, a general statement should be clearly provided within the Listed Accessory Installation Manual such as "This graphics card is for use only with IBM AT or compatible UL Listed personal computers that have Installation Instructions detailing user installation of card cage accessories."

RATIONALE:

The approach specified above is a practical method of addressing the installation of Listed Accessories in the increasing number of personal computers Listed to this Standard. This Installation Instruction will also provide a degree of confidence that if a manufacturer submitted a personal computer to UL 478, the manufacturer took some responsibility for considering user access of a card cage area.

OTHER:

SEE RELATED PAG: 6.2.2.1:002

PAG No. 1.7.1:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.1

(Sub)CLAUSE/ANNEX HEADING: Power Rating

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.2

DESCRIPTION OF ISSUE:

For products that consist of a Listed Class 2 Power Unit (e.g. Direct Plug-in Transformer Unit) in combination with a low voltage device (e.g. digitizer, small notebook computer, etc.), must the electrical ratings of the low voltage device be marked on the device?

APPLICATION GUIDELINE:

If the Listed Class 2 Power Unit is shipped with the product, the voltage rating of the low voltage device does not need to be marked on the device.

If the Listed Class 2 Power Unit is not shipped with the product and instructions are being used to select a suitable Listed Class 2 Power Unit, the voltage rating should be marked on the low voltage device.

RATIONALE:

If the rating marking is conveying useful information, the marking should be marked on the low voltage device.

If the Listed Class 2 Power Unit is provided with the low voltage device, the marking is not conveying useful information and, therefore, is not required.

If the Listed Class 2 Power Unit is not provided with the low voltage device, the marking may be used during the correct selection of a suitable Listed Class 2 Power Unit and, therefore, is required.

OTHER:

SEE RELATED PAG: 1.7.2:001

PAG No. 1.7.1:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7.1

(Sub)CLAUSE/ANNEX HEADING: Power Rating

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.1.2, 1.2.11, 1.4.5

DESCRIPTION OF ISSUE:

Sub-clause 1.7.1 requires a marking of the rated voltage(s) or rated voltage range(s). The definitions of rated voltage (1.2.1.1) and rated voltage ranges (1.2.1.2) both indicate that they are values "as declared by the manufacturer." Sometimes equipment will be marked with a rated voltage, but will have an additional operating (voltage) range declared in the operation manual. For example, equipment may be marked 120 V/240 V, but an operation manual may state an "operating range" of 90 — 125 V/180 — 250 V.

How should "marked ratings" versus otherwise "declared ratings" be considered, especially with regard to determination of supply tolerances?

APPLICATION GUIDELINE:

Sub-clause 1.7.1 requires manufacturers to mark "rated voltage(s) or rated voltage range(s)" on their product. This marking is the base rating and should not be in conflict with any other declarations, either marked on the product or presented in the operation manual. However, the need for a marked rating does not prohibit a manufacturer from declaring other ratings for purposes of communicating supply tolerances.

If marked with a rated voltage range, additional tolerance considerations are not required. The rated voltage range is assumed to include tolerance considerations.

However, if marked with a rated voltage, either (a) standard +6%, -10% tolerances are assumed, (b) other declared tolerances must be declared, or (c) a rated voltage range, which includes tolerances, must be declared. In all cases, there shall not be a conflict between marked and other declared ratings.

For the example provided above, testing of the product should be conducted at 90 — 125 V/180 — 250 V, and not 120/240 V with additional tolerances. Tolerances would be considered inclusive to the declared rated voltage range.

The UL Report will specify the marked rated voltage or voltage range, and whether additional declared ratings, such as those provided in the operation manual, were also considered.

RATIONALE:

Supply tolerances are factored into the Standard's performance testing to simulate variations in utility supply voltages. The need for tolerance considerations are documented in utility power quality studies, such as ANSI C84.1.

Since Sub-clause 1.4.5 only requires tolerances to be considered for a "rated voltage" and not a "rated voltage range," supply tolerances are considered inclusive to a declared rated voltage range.

Therefore, it is permissible for a manufacturer to mark a rated voltage on the equipment and also declare a rated voltage range in the operation manual for purposes of communicating acceptable supply tolerances. The declared rated voltage range would be considered to include tolerances, and additional tolerances would not be required to be applied to the marked rated voltage.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.1:003

(Sub)CLAUSE/ANNEX NUMBER: 1.7.1

(Sub)CLAUSE/ANNEX HEADING: Power Rating

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Devices, such as a keyboard, that are not directly connected to the mains are not required to be marked with either a voltage or current rating. Although not required, if the equipment is provided with a current rating (e.g. 12 V dc, 1.2 A), must the current rating be accurate?

APPLICATION GUIDELINE:

If equipment is marked with a rating, whether required or not, the rating should be accurate. The measured current should be within 110% of the marked rating per Sub-clause 1.6.1.

RATIONALE:

Even if not required, all electrical ratings marked on Listed or Recognized equipment should be accurate, partly because the UL Mark indicates that UL evaluated the product. This approach is consistent with the current UL philosophy for most product categories.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.2:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.2

(Sub)CLAUSE/ANNEX HEADING: Safety Instructions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.1

DESCRIPTION OF ISSUE:

What general guidelines should be followed when manufacturers want to ship Class III products (e.g. digitizers) without a Listed Class 2 Power Unit (e.g. Direct Plug-In Transformer Unit)?

APPLICATION GUIDELINE:

The operation manual must provide simple instructions for the correct selection of a suitable Listed Class 2 Power Unit, including a statement such as "This product is intended to be supplied by a Listed Direct Plug-In Power Unit marked "Class 2" and rated from 12 to 15 V dc, 200 to 300 mA." Essential elements are category name, "Class 2," and electrical rating. Manufacturer and model number are not required and no correlation marking is required on the Class III product. An input test should be conducted to verify that the recommended supply is not overloaded.

RATIONALE:

Today's consumer has more experience around electronic equipment and, therefore, should be able to follow the instructions. The Standard assumes that operators and users can follow basic instructions.

OTHER:

SEE RELATED PAG: 1.7.1:001

PAG No. 1.7.2:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7.2

(Sub)CLAUSE/ANNEX HEADING: Safety Instructions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.3.2, 1.4.9

DESCRIPTION OF ISSUE:

When reviewing end product installation instructions, if instructions are identified that describe the installation of accessories that are not UL Listed or Listed Accessories, are manufacturers required to modify the instructions to address only the installation of Listed accessories or, alternatively, to remove the references to these accessories?

[The types of accessories addressed in this Application Guideline are accessory cards, modems cards, mouses, etc.]

APPLICATION GUIDELINE:

For most applications the manufacturer is not required to submit an optional accessory for Listed Accessory coverage or to remove all accessory references from an installation/operation manual. The exception is an accessory that poses an obvious safety hazard (e.g. mains connected accessory) if it were to be installed incorrectly or unsafely.

Although evaluation may not be required for all Listed Accessories, the consequences of the installation of any accessory should be considered to determine that the installation of the accessory is not likely to pose a hazard during its installation. For example, the effect of loading should be considered, or the impact of the instructions instructing the user to enter the electrical enclosure.

RATIONALE:

Manufacturers cannot be required to submit accessories for Listing or Listed Accessory coverage, since many accessories are manufactured by independent manufacturers, and the submittal of the accessory for Listing or Listed Accessory coverage is generally not the end product manufacturer's responsibility. In addition, industry practice is to design products to accept common accessories.

Nevertheless, even though manufacturers cannot be required to submit accessories for evaluation as Listed Accessories, a determination should be made whether or not the installation of any accessory is likely to pose a risk to the user during installation, or use.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.3:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.3

(Sub)CLAUSE/ANNEX HEADING: Short Duty Cycles

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.2.1, 1.2.2.2, 1.2.2.3, 1.2.2.4, 1.2.2.5, Annex L

DESCRIPTION OF ISSUE:

May equipment be marked with a rated operating/rest time marking (short duty cycle) to comply with performance requirements of this Standard if the design of the equipment makes it reasonable to assume that the marking will be ignored? An example would be a paper copier marked "operating/rest time: 15 min/5 min".

APPLICATION GUIDELINE:

If it is reasonable to assume that the rated operating/rest time marking will be ignored during normal operation, the instructions on this marking should not be considered during the determination of normal load conditions for performance testing.

If the equipment complies with performance requirements without the instructions on the rated operating/rest time marking being considered, then this marking is non-essential and its use is up to the discretion of the manufacturer.

RATIONALE:

When the short-time or intermittent marking is applied to equipment to comply with the Standard's performance requirements, it must be reasonable to assume that the instructions on the marking will be followed (e.g. the equipment has a momentary power switch). If the marking is likely to be ignored, such as with a copier that can be operated for long periods of time without operator attendance, the marking should not be permitted to be used to comply with performance requirements.

OTHER:

SEE RELATED PAG: L:001, L:002, L:003

PAG No. 1.7.4:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.4

(Sub)CLAUSE/ANNEX HEADING: Mains Voltage Adjustment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For equipment provided with a voltage adjustment switch, if a marking is provided on the equipment that meets the intent of the first sentence of Sub-clause 1.7.4, is the equipment also required to be supplied with additional instructions describing voltage adjustment?

[An example of this construction is a non-autoranging power supply rated 120 V/240 V that is supplied with an accessible power select switch clearly marked "120 V/240 V".]

APPLICATION GUIDELINE:

If the voltage adjustment marking addresses the same concern that specific instructions would address, instructions in addition to the marking are not required. The example described above would not require additional instructions.

However, if the equipment was rated 100 — 120 V/200 — 240 V, and the switch was marked "120 V/240 V", additional instructions that clarify voltage selection would be required in the service manual or installation instructions. In this case the marking does not match the equipment rating, thus the marking may not address all safety concerns related to the correct adjustment of the voltage select switch.

When instructions are required, they will be controlled in the UL descriptive report with a summary statement in the Construction Details. The exact instructions normally do not need to be controlled in the report unless there is a unique feature of the adjustment that needs to be addressed and requires additional control.

RATIONALE:

For equipment with straightforward methods of voltage selection and which have a marking that addresses basic concerns with adjustment, it is not reasonable to require detailed instructions to be supplied in the service manual or installation instructions. Sub-clause 1.4.1 allows the reconsideration of requirements where safety is not involved.

For more complex equipment or for equipment with markings that may not address all safety concerns, there is justification for requiring that additional instructions be provided with the equipment.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.6:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.6

(Sub)CLAUSE/ANNEX HEADING: Fuses

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex NAA (1.7.6)

DESCRIPTION OF ISSUE:

For fuses that are relied upon for safety but that are located in a sealed compartment (e.g. welded, riveted shut or encapsulated), may the fuse rating marking normally required by Sub-clause 1.7.6 be waived if the entire compartment has to be returned to the manufacturing facility for fuse replacement?

APPLICATION GUIDELINE:

The standard does not allow special consideration for fuses located in sealed compartments and/or repaired at a manufacturing or service facility. Therefore, a fuse marking meeting the intent of Sub-clause 1.7.6 normally should be provided. An "unambiguous cross reference" to service documentation is also permitted for some constructions.

If the sealed component is a "throw-away when damaged" component and the manufacturer can provide evidence that the component will not be repaired, engineering judgment may be used to determine the need for a marking. A component that is riveted shut or a component requiring a special tool to open is not automatically considered a "throw-away when damaged" component.

RATIONALE:

The standard does not allow special consideration to be given for fuses which are relied upon for safety but which are located in sealed compartments. Although sealed, some components may still be repaired at the manufacturing facility or a service outlet, thus requiring the fuse marking is justifiable.

However, if the manufacturer can provide evidence that a fuse will not be replaced because the power supply or unit is a "throw away when damaged" component, then use of engineering judgment may allow the marking requirement to be waived.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.6:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7.6

(Sub)CLAUSE/ANNEX HEADING: Fuses

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex NAA (1.7.6)

DESCRIPTION OF ISSUE:

Sub-clause 1.7.6 states that a "marking shall be located on, or adjacent to, each fuseholder" specifying the rated current and rated voltage of each fuse. Per Annex NAA (1.7.6), if located in an operator-serviceable area, a fuse replacement statement is also required.

Do 1.7.6 fuse marking requirements apply to all fuses provided in ITE or only to those fuses that are relied upon for safety?

APPLICATION GUIDELINE:

The markings required per Sub-clause 1.7.6 only apply to fuses relied upon for safety.

In the context of this requirement, "relied upon for safety" means a fuse that opened during testing, or that has been otherwise determined to be used to prevent the risk of electrical shock, energy or fire. For example:

Abnormal Condition Testing (5.4) — A fuse is relied upon for safety if the fuse protects a circuit or component during:

a) Component Abnormal Testing per Sub-clause 5.4.6. (Note: a fuse is considered to protect a circuit or component if it opened during UL testing, testing conducted by the manufacturer, or if tests were waived because the fuse was in the circuit); or

b) Motor Overload Testing per Annex B; or

c) Transformer Overload Testing per Annex C.

Limited Power Source (2.11) — A fuse is relied upon for safety if the fuse is used to meet the Limited Power Source definition and Table 9.

RATIONALE:

Although most fuses are relied upon for safety, some equipment may have fuses that are not required for the equipment to comply with the Standard. Because Sub-clause 1.4.1 indicates that, for any sub-clause, requirements should only be applied if safety is involved, engineering judgment may be used to determine if the fuse is required for safety.

In cases where the fuse does not open during testing, or specific component Abnormal Operation Tests may not have been selected, the fuse may still be protecting the circuit, and in such cases it is appropriate to apply the requirement. If questionable, relevant testing should be conducted and the requirement should be applied accordingly.

OTHER:

SEE RELATED PAG:

PAG No. 1.7.8.3:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.8.3

(Sub)CLAUSE/ANNEX HEADING: Symbols

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.8.1

DESCRIPTION OF ISSUE:

What is a working definition of a "stand-by" condition?

APPLICATION GUIDELINE:

For purposes of applying this Standard, a "stand-by" condition exists when part of the equipment is energized and is performing an "active" function while the main (power) switch is in the equipment-off position.

Examples of stand-by conditions include copier machines which energize primary-connected heating elements (resistors) during equipment-off periods to prevent the accumulation of humidity inside the copier enclosure, and computers which charge internal battery packs while the main switch is in the "off" position.

RATIONALE:

Some switches have the appearance of being a disconnect device or power-off switch, but do not completely disconnect the equipment from the supply. For equipment with such switches, the equipment may be energized for a specific function, and this function may have safety-related implications.

When making a determination if a true "stand-by" condition exists or does not exist, electrical schematics and the general operation of the product should be reviewed and understood.

OTHER:

This working definition of a "Stand-by" condition differs from the traditional power-based definition, which associates a Stand-by condition as a condition where a separate source of power is made available in lieu of, or as a supplement to, the usual source of supply. Additional clarification by IEC TC74 may be needed.

See CCA Decision on 1.7.8 (EA(GB)3/93).

SEE RELATED PAG: 1.7.8.3:002, 1.7.8.3:003, 1.7.8.3:004

PAG No. 1.7.8.3:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7.8.3

(Sub)CLAUSE/ANNEX HEADING: Symbols

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.8.1

DESCRIPTION OF ISSUE:

Considering the working definition of a "stand-by" condition, when is the use of the stand-by symbol (IEC 417, No. 5009) required or restricted?

APPLICATION GUIDELINE:

To avoid confusion with a true "off" or "disconnect" condition, the "stand-by" symbol (IEC 417, No. 5009) should be used to indicate the "off" position instead of the "Off" or "O" whenever a condition exists that meets the working definition of a "stand-by" condition <u>and</u> safety is involved.

For example, in some copiers where primary-connected heater resistors are energized in the "off" position to prevent humid air from accumulating inside the copier, a switch marked |/O may mislead an operator into believing that all power is disconnected while the heater draws power. Service personnel may also believe that all power is disconnected while primary components remain energized. Such a switch, rather than marked "|" and "off" or "O", should be marked with "|" and the "stand-by" symbol. Safety clearly is involved.

In some lap-top computers where a battery is trickle-charged by an SELV circuit during "off" conditions, safety may not be involved and more flexibility is permitted. Although the battery may be trickle-charging, there is little chance that the Operator or Service Personnel would be injured due to a misinterpretation of the switch marking. Furthermore, due to abnormal operation condition testing that is conducted on the battery charging circuit as part of the equipment evaluation, the chance that a fire could start is remote. Therefore, the switch may be marked |/O, on/off, | or on/stand-by, or nothing at all.

In cases where all equipment functions are "off" in the switch-off position except passive functions (e.g. energization of filter circuitry due to switch location on load side of filter), the unit switch should be marked "off" or "O" and not stand-by. The circuitry should also be guarded as required by Sub-clause 2.6.4.

RATIONALE:

Some switches have the appearance of being a disconnect device or power-off switch, but do not completely disconnect the equipment from the supply. For equipment with such switches, the equipment may be energized for a specific function, and this function may have safety-related implications.

The copier example is one where a "|"/"O" marking may be misleading and, potentially, could cause injury to service personnel. A hazard is much less likely to occur with the lap top computer example and, therefore, more flexibility may be permitted.

When making a determination if a true "stand-by" condition exists or does not exist, electrical schematics and the general operation of the product should be reviewed and understood.

OTHER:

SEE RELATED PAG: 1.7.8.3:001, 1.7.8.3:003, 1.7.8.3:004

PAG No. 1.7.8.3:003

(Sub)CLAUSE/ANNEX NUMBER: 1.7.8.3

(Sub)CLAUSE/ANNEX HEADING: Symbols

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.8.1, 2.6.8

DESCRIPTION OF ISSUE:

For switches and controls located in the primary, when must they be marked "|"/"O" to indicate "ON" and "OFF" conditions?

APPLICATION GUIDELINE:

Per 2.6.8, switches and controls which are considered the main disconnect device shall be marked "|"/"O". Also, if a switch is located in the primary and it affects safety, e.g. it controls hazardous moving part, it shall be marked "|"/"O". Other switches which do not affect safety, including primary and secondary controls, do not need to be marked "|"/"O", although this is the preferred method of indicating on and off positions. In some cases, if the intent or function of a switch is not clear, additional explanation in the safety instructions may be justified.

RATIONALE:

Sub-clause 1.7.8.1, by nature of its qualifier "affecting safety," allows engineering judgment to be used to determine which switches are required to be marked "|"/"O". The standard specifically states disconnect devices must be marked "|"/"O", but does not state that all switches and controls must be marked "|"/"O". Also, 1.7.8.3 indicates that it is "permitted" to use the "|"/"O" symbols for any primary switches, not necessarily mandated. Engineering judgment should be used to determine if the switch is likely to be used to prevent or to avoid a hazard.

OTHER:

SEE RELATED PAG: 1.7.8.3:001, 1.7.8.3:002, 1.7.8.3:004

PAG No. 1.7.8.3:004

(Sub)CLAUSE/ANNEX NUMBER: 1.7.8.3

(Sub)CLAUSE/ANNEX HEADING: Symbols

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.8.1, 2.6.8

DESCRIPTION OF ISSUE:

For disconnect devices and other switches affecting safety, whether located in the primary or secondary, may the on and off positions be marked "ON"/"OFF" instead on "|"/"O"?

APPLICATION GUIDELINE:

The on and off positions for disconnect devices and other devices affecting safety must be marked "|"/"O".

If a switch is determined not to affect safety, it may be marked "ON"/"OFF" or with any other similar instruction.

RATIONALE:

Sub-clause 1.7.8.1 clearly states that markings used to indicate the functions switches control shall be comprehensible without a knowledge of languages. Since "ON"/"OFF" is an English language instruction, this indication for the on and off positions of disconnect devices and similar switches affecting safety is not in compliance with the standard.

OTHER:

SEE RELATED PAG: 1.7.8.3:001, 1.7.8.3:002, 1.7.8.3:003

PAG No. 1.7.15:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.15

(Sub)CLAUSE/ANNEX HEADING: Durability

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex P.2 (1.7.15)

DESCRIPTION OF ISSUE:

Since UL 969 (and CSA No. 0.15) are in Annex P.2, the use of marking and labeling complying with these Standards is not mandated.

For required markings that are provided labels not evaluated per UL 969, and for other types of markings (e.g. silk-screening, ink stamping, decals, etc.):

a) Is testing always required per Sub-clause 1.7.15?

b) Will the specific material, adhesive and/or ink that the marking is made of, always be controlled in the UL descriptive report?

c) Is annual Follow-Up Service testing required on non-Recognized labels?

APPLICATION GUIDELINE:

a) Testing may not be required if, by sound engineering judgement, the marking has the physical appearance of being permanent and it obviously would comply with the specified compliance criteria. Also, if it is not located in an external area where it is likely to be cleaned with a cleaning solution, rubbed, etc., waiving of testing in general is justified.

b) Generally, it is not practical to control material, adhesive, ink, etc. A generic description (e.g. pressure sensitive label secured by adhesive) is adequate. Testing per Sub-clause 1.7.15 and Test Record documentation is considered adequate. However, the marking tested should be a production sample and not a prototype.

c) Annual Follow-Up Service testing is not required on non-Recognized labels.

RATIONALE:

Most manufacturers are using labels which are Recognized Components or are using a method of labeling, such as silk-screening, which is considered permanent. For other markings for which permanence is uncertain and for which testing is required, Test Record documentation is considered adequate to document compliance with the Standard and detailed Follow-Up Service control of specific label material, adhesive, and ink is not considered crucial because of the minimal associated hazard.

OTHER:

Some international certification agencies require components of a label tested per 1.7.15 to be controlled by manufacture/material type, including label material, ink, adhesive.

SEE RELATED PAG:

PAG No. 1.7.17:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.17

(Sub)CLAUSE/ANNEX HEADING: Replaceable Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.3.21

DESCRIPTION OF ISSUE:

Conditions of Acceptability for Recognized Component Lithium Batteries (BBCV2) evaluated to UL 1642 have a specific wording for required markings and instructions. Often the wording contained in the Conditions of Acceptability is more stringent than the wording described in Sub-clause 1.7.17.

When determining a suitable wording for ITE lithium battery markings and instructions, which wording should be used?

APPLICATION GUIDELINE:

The wording provided in Sub-clause 1.7.17 generally should take precedence over that provided in individual component lithium battery Conditions of Acceptability.

RATIONALE:

Sub-clause 1.5.1 indicates that a component requirement that is superseded by a requirement in this Standard need not comply with the specific component requirement. Since the wording of the marking provided in Sub-clause 1.7.17 generally addresses the same concerns as the lithium battery Conditions of Acceptability, the requirements of this Standard are considered to supersede the battery Conditions of Acceptability.

OTHER:

SEE RELATED PAG: 1.7.17:002

PAG No. 1.7.17:002

(Sub)CLAUSE/ANNEX NUMBER: 1.7.17

(Sub)CLAUSE/ANNEX HEADING: Replaceable Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.3.21

DESCRIPTION OF ISSUE:

Battery marking and/or instruction requirements apply to "replaceable" batteries, in particular replaceable lithium batteries.

What is a "replaceable" versus a "non-replaceable" battery?

APPLICATION GUIDELINE:

If the manufacturer anticipates replacement of the battery over the life of the product, the battery is considered a replaceable battery. Such a battery does not necessarily have to be easily replaceable, i.e. provided in a battery holder. It may be soldered-in and still be considered replaceable.

Examples of replaceable batteries include the following:

a) A battery contained in a battery holder located in an Operator Access Area and intended to be replaced by an Operator or Service Personnel if the battery goes bad.

b) A battery contained in a battery holder located in a Service Access Area and intended to be replaced by Service Personnel if the battery goes bad.

c) A battery soldered to a motherboard and having its operation status monitored by the computer. An Instruction (message or error code) is sent to the Operator (or Service Personnel) if the battery goes bad and needs replacement.

The only time that a battery is not considered "replaceable" is if it is expected by the ITE manufacturer to last the life of the product, and its existence is "invisible" to the Operator, i.e. a message on the monitor screen, or the ITE's User instructions do not indicate that it should be replaced if it goes bad.

RATIONALE:

Sub-clause 1.7.17 does not indicate that all batteries need replacement instructions, only "replaceable" lithium batteries. If a battery may be replaced over the life of the product, whether the battery is provided in a battery holder or is soldered in, the battery should be considered a replaceable battery and subject to the replacement requirements of Sub-clause 1.7.17.

OTHER:

See CCA Decision 95/13 on 1.7.17.

SEE RELATED PAG: 1.7.17:001

PAG No. 1.7.18:001

(Sub)CLAUSE/ANNEX NUMBER: 1.7.18

(Sub)CLAUSE/ANNEX HEADING: Operator Access with a Tool

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For power supplies located in user access areas of personal computers and similar equipment, if the same tool that can be used to gain access to the user access area can be used to open the power supply and access hazardous voltage parts, is the marking described in Sub-clause 1.7.18 required to be marked on the power supply?

APPLICATION GUIDELINE:

If the same tool, e.g. a screwdriver, that is used to open a computer's user access area can also open the power supply, potentially exposing the user to hazardous live parts, the marking described in Sub-clause 1.7.18 is required.

Exempt from this requirement are applications where the power supply has to be completely removed from the equipment to access the screws or other fastening means to open the cover. In such cases, power generally has to be disconnected from the power supply before the cover can be opened.

During component Recognition of power supplies and similar components, if the component is likely to be installed in a user access area, manufacturers will be informed of this requirement and the appropriate marking should be added. Alternatively, a Condition of Acceptability may be added to the Component Recognition Report.

RATIONALE:

Sub-clause 1.7.18 requires a marking alerting the user to stay out of certain areas near a user access area if the user is instructed to enter a user access area and could mistakenly open other covers leading to hazardous voltage areas.

This scenario is possible with personal computers and similar equipment that have user access areas which are opened with a common tool, e.g. a screwdriver. Therefore, the potential hazard should be addressed.

Logical exceptions are constructions where the hazardous area cannot be accessed unless the hazardous area or part is removed from the equipment, requiring de-energization of the part.

OTHER:

SEE RELATED PAG:

PAG No. 2.1.3.2:001

(Sub)CLAUSE/ANNEX NUMBER: 2.1.3.2

(Sub)CLAUSE/ANNEX HEADING: Hazardous Voltage Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1.2, 2.9.4, 3.1.5, 4.2.2

DESCRIPTION OF ISSUE:

A common construction within personal computers (PCs) and similar ITE is for a power switch to be located in a separate area than the enclosed power supply, and for the power switch to be interconnected to the power supply by a flexible cord or a wiring harness. The primary circuit connected power switch and accessible conductors are located in an Operator Access area.

What are the special construction and performance considerations for this common construction?

APPLICATION GUIDELINE:

Sub-clause 2.1.3.2 requires that operator accessible wiring at Hazardous Voltages meet the requirements of 2.9.4 (distance through insulation) and 3.1.5 (wiring electric strength considerations) for Double or Reinforced insulation.

The insulation over the switch terminals (typically shrink tubing) also shall meet a level of requirements equivalent to that required for the wiring.

Generally, the mechanical considerations applicable to the wiring or the switch terminal insulation include (a) 0.4 mm DTI per 2.9.4 and (b) a 30 N steady force test per 4.2.2, including a pull (strain relief-type test) on the wire.

RATIONALE:

The common construction described above may be evaluated to the requirements in.the Standard. In particular, Sub-clause 2.1.2 allows the construction and Sub-clause 2.1.3.2 outlines the specific requirements for such constructions.

Note: The Standard does not address assumptions about components needing repair or replacement. Generally, UL will expect that components and parts (including shrink tubing), if needing replacement during the life of the product, will be replaced with like components and constructions.

OTHER:

SEE RELATED PAG:

PAG No. 2.1.4.2:001

(Sub)CLAUSE/ANNEX NUMBER: 2.1.4.2

(Sub)CLAUSE/ANNEX HEADING: Protection in Restricted Access Locations

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.7.3, 2.1.2

DESCRIPTION OF ISSUE:

Sub-clause 2.1.4.2 provides relaxation of some operator accessibility requirements in "Restricted Access Locations."

May special consideration be given to the application of operator accessibility requirements, in particular the application of the test pin (Fig. 20), to equipment installed in other areas, such as a commercial environment or a computer room?

APPLICATION GUIDELINE:

Special consideration may not be given to application of operator accessibility requirements, including the test pin, other than the considerations allowed in UL 1950 for restricted access locations.

RATIONALE:

Although UL 1950 exempts the application of the test pin inside external electrical enclosures, and relaxes some other accessibility requirements for equipment installed in restricted access locations, it does not mention other exemptions based on other equipment locations. Further relaxation of the written requirement would fall outside of the intent of IEC 950/UL 1950.

OTHER:

SEE RELATED PAG:

PAG No. 2.1.10:001

(Sub)CLAUSE/ANNEX NUMBER: 2.1.10

(Sub)CLAUSE/ANNEX HEADING: Discharge of Capacitors in the Primary Circuit

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

If equipment with a mains-connected filter capacitor exceeding 0.1 pF has a fuse located in the circuit between the capacitor and its bleeding resistor, should the time-constant determination be measured with the fuse opened?

APPLICATION GUIDELINE:

The time constant measurement should be taken with the fuse opened, isolating the capacitor from its bleeding resistor.

RATIONALE:

The purpose of the requirement is to prevent a risk of electric shock from stored charge on capacitors connected to the mains circuit. If an operator or service person disconnects the mains supply plug after a fuse blows, there could be a risk of electric shock on the plug pins if the capacitor is not discharged. Therefore, a large filter capacitor should not be separated from its bleeding resistor by a fuse.

OTHER:

This position is consistent with TC74 Chairman's Advisory Panel's (Question 8) position.

SEE RELATED PAG:

PAG No. 2.1.10:002

(Sub)CLAUSE/ANNEX NUMBER: 2.1.10

(Sub)CLAUSE/ANNEX HEADING: Discharge of Capacitors in the Primary Circuit

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When determining compliance of equipment to Sub-clause 2.1.10, the test specifications state that "any capacitor having a marked or nominal capacitance exceeding 0.1 pF" complies with the requirement if it has a means of discharge resulting in a time constant not exceeding specified values.

If equipment has no single capacitor exceeding 0.1 pF but has parallel capacitors that may exceed 0.1 pF when considered together, should the circuit be tested?

APPLICATION GUIDELINE:

Unless it is obvious that there is not a circuit capacitance greater than 0.1 pF, the capacitance discharge test described in the sub-clause should be conducted. The fact that a single capacitor may not exceed 0.1 pF should not restrict the test from being conducted.

RATIONALE:

Although the test specification specifies "any capacitor having a marked or nominal capacitance capacitor exceeding 0.1 pF," the intent of the requirement is to determine that the circuit capacitance of the circuit does not pose a hazard at the external point of disconnection, especially since parallel capacitors have additive capacitance. Therefore, the investigation and test program should address all questionable constructions with a circuit capacitance greater than 0.1 pF.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.2:001

(Sub)CLAUSE/ANNEX NUMBER: 2.2.2

(Sub)CLAUSE/ANNEX HEADING: Properties of Insulating Materials

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex P.2 (Insulating Materials)

DESCRIPTION OF ISSUE:

Sub-clause 2.2.2 indicates that the choice of application of an insulating material shall take into account the needs for electrical, thermal and mechanical strength, frequency of the working voltage, and working environment, including temperature, pressure, humidity and pollution.

When determining the suitability of an insulating material, what is the level of investigation required on the material to determine compliance of the material with Sub-clause 2.2.2?

APPLICATION GUIDELINE:

To determine compliance of an insulating material with Sub-clause 2.2.2, some level of evaluation of the material other than the basic tests required by the Standard is required. As a general rule, for UL investigations, the insulating material should meet the applicable performance criteria established for insulators found in Sections 8 and 9 of the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C.

To meet all other UL 1950 insulating material requirements, the insulating material shall meet the applicable creepage, clearance distance, distance through insulation (2.9), heating (5.1), electric strength (5.3), and ball pressure (5.4.10) requirements outlined in UL 1950.

The most straight forward method for determining compliance is for the insulating material to be UL Component Recognized at the thickness used in the application, and for the material to have suitable electrical properties per Table 9.1 of UL 746C.

RATIONALE:

Sub-clause 2.2.2 specifies characteristics that need to be taken into account when determining the suitability of insulating materials.

This topic was discussed at the April 1996 meeting of the Bi-National Working Group (BNWG). As documented in the February 6, 1997 meeting report "it was agreed that humidity and electric strength testing, alone, are not sufficient to determine suitability of a material as an insulator." Therefore it was agreed to provide UL 746C in Annex P.2 as one method of determining compliance with insulating materials with all condition in the first paragraph of Sub-clause 2.2.2. Other equivalent methods may be considered.

Since the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C, is the UL reference standard for determining the suitability of electrical properties associated with insulating materials, it will be promoted for UL 1950 investigations.

OTHER:

Most international certification agencies accept insulating materials based purely on Humidity Conditioning, Distance Through Insulation, Electric Strength and Ball Pressure Testing, ignoring the other consideration outlined in the first paragraph of 2.2.2.

SEE RELATED PAG: 2.2.2:002

PAG No. 2.2.2:002

(Sub)CLAUSE/ANNEX NUMBER: 2.2.2

(Sub)CLAUSE/ANNEX HEADING: Properties of Insulating Materials

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Annex P.2 (2.2.2 — Insulating Materials) indicates that the following materials are considered acceptable for the support of uninsulated live parts: slate, porcelain, phenolic, or cold-molded composition, unfilled polycarbonate, unfilled nylon, nylon filled with inorganic compounds, melamine, melamine-phenolic, and urea formaldehyde.

What is the significance of using these materials (compared to other materials) as insulation used for the support of uninsulated live parts?

APPLICATION GUIDELINE:

The materials listed above are considered "grandfathered" materials when used as insulators and are inherently considered to meet the intent of the first paragraph of Sub-clause 2.2.2. That is, they may be used for support of live parts without further investigation. The only stipulation is that, to be considered "grandfathered materials", and thus not requiring further evaluation, they must be used at a minimum thickness of 0.71 mm.

If the materials listed above are used as insulators at thicknesses below 0.71 mm thickness, the materials may be used, but they are no longer considered "grandfathered" materials. Thus, they should be subjected to further evaluation, such as a determination that they comply with the applicable requirements in the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C (Section 9).

RATIONALE:

The "grandfathered" materials listed in Annex P.2, if used at suitable thicknesses, are considered by nature of their historical use generically suitable for the insulation of live parts without further consideration. Therefore, at minimum 0.71 mm minimum thickness, they are not required to be subject to additional evaluation to meet the first paragraph of Sub-clause 2.2.2.

However, the same level of confidence does not exist in the ability of these materials to act as insulators of uninsulated live parts when used at thicknesses below 0.71 mm. Therefore, further investigation is required, typically to Section 9 of UL 746C.

OTHER:

SEE RELATED PAG: 2.2.2:001

PAG No. 2.2.2:003

(Sub)CLAUSE/ANNEX NUMBER: 2.2.2

(Sub)CLAUSE/ANNEX HEADING: Properties of Insulating Materials

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For line chokes and inductors, when determining compliance of their insulation to heating test requirements, do Class A (105) limits apply?

APPLICATION GUIDELINE:

When choke and inductor insulation, including bobbins and interleaved insulation, is acting as operational insulation, there are no specific RTI requirements for materials operating below Class A (105) limits.

For insulating materials operating above Class A limits, the acceptability of the insulation material is to be determined based on (a) the overall size of the component and whether it would contribute to a fire if it caught fire, (b) whether it is mounted on V-1 printed wiring, or is separated from more flammable components by either 13 mm of air or a solid V-1 material, and (c) whether it is operating within the RTI (either generic or Recognized Component) of the material.

RATIONALE:

When insulation of line chokes and similar inductors is classified as Operational insulation, the concern with overheating of the component insulation is not as great as with transformers which serve as a level of protection against electric shock. Therefore, materials used in such constructions are considered acceptable as long as they are of limited size, are spaced away from more flammable materials, and the temperatures achieved by the component are below Class A (105) limits, or below the Relative Thermal Index (RTI) of the insulation materials.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.2:004

(Sub)CLAUSE/ANNEX NUMBER: 2.2.2

(Sub)CLAUSE/ANNEX HEADING: Properties of Insulating Materials

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.3

DESCRIPTION OF ISSUE:

Sub-clause 2.2.2 specifies that hygroscopic material shall not be used as insulation. The test specification indicates that compliance should be determined by an evaluation of material data and, if such data does not confirm the hygroscopic nature of the material, compliance is to be determined by the humidity test described in Sub-clause 2.2.3.

What is a practical level of investigation required to determine if an insulating material is hygroscopic?

APPLICATION GUIDELINE:

Generally, if a material is UL Recognized and has been subjected to humidity testing as part of its UL Recognition, humidity testing per Sub-clause 2.2.3 is not required.

Since a majority of the insulation used in ITE is either Recognized Component — Plastic (QMFZ2) or Insulating Tape (OANZ2), humidity testing often will not be required.

If insulation is not UL Recognized, the insulation may require testing. However, engineering judgement should be used to keep the amount of testing to a minimum. For example, if a transformer is constructed using a variety polyester web tapes that are not Recognized, a single humidity test on a single polyester web test to determine compliance with humidity test requirements is generally adequate.

If practical, testing should be conducted on components or sub-assemblies (e.g. transformer or insulation sheet), rather than on complete equipment.

RATIONALE:

Because materials that absorb moisture have decreased dielectric properties as a result of the moisture absorption, the use of hygroscopic materials in ITE is not permitted.

However, the standard does allow a review of "material data" to determine if a material is hygroscopic. Since much of the insulation material used in ITE is UL Recognized, if a humidity test has been conducted as part of the Recognition of the material, the test does not need to be repeated.

For Recognized Component — Plastics that have been subjected to electrical property testing as part of their component recognition, a stringent humidity test (96 hrs, 95% RH) is conducted as pre-conditioning to material dielectric testing. Since a large amount of insulation is UL Recognized with electrical property testing, humidity testing is conducted as part of the component Recognition. A review of the recognition report may help to determine the suitability of the material.

For Recognized Component Insulating Tapes, a humidity test (96 hrs, 95% RH) is typically conducted when the tape is suitable for damp locations. Therefore, a humidity test is not required for any tape that is suitable for damp (or wet) locations and that has adequate dielectric ratings. The suitability of tape can be determined by reviewing the tape Conditions of Acceptability.

Note 1: From a practical standpoint, the concern being addressed by humidity testing was more prevalent in the past, especially with regard to transformers, when practice was to use large linear transformers with paper and wood-based insulation systems. Due to the size of these transformers and the subsequent amount of material that was likely to be subjected to absorption of moisture, determining the suitability of the construction by humidity testing was valid.

Considering modern designs, where industry practice is to use switching transformers with polymeric-based insulation systems, the concern with absorption of moisture by insulation systems is not as significant.

Additionally, even transformers with paper or fiber-based insulators are adequately treated with compounds that make the material moisture resistant.

Note 2: Tracking across insulation due to build-up of moisture on the insulation is not the concern being addressed by the sub-clause. Therefore all results achieved that indicate non-compliance should be investigated to determine that failures are not due to surface tracking.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.5:001

(Sub)CLAUSE/ANNEX NUMBER: 2.2.5

(Sub)CLAUSE/ANNEX HEADING: Insulation Parameters

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.4, 2.9, 5.3

DESCRIPTION OF ISSUE:

Most open frame power supplies and similar components have internally generated working voltages which exceed the nominal mains supply voltage of the component.

When mounted in an end product, should (a) spacings between a component with internal working voltages exceeding the mains supply voltage and the rest of the end product, and (b) corresponding electric strength test voltages be based on the highest working voltage in the component rather than the nominal mains supply voltage?

APPLICATION GUIDELINE:

The spacings between a component with working voltages exceeding the nominal mains supply voltage and the rest of the end use product, and corresponding electric strength test voltages, should be based on the highest working voltage in the component and not the nominal mains supply voltage.

The specific information on the highest measured working voltage documented during the component investigation and associated with the component should be communicated to the end product engineer through an appropriate Condition of Acceptability in the component UL Report.

RATIONALE:

When a component is mounted in an end product and is to be subjected to end product testing, it is not always easy to determine if internally generated working voltages exceed the nominal ratings of the component. Spacings could be compromised if the actual working voltage is not known, and spacings and electric strength evaluations are not based on the highest working voltage.

For example, an open frame power supply which is mounted on a flat, earthed dead metal enclosure is required to meet insulation requirements between the bottom of the power supply (i.e. pwb traces) and the dead metal. The spacings, and corresponding electric strength test voltages, should be based on the actual working voltage of the power supply and not the nominal supply voltage. A Condition of Acceptability in the UL Component Report is the easiest way to communicate this information.

On the other hand, a fully enclosed power supply, such as one found in a typical PC, does not introduce additional spacings considerations when installed in the end product. In this case the integral working voltages of the power supply are not critical information and a Condition of Acceptability is not warranted.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.7:001

(Sub)CLAUSE/ANNEX NUMBER: 2.2.7

(Sub)CLAUSE/ANNEX HEADING: Determination of Working Voltage

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.9.6

DESCRIPTION OF ISSUE:

When determining a working voltage that an insulation system will be subjected to, should single fault conditions be considered?

APPLICATION GUIDELINE:

Single fault conditions should not be considered when measuring working voltages.

RATIONALE:

The definition of working voltage per Sub-clause 1.2.9.6 specifies that it is the highest voltage the insulation is subjected to "under conditions of normal use." There is no justification for taking measurements under single fault conditions.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.7:002

(Sub)CLAUSE/ANNEX NUMBER: 2.2.7

(Sub)CLAUSE/ANNEX HEADING: Determination of Working Voltage

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Power supply working voltage (and SELV reliability) measurements may be greatly affected by the power supply circuit reference(s) maintained during testing. For example, if a power supply is intended to have its output returns earthed, but the output returns are floating during working voltage measurements, the measurements taken during the component evaluation may be inaccurate compared to actual working voltages that will be present after end product installation.

What considerations are valid for working voltage measurements with respect to circuit referencing and the need to consistently make and document accurate measurements?

APPLICATION GUIDELINE:

Component power supply manufacturers who design power supplies for installation in a variety of end products should specify the input and output circuit reference requirements for a particular power supply being submitted under this Standard. This information should be recorded on the data sheet package under "conditions of test," and the power supply should be tested per the manufacturers specifications.

The circuit reference requirements used to determine compliance of a component power supply to this Standard should then be documented as an installation condition in a Condition of Acceptability (C of A) for the power supply. It then is the responsibility of the end product engineer to verify that the power supply is installed in accordance with the C of A. If the power supply is not installed in accordance with the C of A, additional end product evaluation of the power supply may be necessary.

If a power supply manufacturer requests not to specify reference configurations for input and output circuits, multiple sets of Working Voltage and SELV reliability measurements will be needed under all possible circuit reference conditions. Again, the test conditions should be documented as installation considerations in a Condition of Acceptability.

RATIONALE:

Input and output circuit referencing may have a significant effect on the accuracy of working voltage measurements, and could affect other tests such as component fault testing. In fact, if the input and output circuit reference schemes used during a component power supply evaluation are not adhered to when the power supply is installed in an end product, the measurements and tests made during the component investigation may not be valid in the end product. Clearance/creepage distances or insulation provided in the power supply and accepted on the component level may be inadequate for the potentials present in the end use application. This concern is applicable to all switching power supplies, i.e. ac-dc, dc-dc, etc.

Since it may be difficult to predict circuit reference conditions which will generate worst case Working Voltage and SELV Reliability measurements, the manufacturer should be given the responsibility of defining the circuit referencing scheme(s) that is appropriate for the power supply.

By documenting the power supply circuit references used in the component evaluation, the suitability of the power supply in the end product installation can be determined and additionally the need for additional end product working voltage measurements which are needed to verify compliance with the standard can be determined.

OTHER:

SEE RELATED PAG:

PAG No. 2.2.8.3:001

(Sub)CLAUSE/ANNEX NUMBER: 2.2.8.3

(Sub)CLAUSE/ANNEX HEADING: Double or Reinforced Insulation Bridged by Components — Accessible Parts

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.4

DESCRIPTION OF ISSUE:

Capacitors are allowed to bridge reinforced or double insulation, i.e. Pri — SELV, provided that they meet certain conditions. One such condition is that "accessible parts shall comply with the requirements in Sub-clause 2.4 Limited Current Circuits." For compliance with the current limitations in Sub-clause 2.4.2, where should this measurement be taken?

APPLICATION GUIDELINE:

Although Sub-clause 2.2.8.3 states that compliance is determined at "accessible parts", the measurement per Sub-clause 2.4.2 should be taken directly at the output of both (or one Y1) bridging capacitors to earth, and from each bridging capacitor, separately, and earth, if two are provided.

RATIONALE:

The purpose of the requirements in Sub-clause 2.2.8.3 is to limit the amount of current flowing between Primary and SELV circuits if double or reinforced insulation is bridged by components. Taking the measurement at "accessible parts" does not accurately address this purpose. Until the Standard is revised, the described method is more appropriate.

OTHER:

SEE RELATED PAG:

PAG No. 2.3.3:001

(Sub)CLAUSE/ANNEX NUMBER: 2.3.3

(Sub)CLAUSE/ANNEX HEADING: Voltages under Fault Conditions

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.4.5, 1.6.5, 2.2.7.1, 2.3.1, 2.3.2

DESCRIPTION OF ISSUE:

While conducting SELV reliability testing (i.e. single component fault or single failure of basic or supplementary insulation, while monitoring voltages on accessible parts), should supply tolerances (+6/-10%) be considered?

APPLICATION GUIDELINE:

During SELV reliability testing, supply tolerances should not be considered. Nominal supply voltages should be used.

RATIONALE:

The standard indicates in Sub-clause 2.2.7.1 that nominal supply voltages are used for working voltage measurements. Although the standard does not specifically indicate that the same consideration is valid for SELV reliability testing, nominal supply voltages should be used for consistency.

The position is valid because, theoretically, if supply tolerances were considered, a circuit could be determined to be operating at ELV during working voltage measurements, but could be determined to be operating at a hazardous voltage before subjecting the component to fault testing. Thus there would be a discrepancy.

OTHER:

SEE RELATED PAG:

PAG No. 2.3.3.1:001

(Sub)CLAUSE/ANNEX NUMBER: 2.3.3.1

(Sub)CLAUSE/ANNEX HEADING: Separation by Double or Reinforced Insulation (Method 1)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.6

DESCRIPTION OF ISSUE:

A tandem transformer construction is submitted to meet the Method 1 requirements for SELV circuits. "Basic" insulation is provided in the first transformer and "Supplementary" insulation is provided in the second.

May the intermediate circuit operate at a hazardous voltage level, if the output voltage continues to meet SELV levels after single component faults of all "basic" and "supplementary" insulation within the tandem transformer construction?

APPLICATION GUIDELINE:

The intermediate voltage in constructions using the tandem transformer option described under Method 1 should be operating at ELV levels. Hazardous voltage levels are not permitted for this construction when being submitted to meet Method 1 requirements.

RATIONALE:

The tandem transformer method mentioned in Sub-clause 2.3.3.1 requires the intermediate circuit voltage to be considered when evaluating this construction because the two insulation systems being provided are formally being called "Basic" and "Supplementary" insulation. If both transformers are considered as a pair, the basic concepts in Sub-clause 2.2.6 require two levels of protection between hazardous and SELV circuits, thus prohibiting an intermediate circuit from operating at hazardous voltage levels and separated from the SELV output by basic or supplementary insulation.

OTHER:

SEE RELATED PAG:

PAG No. 2.3.3.1:002

(Sub)CLAUSE/ANNEX NUMBER: 2.3.3.1

(Sub)CLAUSE/ANNEX HEADING: Separation by Double or Reinforced Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.2, 2.9.4, 5.3

DESCRIPTION OF ISSUE:

The third dashed paragraph of Sub-clause 2.3.3.1 allows SELV wiring to be routed with other circuits, including hazardous, provided certain conditions are met.

What are the requirements for the wiring, and how is the wiring controlled in the UL descriptive report?

APPLICATION GUIDELINE:

The insulation on either the hazardous voltage or SELV conductors is required to meet supplementary or reinforced insulation requirements for the highest working voltage, including distance through insulation (Sub-clause 2.9.4), heating (Sub-clause 5.1) and electric strength (Sub-clause 5.3).

If the insulation on the conductors only meets the requirements for supplementary insulation, the insulation on the other conductors should meet the requirements for basic insulation based on the highest working voltage between the two circuits.

The conductor with the supplementary or reinforced insulation should be controlled as: Recognized Component — (AVLV2), style, rating, insulation thickness, insulation material description or marked VW-1.

RATIONALE:

Sound application of sub-clause, related sub-clauses, and the Standard's Principles of Safety. The UL Report description controls all pertinent characteristics of the wiring addressed by the sub-clause and the rest of the Standard.

OTHER:

SEE RELATED PAG:

PAG No. 2.3.3.3:001

(Sub)CLAUSE/ANNEX NUMBER: 2.3.3.3

(Sub)CLAUSE/ANNEX HEADING: Protection by Earthing of the SELV Circuit (Method 3)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.5.11

DESCRIPTION OF ISSUE:

Method 3 permits parts of SELV circuits to be protected by earthing in order to meet the requirements of Sub-clause 2.3.3.

What level of investigation is required to determine compliance of a construction with Method 3 of Sub-clause 2.3.3.3?

APPLICATION GUIDELINE:

There are two significant parts of an evaluation to determine compliance of a construction using Method 3 as described in Sub-clause 2.3.3.3. These parts are (a) fault tests and (b) an earthing test.

Fault Tests — Basic (or operational) insulation separating an earthed SELV circuit from other circuits should be short circuited to determine that the fault current will not open or otherwise damage the circuit path to earth. Although this test also is justified within secondary circuits, the main emphasis should be placed on determining the effect of primary to secondary circuit earth faults.

For efficiency purposes, this testing may be combined with SELV reliability testing if the SELV output circuit voltages are monitored during single component and insulation fault testing.

Earthing Test — An earthing test in accordance with Sub-clause 2.5.11 should be conducted from the "earthed side of the SELV circuit" to the main protective earthing terminal. If multiple circuits and traces are earthed, multiple earthing tests may be needed. The earthing path resistance shall not exceed 0.1 ohm.

Upon successful completion of the required tests, a construction that has been subjected to the evaluation will be controlled in the UL Report. In a linear power supply, the specific wiring, connections, etc., will be controlled. In a switching power supply, the specific PWB trace layout will be controlled.

RATIONALE:

When earthing is incorporated into a secondary circuit as a level of protection against electric shock, it is done so that a low impedance path will be provided between the circuit and earth. If incorporated correctly into the circuit, during a short circuit of basic insulation, this low impedance path will permit overcurrent protective devices to open before hazardous voltages are impressed on the secondary circuit outputs.

Sub-clause 2.3.3.3 includes a statement that SELV circuits "shall have adequate fault current-carrying capacity to ensure operation of the protective device, if any, and to ensure that the fault current path to earth will not open." Simulating reasonable fault conditions across basic (and operational) insulation, which considers the effects of large ground fault currents, allows a determination that "fault current path to earth will not open."

Sub-clause 2.5.11 (4th compliance paragraph) requires that SELV circuits derived per Sub-clause 2.3.3.3 be subjected to an earthing test, which simulates steady state fault currents. It states that the 0.1 ohm earth path resistance is to apply "between the earthed side of the SELV circuit and the earthing terminal or earthing contact." No other evaluation of the earthed traces is required.

OTHER:

SEE RELATED PAG:

PAG No. 2.3.5:001

(Sub)CLAUSE/ANNEX NUMBER: 2.3.5

(Sub)CLAUSE/ANNEX HEADING: Connection of SELV Circuits to Other Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Accessible parts of SELV circuits are often interconnected with circuits operating at hazardous voltages. The same hazardous voltage parts of the circuits are often directly connected to the earthed chassis without basic insulation between the parts.

For example, a monitor usually has a hazardous voltage B+ circuit (typically 120 — 150 Vdc) interconnected with other secondary circuits that eventually become accessible and need to be classified SELV. The same construction may have a capacitor connected between a hazardous part of the secondary circuit and chassis.

What guidance should be used to evaluate these circuits?

APPLICATION GUIDELINE:

The provisions of Sub-clause 2.3.9 should be used for guidance whenever constructions are encountered where accessible and hazardous voltage circuits are interconnected and are not isolated from each other. The sub-clause formalizes the single component/insulation fault concept of establishing SELV circuit and accepting constructions where insulation levels may not be less than normally required in the past.

RATIONALE:

Sub-clause 2.3.5 replaces the previous Method 4 and is intended to address constructions such as described above which have been somewhat controversial in the past. The basic concept is simple — if it can be shown that "accessible parts" of SELV circuits meet the SELV circuit voltage limits "in the event of a single failure of any component or insulation of the SELV circuit, or of any component or insulation of the secondary circuit which it is connected", the accessible part of the circuit may meet the SELV circuit definition although part of the circuit is operating at a hazardous voltage.

OTHER:

SEE RELATED PAG:

PAG No. 2.5:001

(Sub)CLAUSE/ANNEX NUMBER: 2.5

(Sub)CLAUSE/ANNEX HEADING: Provision for Earthing

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For ITE with a non-detachable power supply cord, must the protective earthing conductor associated with the cord always be routed directly to chassis, or is it acceptable for the protective earthing conductor to be routed or spliced through a connector before a chassis connection?

APPLICATION GUIDELINE:

Protective earthing conductors do not always need to be routed directly to chassis.

Permanent splicing of conductors, or routing of the supply and earthing conductors through the same connector, may be permitted if the overall integrity of the protective earthing is not compromised, and a determination is made, using sound engineering judgment, that the principles and provisions of Sub-clause 2.5 are complied with.

RATIONALE:

Traditionally, protective earthing conductors have been required to be connected directly to chassis without splices or connectors in the main protective earthing path. However, ITE manufacturers often have good reasons for requesting a connector or splice in the internal protective earthing wiring.

For example, manufacturers designing for an international market, but desiring to use a non-detachable power supply cord, want to include connectors at the end of the power supply cord conductors to simplify the manufacturing process of interchanging multiple cord types. Also, with some modular constructions, which incorporate service-replaceable power supplies and components designed to be removed and replaced easily, all service steps need to be straightforward and time efficient, sometimes resulting in splices or connectors being placed in the protective earthing path.

Connectors and splices located in the protective earthing path do not necessarily compromise safety if the principles of 2.5 are adhered to.

OTHER:

SEE RELATED PAG: 2.5:002, 2.5.1:001, 2.5.1:002

PAG No. 2.5:002

(Sub)CLAUSE/ANNEX NUMBER: 2.5

(Sub)CLAUSE/ANNEX HEADING: Provisions for Earthing

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Inductors may be introduced into the protective earthing circuits of ITE in an effort to reduce electromagnetic interference (noise) associated with the equipment. Typical constructions consist of either:

(1) An insulated protective earthing conductor wrapped around a toroid; or

(2) An open-coil inductor placed in a PWB protective earthing circuit, bridging two traces associated with protective earthing.

Does the introduction of an inductor in equipment protective earthing introduce any concerns with the overall reliability of the protective earthing of the equipment?

APPLICATION GUIDELINE:

The introduction of an inductor in a protective earthing path is not prohibited in ITE evaluated to this Standard. However, since a component is being added to a critical safety-related feature of the equipment, a determination must be made, either through engineering judgment or test, that the component does not affect the overall integrity of the protective earthing.

Constructions consisting of the protective earthing conductor wrapped around a toroid do not introduce any additional considerations into the product investigations and these constructions generally may be accepted without additional testing.

Constructions consisting of an open-coil inductor, serving to bridge two traces of a PWB protective earthing path, introduce a greater concern. They should be evaluated using the same criteria established for printed wiring traces used as protective earthing.

As described in Application Guideline 2.5.1:001, if a construction does not have any significant accessible dead metal (construction a), compliance with the stated requirements of the standard should be an adequate level of protection. Compliance is determined by an Earthing Test and the Abnormal Operation Test program.

However, if the earthing of accessible dead metal parts is relying upon this feature (constructions b and c of Application Guideline 2.5.1:001) as a level of protection against electric shock, a performance-based evaluation as described in Application Guideline 2.5.1:002 should be conducted. This includes the Earthing Test, Earth Fault Current Test, and 100% production-line testing.

To assure that future production samples will be constructed like the sample submitted for type testing, the following descriptions should be included as part of the UL Report: Inductor core size, inductor wire gauge, connection of inductor to PWB, and PWB trace layout.

RATIONALE:

When an inductor is placed in a protective earthing path, there is an increased likelihood that the protective earthing scheme could fail because a potential weak link is being placed in the path. The integrity of the earthing path noted in construction (a) of Application Guideline 2.5.1:001 is not a major concern because of a lack of accessible dead metal. In constructions (b) and (c) of Application Guideline 2.5.1:001, dead metal may become directly energized as a result of a single fault and the acceptability of the construction should be determined through a performance based evaluation.

OTHER:

SEE RELATED PAG: 2.5.1:001, 2.5.1:002

PAG No. 2.5:003

(Sub)CLAUSE/ANNEX NUMBER: 2.5

(Sub)CLAUSE/ANNEX HEADING: Provisions for Earthing

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When a tab and quick-connect connector combination is used for protective earthing and the combination is not soldered together, what type of investigation is required to determine compliance of the combination with the requirements of Sub-clause 2.5 and Item 3 of the Subject 1950 Bulletin dated September 22, 1989 which permits this construction?

APPLICATION GUIDELINE:

General — There are two factors to be considered in the evaluation of a tab and quick-connect terminal combination used for protective earthing: The tab construction, and the quick-connector Listing or Recognition.

Tabs for quick-connect terminations, such as those found on EMI filters, usually are not evaluated on the component level. Therefore, they have to be fully considered at the end-product level. IEC 1210, Connecting Devices, Flat Quick-Connect Terminations for Electrical Copper Conductors, specifies standard dimensions for quick-connect terminals. This standard is referenced in the Standard for Electrical Quick Connect Terminals, UL 310, and establishes basic compliance criteria for tabs.

Tab Complies with Standard IEC 1210 Dimensions

If the tab dimensions comply with the requirements of UL 310 paragraph 6.2 (which is based on IEC 1210), no additional evaluation of the tab is required. The tab dimensions will be controlled in the end product report.

In this case there are two acceptable alternatives for evaluation of the quick-connect terminal/tab combination:

a) If the quick-connect connector is Listed, no further evaluation is required and the connector may be described simply as "Listed."

b) If the quick-connect connector is Recognized, the connector report will be reviewed for Conditions of Acceptability (C of A's) placing limitations on the use of the connector due to its construction or the test program originally conducted on it. (Some Recognized Component connectors are evaluated for use only with certain tab sizes or have use limitations placed on them due to failing test results or tests not conducted.)

If the Recognized Component connector is found to be unsuitable (via a C of A) because of incompatibility with the tab requirements, the Engagement-Disengagement Test of UL 310, Section 13, should be conducted to determine the acceptability of the combination. The UL report description will include the tab dimensions and the connector description, i.e. R/C (RFWV2), manufacturer and type.

Tab Does Not Comply with Standard IEC 1210 Dimensions

If the tab dimensions do not comply with the requirements of UL 310, Paragraph 6.2 (which is based on IEC 1210), additional evaluation of the tab/connector combination will be required.

If the connector is Listed, then the Engagement-Disengagement Test of UL 310 should be conducted to determine acceptability. In this case the tab dimensions should be controlled and the connector should be described as "Listed".

If the connector is a Recognized Component, C of A's should be reviewed and the Engagement-Disengagement Test should be conducted. The end product report will include the tab dimensions and a description of the connector, i.e. R/C (RFWV2), manufacturer and type.

RATIONALE:

The primary concern with the use of quick-connect connectors for protective earthing terminals is secureness and reliability of the electrical connection afforded by this method. UL 310 describes methods of evaluating tabs, quick-connect connectors and combinations of tabs and connectors.

OTHER:

See Subject 1950 Bulletin dated September 22, 1989.

SEE RELATED PAG:

PAG No. 2.5.1:001

(Sub)CLAUSE/ANNEX NUMBER: 2.5.1

(Sub)CLAUSE/ANNEX HEADING: Provisions for Earthing — Class I Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Some ITE use printed wiring board (PWB) traces as conductors for protective earthing. Generally, these designs incorporate an appliance inlet with the earthing pin mechanically secured and soldered to a PWB protective earthing trace. The protective earthing trace is conductively connected to a dead metal chassis, an enclosure, or an appliance outlet (receptacle) protective earthing pin.

This type of protective earthing scheme is used in three basic designs:

(1) Earthing of Class I equipment with no accessible dead metal parts that are likely to become directly energized as a result of a single fault.

Example: a monitor with a plastic enclosure and no accessible dead metal parts except secondary connectors that have accessible dead metal housings.

(2) Earthing of Class I equipment with dead metal that is likely to become directly energized as a result of a single fault.

Example: a stand-alone disk drive with a sheet metal bottom enclosure.

(3) Earthing of Class I equipment that supplies primary power to other equipment through an earthing (grounding) type appliance outlet (receptacle).

Example: small power distribution unit with an inlet connector and an output NEMA or IEC receptacle that relies upon an earthing path which is routed through a PWB.

What criteria should be used to determine if a PWB protective earthing scheme must be subjected to further evaluation than what is normally required by the Standard to evaluate the overall integrity of the protective earthing?

APPLICATION GUIDELINE:

If the PWB protective earthing scheme is earthing accessible dead metal parts that are likely to become directly energized as a result of a single insulation or component fault (Example 2), or if a receptacle (supplying other Class I equipment) ground pin is relying upon an earthed trace for its earthing source (Example 3), the construction should be subjected to a performance-based evaluation which extends beyond the normal evaluation required by the standard. This performance based program consists mainly of additional short circuit testing (See Application Guideline 2.5.1:002).

If there are no accessible dead metal parts that are likely to become directly energized due to a single component fault, or if the earthed trace does not provide earthing for a grounding type receptacle, the suitability of the construction may be determined by conducting both an earthing test (2.5.11) and additional component faults between primary circuits and the earthed traces during the abnormal operation test program (5.4.6).

Unacceptable results of the abnormal operation testing is evidence of fire or damage to the insulation system being subjected to the faults as outlined in 5.4.9. An electric strength test following the short circuit testing is adequate to determine if insulation has been damaged.

RATIONALE:

Sub-clause 2.5.1 states that accessible conductive parts of Class I equipment that might assume a hazardous voltage in the event of a single insulation fault should be "reliably" connected to the protective earthing conductor within the equipment.

If accessible dead metal parts are likely to become energized and the means used to provide the protective earthing is questionable with regard to its overall integrity and reliability, consideration should be given to conducting a performance-based evaluation extending beyond the tests outlined in the standard.

With regard to the three typical constructions outlined above, the integrity of an earthing path provided in construction (1) is not a major concern because the accessible dead metal parts are not likely to become directly energized as a result of a single component fault. Therefore, applying requirements (i.e. Earthing test, faults of basic insulation) already contained in the Standard is considered an adequate level of investigation.

Because the construction (2) has dead metal that is likely to become directly energized as a result of a single fault, and because construction (3) allows a variety of products (usually Listed) to be plugged into the NEMA/IEC receptacles, the protective earthing scheme used for these constructions must be proven reliable and the acceptability of the construction should be determined through a rigorous performance-based test program.

OTHER:

See CSA TIL No. I-27 and CSA Technote TN-017.

CCA Decision EA(GB)3/93(2.5) permits the construction without any further evaluation other than 2.5.11.

SEE RELATED PAG: 2.5.1:002

PAG No. 2.5.1:002

(Sub)CLAUSE/ANNEX NUMBER: 2.5.1

(Sub)CLAUSE/ANNEX HEADING: Provisions for Earthing — Class I Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Sub-clause 2.5.1 states that accessible conductive parts of Class I equipment that might assume a hazardous voltage in the event of a single insulation fault shall be reliably connected to the protective earthing conductor within the equipment.

If equipment incorporates a protective earthing scheme that includes a protective earthing path through a printed wiring board, and it is determined through a construction review that the protecting earthing path has unknown reliability (see Application Guideline 2.5.1:001), what level of investigation is required to determine the overall reliability of the PWB earthing?

APPLICATION GUIDELINE:

If it is determined that protective earthing is critical to the overall safety of the equipment and the earthing path has unknown reliability, the suitability of the earthing should be determined by a performance-based evaluation.

The performance-based evaluation generally should consist of two tests/measurements: Resistance of Protective Earthing Conductors (Earthing) Test per 2.5.11, and Earth Fault Current Test.

Additionally, to address continued compliance of the construction with the requirements, special considerations will be given to the construction during Follow-Up Service.

(A) Resistance of Protective Earthing Conductors (Earthing) Test

The Earthing Test as described in Sub-clause 2.5.11 should be applied to measure the earthing resistance between the earthing terminal and any accessible dead metal part that is required to be earthed, including earthing (ground) pins of appliance outlet (receptacles).

The test should be run as described in 2.5.11. The test current should be 1.5 times the current rating of the circuit under test and the duration of the test should be 60 seconds.

The current rating of the circuit depends on the provision and location of overcurrent devices and shall be taken as the smallest of either the rated overcurrent device (branch circuit) specified by the manufacturer to be installed in the building, or the rating of the overcurrent (Supplementary) device in the equipment that protects the circuit or part required to be earthed.

The measured resistance between the earthing terminal and the accessible dead metal part shall be documented for future reference, and shall not exceed 0.1 ohm.

(B) Earth Fault Current Test

To determine the effect that the current associated with an earth fault would have on the PWB protective earthing scheme, the equipment should be subjected to a fault that simulates an earth fault when the equipment is connected to a branch circuit.

The basic procedure should be per Sub-clause 4.3 (Limited Short-Circuit Test) and the test capacity should be per Table 5 (Capacity of Test Circuit) of CSA C22.2 No. 0.4-M1982, Bonding and Grounding of Electrical Equipment (Protective Grounding).

Generally, a calibrated power source with a 75 — 80% power factor is desired. These parameters should be verified with suitable instruments.

For single phase equipment, rated 120 V and 9.8 A or less, or rated 240 V and 4.9 A or less, the test circuit capacity is 200 A, and the test generally can be performed on a standard laboratory test bench which has the capability to deliver 200 A under short circuit conditions.

For products which exceed the above current limitations, a test circuit capacity of 1000 A or larger is required, usually requiring a calibrated power source.

Before and after the test, a resistance measurement should be made between the earthing terminal and the accessible dead metal part required to be earthed using the method described in the Earthing Test.

To conduct the Earth Fault Current Test, a test circuit should be prepared with the following components in series: Power source (+), test switch, branch circuit protection, minimum length of power supply cord supplied with the equipment, earthing path, power source (-).

Consideration should be given to including supplementary protection in the test circuit (e.g. front end cartridge fuse) if supplementary protection is provided with the equipment and there is no likelihood that an earth fault will occur before the supplementary protection.

Because it is difficult to introduce the short circuit condition exactly at the peak of the voltage waveform, three samples shall be subjected to the test, and the PWB construction subjected to the test should be the minimum trace thickness that will be used during production.

The following test results are considered acceptable:

1) Measured "before" and "after" resistances do not exceed 0.1 ohm;

2) The protective earthing path "before" and "after" resistances are stable. For purposes of defining "stable," a 10% difference should be used as a general guide, although based on the actual measured values, engineering judgment may allow further deviation from this guideline;

3) There is no visual damage to the protective earthing trace.

Note: The opening of either the branch circuit or supplementary protection are considered acceptable terminations of the test. If a primary trace opens, additional consideration shall be given to the construction in accordance with the D2 Deviations of Sub-clause 5.4.9.

(C) Follow-up Considerations

Once protective earthing through a PWB has been determined to be suitable through a performance based evaluation, further consideration should be given to assuring that future production of the sample will continue to comply with the requirements.

The UL descriptive report will control the PWB construction with a PWB trace layout, and either a description of the PWB by manufacturer and type number, or a generic description of ZPFW2 Recognition parameters important for the application, such as Minimum Cladding Conductor Width, Minimum Edge Cladding Conductor Width, Cladding Conductor Thickness, etc.

As a production line test, an Earthing Test (as described above) shall be conducted on 100 percent of production units between the ground pin and accessible dead metal parts. The measurements will be compared to values obtained during UL type testing and will be documented in a Special Appendix in the UL Follow-Up Service Procedure.

To implement Follow-Up Service verification, the project engineer and manufacturer will negotiate a value to be placed in the Appendix. Typically, it will be acceptable to state a production line value that is based on the worst case Type test value rounded upwards toward the nearest 0.01 ohm. For example, if the Type test measurement was 0.042 ohm, the Appendix could state an acceptable production line measurement to 0.05 ohm.

RATIONALE:

For protective earthing schemes incorporating standard hardware (e.g. studs, nuts, AWM, etc.), practice has been to determine the suitability of such constructions by a construction-based review. Due to the nature of the components and hardware used in such constructions, and considering UL 478/114 experience, there has not been difficulty considering these constructions reliable.

On the other hand, for PWB protective earthing schemes where a PWB trace is a critical element of the protective earthing, UL does not have the same level of confidence that they are reliable based solely on a construction-based review. Because there is an increased likelihood that these protective earthing schemes could fail or have degraded characteristics over the life of the equipment, UL has determined that a performance-based evaluation is required.

The Earthing Test described in Sub-clause 2.5.11 is a reliable and consistent method of taking earthing resistance measurements, so it should be used for determining the resistance associated with PWB earthing paths and the impact overload current may have on such paths.

The Earth Fault Current Test, which determines the ability of the protective earthing path to withstand an earth fault while connected to a branch circuit, is a test that has been developed for temporary power taps and similar product categories.

The specified Follow-Up Service considerations allow UL to determine that continued compliance of the PWB earthing scheme with the requirements of the standard.

OTHER:

See CSA TIL No. I-28 and CSA Technote TN-017. CCA Decision EA(GB)3/93(2.5) permits the same construction with any further evaluation other than 2.5.11.

SEE RELATED PAG: 2.5.1:001

PAG No. 2.6.1:001

(Sub)CLAUSE/ANNEX NUMBER: 2.6.1

(Sub)CLAUSE/ANNEX HEADING: Disconnection from Primary Power — General Requirements

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When included as part of the equipment, is the disconnect device required by Sub-clause 2.6.1 required to be in an operator accessible area?

APPLICATION GUIDELINE:

The disconnect device required by Sub-clause 2.6.1 does not need to be located in an operator access area.

RATIONALE:

Disconnect devices are required to protect service personnel from hazards during servicing. The disconnect device is not specifically provided for the operator to address a safety function (e.g. equipment on/off) or for any other operator maintenance or servicing function. Therefore, the operator does not need access to a service disconnect device and the disconnect device required by Sub-clause 2.6.1 may be located in a service-only access area.

OTHER:

SEE RELATED PAG:

PAG No. 2.7:001

(Sub)CLAUSE/ANNEX NUMBER: 2.7

(Sub)CLAUSE/ANNEX HEADING: Overcurrent and Earth Fault Protection in Primary Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

A common construction for a switching power supply is for a single fuse to act as supplementary overcurrent protection in the primary circuitry. The supply is usually designed for connection to a single phase, 125 V or 250 V source of supply of an unidentified power distribution system.

Does this common construction require any special considerations and does it conflict with any of the provisions outlined in Sub-clause 2.7?

APPLICATION GUIDELINE:

As long as the fuse is not wired in the identified neutral, a single fuse acting as supplementary protection in a switching power supply does not present a conflict with the requirements of Sub-clause 2.7.

Included in this consideration are single fuses, acting as supplementary protection, which are wired in power supplies which may be connected to power distribution systems with two hot lines (e.g. 250 V power supply intended for connection to a U.S. 125 V/250 V supply).

RATIONALE:

Supplementary protection is provided in equipment to protect against hazards associated with abnormal operating conditions (Sub-clause 5.4.6) within the equipment. As long as a single fuse is not provided in the neutral of a supply, there is no conflict with the provisions of Sub-clause 2.7.

Verification that a fuse is not wired in the neutral is accomplished as part of the construction review of the component or the end product.

OTHER:

See CCA Decision EE(chm) 1/94 on 2.7.4.

SEE RELATED PAG:

PAG No. 2.7:002

(Sub)CLAUSE/ANNEX NUMBER: 2.7

(Sub)CLAUSE/ANNEX HEADING: Overcurrent and Earth Fault Protection in Primary Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.6

DESCRIPTION OF ISSUE:

ITE sometimes has an a.c. rated fuse located in a d.c. circuit. This practice is common in several applications:

(a) Supplementary protection of centralized d.c. supply systems (typically -48 V d.c.).

(b) Limited power protection of secondary d.c. output circuits of switching power supplies.

What level of investigation is required to determine if an a.c. rated fuse is acceptable in a d.c. circuit?

APPLICATION GUIDELINE:

The preferred position regarding any fuse relied upon for safety is that the fuse be suitably rated for the application. Therefore, manufacturers are encouraged to use d.c. rated fuses in d.c. circuits.

However, as with most constructions, components may be used outside of their ratings if it can be determined that the use of a component outside of its rating does not introduce a hazard during the operation or servicing of the equipment, i.e. application of concepts per the 3rd dashed paragraph of Sub-clause 1.5.2.

Considerations applicable to the two most common applications described above are provided below:

A.C. fuse in D.C. supply circuit — The use of an a.c. fuse in a centralized d.c. supply circuit, UPS output or similar application, may be considered if the construction is subjected to the following conditions:

(a) Short Circuit Test — 5 samples of the fuse are each subjected to a short circuit test in the circuit while connected to a simulated "stiff" supply. The a.c. fuse in the d.c. circuit shall not explode or otherwise contribute to a potential hazard.

For purposes of applying this requirement, a "stiff" supply is a d.c. supply source with a current capacity at least ten times the rating of the expected branch circuit protection.

(b) Restrike Test (filled fuses only) — 3 samples of fuses with filler material (e.g. sand) are resistively loaded to 200% of their marked rating while connected to a d.c. source.

After opening, the circuit shall remain energized for one additional minute, and there shall be no indication of tendency for the filled fuse to restrike.

(c) The individual fuse type tested will be controlled by manufacturer, part no., and ratings.

(d) No special markings or instructions are required other than specified in Sub-clause 1.7.6.

A.C. fuse in secondary D.C. circuit — There generally are no special considerations for a.c. rated fuses used in secondary d.c. circuits (e.g. output circuit of a switching power supply).

However, engineering judgement may support short circuit testing of an a.c. fuse in a secondary d.c. circuit if the available secondary power is such that there is a concern that fuse may not be able to safely clear the circuit (e.g. without exploding) in the event of an abnormal condition.

For a.c. fuses in d.c. circuits which do not meet the conditions outlined above, an appropriately rated and certified d.c. fuse shall be used.

RATIONALE:

Standard design practice and adherence to general safety principles dictates the use of components that are suitably rated for the types of circuits that they are used in. Therefore, it is the preferred position that any fuse which is relied upon for safety should be used in a circuit that is compatible with the fuse's ratings.

However, manufacturers sometimes experience situations where their application precludes the use of a fuse with a d.c. rating, or they do not have a reliable source of certified fuses which are suitably rated for their application and are cost effective.

In these cases, rather than reject the construction outright, the consequences of the use of the specific component in the application will be considered. The construction may be accepted if it can be determined that there are no hazards introduced as a result of the use of this specific component. The third dashed paragraph of 1.5.2 supports sound engineering decision-making of this type.

The main concerns with fuses used outside of their ratings are (a) the ability of the fuse to protect the circuit it is supposed to protect, (b) the consequences of the fuse clearing, and (c) consideration whether a fuse is likely to be replaced with the same or similar fuse.

The ability of the fuse to protect a circuit can be determined by applying the abnormal operation testing already in the standard. The consequences of the fuse clearing can be determined by conducting a sufficient number (5) of short circuit tests on the fuse while the fuse is connected to an actual or simulated branch circuit, and by overloading filled fuses to determine that they do not restrike.

For the purposes of this guideline, it will be assumed the fuses will be replaced by the same type of fuse if the marking or instruction requirements already contained in the Standard are altered too.

OTHER:

SEE RELATED PAG:

PAG No. 2.7.3:001

(Sub)CLAUSE/ANNEX NUMBER: 2.7.3

(Sub)CLAUSE/ANNEX HEADING: Short-Circuit Back-Up Protection

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex NAE (2.7.3)

DESCRIPTION OF ISSUE:

Sub-clause 2.7 and Annex NAE (2.7) require certain constructions of ITE to have branch circuit type overcurrent protection with adequate breaking (rupturing) capacity inside the equipment to protect standard supply outlets and medium-based lampholders against overcurrent, short circuit and earth fault conditions.

For branch circuit type protection provided inside equipment to meet this requirement, are there any special requirements for the size of the interrupting (short circuit) current rating marked on this overcurrent protection?

APPLICATION GUIDELINE:

When branch circuit protection is provided inside equipment as overcurrent protection to comply with Sub-clause 2.7 and NAE (2.7), the interrupting rating of this overcurrent protection need not be evaluated nor controlled. It should be assumed that the interrupting rating of the equipment branch circuit is adequate based on the manufacturer's determination.

RATIONALE:

For <u>any</u> component installed internal to ITE, UL 1950 does not specify requirements for short circuit ratings. Applying specific short circuit requirements (e.g. min. 10,000 amps), if a concern, would require a revision to the standard. Furthermore, UL 114 and UL 478 did not have a requirement for interrupting (short circuit) current ratings of overcurrent protection, and field experience has not warranted consideration for adding additional restrictions.

OTHER:

SEE RELATED PAG:

PAG No. 2.9.2:001

(Sub)CLAUSE/ANNEX NUMBER: 2.9.2

(Sub)CLAUSE/ANNEX HEADING: Clearances

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.1

DESCRIPTION OF ISSUE:

Small amounts of a topical adhesive/insulator (e.g. silicone) often are applied between components within a power supply to maintain required clearances per Sub-clause 2.9.2, including clearances required after the application of a 10 N force per Sub-clause 2.9.1.

What considerations are valid for topical adhesives/insulators applied between components to meet Sub-clause 2.9.2?

APPLICATION GUIDELINE:

An adhesive/insulator applied between individual components may be relied upon to meet Sub-clause 2.9.2. However, there should be evidence that the application of the adhesive/insulator will be consistent during manufacturing.

The material should comply with Sub-clause 2.2.2 (e.g. a Recognized Component) material and have a suitable temperature rating (electrical), based on the operating environment. The 94V-2 requirement is waived, if small amounts are used, and no Stress Relief Test is required before the Push Test. A brief description of the material and location of the adhesive/insulator will be provided in the UL Report.

RATIONALE:

Although not specifically described in the Standard, current industry practice is to use this method to maintain adequate clearances. Therefore, this construction may be considered.

Although there should be concern that the application of the adhesive/insulator is in accordance with good manufacturing practice, very detailed control of the application and material of each adhesive/insulator used on a power supply is not considered practical nor warranted. Therefore, minimal control will provide a suitable level of safety. This approach assumes that creepage distances measured on all surfaces of the insulator will continue to be evaluated using Pollution Degree 2 (or higher) levels.

OTHER:

SEE RELATED PAG:

PAG No. 2.9.3:001

(Sub)CLAUSE/ANNEX NUMBER: 2.9.3

(Sub)CLAUSE/ANNEX HEADING: Creepage Distances

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.14.3

DESCRIPTION OF ISSUE:

When determining a working voltage for application of Table 6 (minimum creepage distances), may a peak measurement be made and considered equivalent to d.c.?

APPLICATION GUIDELINE:

No. D.C. working voltages and associated creepage distance requirements apply only to a true d.c. voltage (defined in Sub-clause 1.2.14.3). Sinusoidals and non-d.c. signals should be measured with a true r.m.s. meter having a suitable frequency response.

RATIONALE:

Creepage distance requirements are based on the need to prevent degradation of spacings over long periods, i.e. steady state, and not short periods.

Thus, r.m.s. and d.c. measurement techniques are more appropriate and are specifically stated in the Standard.

OTHER:

SEE RELATED PAG:

PAG No. 2.9.4:001

(Sub)CLAUSE/ANNEX NUMBER: 2.9.4

(Sub)CLAUSE/ANNEX HEADING: Solid Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2, 5.3

DESCRIPTION OF ISSUE:

For switching transistors and similar components operating at hazardous voltages and mounted against a protectively earthed dead metal heat sink, what are the options available for providing Basic solid insulation between internal live parts of the component to the protectively earthed dead metal heat sink?

APPLICATION GUIDELINE:

The following options are available:

(a) Provision of a separate, definable insulation layer complying with Sub-clauses 2.2, 2.9.4 and 5.3 between the component and the protectively earthed dead metal part. The insulation will be controlled in the UL Report.

(b) Use of a Recognized Component Power Switching Semi-conductor (QQQX2). Based on the working voltage, an Electric Strength test for Basic insulation will be conducted per Sub-clause 5.3 between the component and the protectively earthed heat sink. In the UL Report, the component will be controlled by component CCN, manufacturer and part number.

(c) Provision of a component with Basic insulation integrally designed into it. To qualify for this option, the component specifications shall indicate that the component casing has a minimum dielectric property not less than the electric strength value required by Sub-clause 5.3. Based on the working voltage, an Electric Strength test for Basic insulation will be conducted per Sub-clause 5.3 between the component and the protectively earthed dead metal heat sink. In the UL Report, the component will be controlled by manufacturer and part number.

RATIONALE:

If a transistor or similar device is mounted to an earthed heat sink, insulation equivalent to basic insulation is required and shall meet the requirements of Sub-clauses 2.2, 2.9 and 5.3.

All three options provide an equivalent level of safety, meet the intent of the Standard, and give assurance of continued compliance of the product to the Standard as part of UL Follow-Up.

OTHER:

CCA Decisions 95/17 on Sub-clause 2.9.4, and 95/7 on Sub-clause 2.9.4.1, allow similar considerations. The intent and impact of CCA Decision EE(Chm) 1/94 on 2.9 is unknown.

SEE RELATED PAG:

PAG No. 2.9.4.1:001

(Sub)CLAUSE/ANNEX NUMBER: 2.9.4.1

(Sub)CLAUSE/ANNEX HEADING: Minimum Distances Through Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.2, 5.3

DESCRIPTION OF ISSUE:

What is the minimum distance through insulation requirement for Basic insulation?

APPLICATION GUIDELINE:

As specified in the 2nd-dashed paragraph of Sub-clause 2.9.4.1, Basic insulation does not have a minimum distance through insulation requirement. The thickness of Basic insulation that is acceptable is the thickness that complies with the electric strength test requirements.

However, this requirement only addresses the dielectric suitability of the insulation. Sub-clause 2.2.2 may require additional evaluation to determine the suitability of the material for the intended use, based on factors such as working environment and other electrical considerations. The additional evaluation under Sub-clause 2.2.2 may determine that a specific thickness is required for the overall application.

RATIONALE:

Sub-clause 2.9.4.1 states that there is no minimum distance through insulation requirement for Basic insulation. Since there is no minimum distance through insulation specified, any thickness is acceptable as long as it complies with the electric strength test and it is used at a suitable thickness meeting the considerations given to insulating materials outlined in Sub-clause 2.2.2.

OTHER:

SEE RELATED PAG: 2.2.2:001, 2.2.2:002

PAG No. 2.9.7:001

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compound

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

Both Sub-clause 2.9.7 and Annex F make reference to "cemented" and "uncemented" joints. However, the Standard does not provide a definition of either a "cemented" or "uncemented" joint. If two materials are bonded together, when may the bond be considered a "cemented" joint?

APPLICATION GUIDELINE:

In general, a "cemented" joint should be considered a material bonding means that forms a solid homogeneous joint.

The following generic bonding methods generally are methods available to provide a "cemented" joint: Epoxy, Acrylic Adhesive, Polyurethane adhesive, and solvent cements. Additionally, sonic welding, although not a cement, is typically considered a reliable process for bonding two materials.

Other materials, such as RTV and glue, are not proven reliable and are not considered "cemented" joints.

RATIONALE:

Based on input with the UL Plastics Engineering Group, the bonding materials specified above have shown through experience to be reliable bonding agents and meet the intent of the Standard if tested per Sub-clause 2.9.7.

OTHER:

SEE RELATED PAG: 2.9.7:002, 2.9.7:006

PAG No. 2.9.7:002

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compound

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

Sub-clause 2.9.7 allows relaxation of clearance and creepage distance requirements "where insulation is reliably cemented together with insulating compound". For transformers, can the adhesive on insulation tape be used to "cement" a joint (tape-tape, tape-bobbin) and thus allow the windings to comply only with Distance-Through-Insulation requirements (Sub-clause 2.9.4)?

APPLICATION GUIDELINE:

No. An adhesive joint is not considered equivalent to a cemented joint.

RATIONALE:

Note 1 of Sub-clause 2.9.7 provides examples of acceptable constructions, including "potting," "encapsulation," and "vacuum impregnation." Adhesive is not considered an equivalent level of bonding because of concern with its ability to maintain consistent properties over extended time. Spacings are not "effectively filled" with insulating compound. Also, insulation tape adhesive is not controlled during the Recognition of the tape nor is it possible to easily provide Follow-Up Service on its composition. Therefore, an adhesive joint is not considered equivalent to a cemented joint.

OTHER:

SEE RELATED PAG: 2.9.7:001

PAG No. 2.9.7:003

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compound

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

Sub-clause 2.9.7 allows relaxation of spacing requirements for components that are treated by "potting", "encapsulation", or "vacuum impregnation" to prevent ingress of dirt and moisture. Can a completely varnished transformer be evaluated per Sub-clause 2.9.7 as a potted, encapsulated or vacuum impregnated component and thus be allowed the spacings relaxations per Sub-clause 2.9.7?

APPLICATION GUIDELINE:

The process of varnishing is not considered equivalent to potting, encapsulation or vacuum impregnation. Therefore, varnished transformers should not be evaluated to Sub-clause 2.9.7.

RATIONALE:

The varnishing procedure is not considered as reliable and complete as a potting, encapsulation, or vacuum impregnation process. The intent of the sub-clause cannot be met because varnishing a transformer does not produce a construction "where distances between conductive parts are effectively filled with insulating compound".

OTHER:

SEE RELATED PAG:

PAG No. 2.9.7:004

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compounds

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

Sub-clause 2.9.7 provides a test program for components treated with an insulating compound (either by potting, encapsulation or vacuum impregnation). When a component meets the requirements of the sub-clause, parts internal to the component only need to be subjected to the distance through insulation requirements of Sub-clause 2.9.4.

Do components treated with generic epoxy need to be subjected to the complete test program (referenced in Sub-clause 2.9.7) required for components treated with an insulating compound filling?

APPLICATION GUIDELINE:

Generic epoxy has known stable insulating properties when operating at 90°C or below. Therefore, generic epoxy used as an insulating compound in a component does not need to be subjected to the Thermal Cycling Tests of Sub-clause 2.9.7 if the epoxy does not achieve a temperature above 90°C (with Tmra factored in) during the Heating Test.

However, the component shall be subjected to the applicable Humidity and Electric Strength Test after the Heating Test and the component shall be visually inspected and sectioned to determine that there are no significant voids in the insulating material.

If the epoxy material temperature exceeds 90°C (with Tmra factored in) the full test program shall be conducted as described in Sub-clause 2.9.7.

RATIONALE:

Experience with epoxy when used as insulating material at temperatures below 90°C has shown it to be a stable material that adequately prevents the ingress of moisture. If the material meets the generic temperature indices in the Standard for Polymeric Materials — Long Term Property Evaluations, UL 746B, a detailed test program to determine its ability to retain long term insulating properties is not considered necessary.

However, since visual inspections and sectioning are used to check for adequate manufacturing processes, it is reasonable to subject all components which are treated with an insulating compound to this step, whether the material is a generic epoxy or not.

OTHER:

SEE RELATED PAG: 2.9.7:005

PAG No. 2.9.7:005

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compounds

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

When evaluating an encapsulated component to Sub-clause 2.9.7, and the component includes one or more critical sub-components (e.g. safety isolating transformer within an encapsulated power supply), should internal components (e.g. the transformer) be considered separately from the overall component assembly for compliance to Sub-clause 2.9.7?

APPLICATION GUIDELINE:

Internal sub-components should be evaluated to normal spacing requirements (i.e. distance through insulation and clearance/creepage distances) unless the manufacturer also requests the evaluation of the sub-component to Sub-clause 2.9.7.

If the manufacturer requests the evaluation of both the overall component and the sub-components to Sub-clause 2.9.7, the overall component and the sub-components should be sectioned to determine that there are no voids or shrinkage of the insulating material.

RATIONALE:

Potted, encapsulated and vacuum impregnated components that include sub-components may not have been manufactured so that all internal sub-components meet the intent (and thus clearance/creepage distances relaxation) of Sub-clause 2.9.7. If the relaxations allowed under Sub-clause 2.9.7 for sub-components are to be considered, special steps should be taken to determine that they also meet the intent of the sub-clause.

OTHER:

SEE RELATED PAG: 2.9.7:001, 2.9.7:003, 2.9.7:004

PAG No. 2.9.7:006

(Sub)CLAUSE/ANNEX NUMBER: 2.9.7

(Sub)CLAUSE/ANNEX HEADING: Spacings Filled by Insulating Compound

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.4, 2.9.6, Annex F

DESCRIPTION OF ISSUE:

For multi-layer PWBs, what are the applicable considerations and performance requirements to permit reduced spacings within a single layer of the multi-layer board?

APPLICATION GUIDELINE:

Distances between conductive parts within prepreg or similarly constructed PWBs used within their Recognized maximum operating temperature may be considered "adequately enclosed by envelopes or hermetic sealing" inherently, thus not requiring testing per Sub-clause 2.9.6 to permit Pollution Degree 1 spacings to be applied between the parts.

Distances between conductive parts within prepreg or similarly constructed PWBs subjected to the additional performance requirements in Sub-clause 2.9.7 (Thermal Cycling Test) may be considered solid insulation and may be permitted to comply with the Distance Through Insulation requirements of Sub-clause 2.9.4, i.e. minimum 0.4 mm spacings. However, the Thermal Cycling Test is not required for R/C printed wiring consisting of prepreg cured with epoxy resin and used at temperatures not exceeding 90°C (with Tmra factored in).

Unless Recognized Component — Wiring, Printed-Flexible Material (ZPXK2) is used within its rated maximum operating temperature, distances between conductive parts within flexible PWBs, such as multi-layer polyimide or mylar, should be considered "uncemented" joints, requiring compliance with Sub-clause 2.9.6 in order to consider Pollution Degree 1 spacings.

RATIONALE:

Note 2 of Sub-clause 2.9.7 indicates multi-layer PWBs as falling under the considerations of this sub-clause.

The internal layers of prepreg and similar constructions used within their Recognized Maximum Operating Temperature are inherently sealed by the curing process and may be considered inherently Pollution Degree 1 without additional conditioning tests.

Prepreg constructions wanting to take advantage of the additional spacings relaxation permitted for solid insulation (i.e. 0.4 mm DTI spacings), may be accepted based on further Conditioning Tests per Sub-clause 2.9.7, or if generic epoxy-cured prepreg is used at temperatures of 90°C or below.

Non-prepreg constructions, in particular flexible printed wiring, may also take advantage of Pollution Degree 1 spacings if Thermal Cycling Tests show that the construction remains sound after conditioning.

The above positions are considered practical approaches which limit unnecessary testing of common constructions, typically Recognized to UL 796 (Printed Wiring Boards), and which meet the intent of the Standard.

OTHER:

SEE RELATED PAG: 2.9.7:001, 2.9.7:004

PAG No. 2.11:001

(Sub)CLAUSE/ANNEX NUMBER: 2.11

(Sub)CLAUSE/ANNEX HEADING: Limited Power Sources

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, Annex P.2 (2.11)

DESCRIPTION OF ISSUE:

What considerations are applicable for the use of positive temperature coefficient (PTC) devices, or thermistors, to meet the requirements of this Standard, in particular the use of Recognized Component (XGPU2) devices to comply with definition of a Limited Power Source?

APPLICATION GUIDELINE:

General — PTC devices used in ITE and required for the equipment to comply with this Standard either should be separately certified to IEC 730-1, and accepted per UL policies for accepting components certified by other agencies, or should be UL component Recognized under the product category Thermistor Type Devices (XGPU2). The requirements for XGPU2 Component Recognition are contained in a set of requirements published under Subject 1434.

Limited Power Sources — When used in a current limiting application to form a Limited Power Source per the second dashed paragraph of Sub-clause 2.11, the PTC device should be considered a fixed (limiting) impedance and not an overcurrent protective device (e.g. fuse).

To determine compliance of a circuit with the Limited Power Source definition, a measurement should be taken at the circuit output, i.e. load side of the thermistor, and the maximum output current (Isc) and VA should be limited to the specific values indicated in Table 8. Both the Isc and VA values should not be exceeded after one (1) minute at any load.

Since Table 8 only requires the output of a Limited Power Source to be limited to 8 amperes (or 150/Uoc for circuits up to 60 V dc), Recognized (XGPU2) devices may be used without test if it can be determined that the device's marked or stated rating will limit the available current to the Table 8 limits within one minute.

The following Condition of Acceptability has been added to some component PTC Reports when requested by the component manufacturer:

"These devices act as a current limiting impedance, per the National Electrical Code (NEC), Table 73-31(b), Note 1. When used in a draft free environment of 25°C, these devices will limit the abnormal current to 8 amps within 5 seconds. Temperatures higher than 25°C will cause a faster trip rate; temperatures lower than 25°C or other heat sinking (such as substantial air movement) will have the opposite effect."

A Recognized PTC device with the above Condition of Acceptability which is used per its ratings may be considered a suitable limiting impedance which provides a Limited Power Source in accordance with Sub-clause 2.11 and Table 8. This device may be accepted without test and may replace an existing fuse used to comply with Table 9.

Other Considerations — The following additional considerations are important when determining the suitability of PTC devices in current limiting applications used to meet the requirements of the Standard:

Conditions of Acceptability — The Conditions of Acceptability for the thermistor should be reviewed to determine the suitability of the device's installation and operation.

Temperature — Under normal operating conditions, these devices dissipate power, albeit small amounts, in the form of heat. Therefore, temperatures on and adjacent to the PTC devices should be considered and should not exceed specified temperature limits.

Ambient Temperature — The trip characteristics of thermistors are temperature (ambient) sensitive. In general, thermistors are rated based on anticipation of placement in a 25°C ambient. Installation of the device in a higher ambient will cause the device to trip faster. Conversely, in an ambient lower than 25°C, or in an area where significant heat sinking takes place (such as in the path of substantial air movement generated by fan cooling), the devices will tend to have a slower trip rate. Additional end product measurements to confirm trip times may be required in some environments.

Current Hold and Trip Ratings — Thermistors usually have hold and trip current ratings. The hold rating is the maximum current at which the device will not trip. The trip rating is the rating at which the device is designed to trip, although not immediately. Between these two ratings, the device may or may not trip. Typical ratings may be 3.5 A, hold, 7.0 A, trip. For device with these ratings, the actual time required to trip the device at 15 A could be as long as 15 seconds.

Note: the above ratings may not be easy to correlate with Table 8 requirements without test. The example Condition of Acceptability described above is much more useful.

Abnormal Current Characteristics — If the Recognized Component Report does not have the Condition of Acceptability described above and if it cannot be determined that the current hold and trip ratings meet Table 8 requirements, determination that the PTC device complies with Table 8 parameters may be made by reviewing the Test Record for the device. The Test Record may show that the device trips within one minute at a current level not exceeding the VA limit.

Maximum Current (Interrupt) Rating — Thermistor devices are tested during the UL Recognition on supply circuits with known and documented current capacity. This source current capacity is specified in the UL Recognition report of the device and is typically known as the maximum current (interrupt) rating.

This rating is important because the circuit that the device is placed in should have a power source limitation not exceeding the maximum current (interrupt) rating.

The power source power capability often can be determined by reviewing power supply output measurements.

Automatic Restart of the Equipment — Although not a common concern, PTC devices are resettable. Potential hazards (hazardous energy levels, injury to persons) to operators or service personnel resulting from PTC's resetting should be considered. Most thermistors are designed to latch in an open state and cannot be reset unless they are sufficiently cooled and power is removed from the circuit.

Descriptive Report — The UL Report will describe the thermistor by category (CCN), manufacturer and type designation. Spacings to other components or parts may also be applicable. For further reference, the maximum trip rating and maximum current (interrupt) rating for the device may be provided within parentheses in the component description.

Alternate Component Requests — Additional thermistor devices may be added as alternates without additional testing, if the parameters of the circuit for the alternate device are compatible with the (1) Maximum Trip Rating or Abnormal Current Characteristics and (2) Maximum Current (Interrupt) Rating.

RATIONALE:

Generally, when used in ITE to meet the requirements of the Standard, PTC devices are used in the output circuits of Limited Power Circuits. When used in current limiting applications, PTC resistors more closely resemble fixed impedances than traditional overcurrent protective devices. Therefore, if used in a Limited Power Source, the combination of the PTC device and transformer should be evaluated for compliance with Table 8, similar to the investigation required of fixed impedances.

Since UL has a component category for PTC devices and the reliability of a PTC device is critical, PTC devices used to meet the requirements of the Standard preferably should be UL component Recognized under the product category Thermistor Type Devices (XGPU2) and subjected the requirements outlined in Subject 1434. This guideline provides same considerations and advantages of using Component Recognized (XGPU2) devices. However, since Subject 1434 is contained in Annex P.2 and not Annex P.1, the use of Recognized Component (XGPU2) devices is not mandated.

OTHER:

SEE RELATED PAG:

PAG No. 3:001

(Sub)CLAUSE/ANNEX NUMBER: 3

(Sub)CLAUSE/ANNEX HEADING: Wiring, Connections and Supply

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Component Recognized (QQGQ2) power supplies usually contain a Condition of Acceptability that the acceptability of the output wiring method is to be judged in the end-use product. However, for Listed (QQGQ) power supplies, output wiring methods are considered as part of the Listing investigation.

What are the output wiring requirements for Listed (QQGQ) power supplies?

APPLICATION GUIDELINE:

UL Listed power supplies should comply with all the applicable output wiring requirements, including these most significant ones:

Sub-clause 1.1.1

Wiring methods shall be in compliance with NFPA 70 (NEC) and CSA C22.1 (CEC).

Annex NAE (Sub-clause 1.7)

The QQGQ Guide Information requires the output connection to be marked with a voltage and current rating.

The QQGQ Guide Information also permits the manufacturer to mark the output "LPS" if the output complies with Sub-clause 2.11. Although the marking is optional, it will permit OEMs and safety engineers who incorporate the power supply into end products to apply less stringent requirements in the end product. Example — fire enclosure not required around circuitry supplied by a Limited Power Source.

Annex NAE (Sub-clause 1.7.2) [Annex NAA (3.3.9)]

Wiring connections that are evaluated as NEC Class 2 outputs and that are intended to be field wired are required to be marked "NEC Class 2" or "NEC Class 2 Output." Relaxation of wiring requirements, including use of wire wrapping and exposed terminal blocks, are permitted for such marked products.

Sub-clause 3.1.2

Requires all wiring, including wiring installed in the field, to be free from mechanical damage due to burrs, sharp edges, etc.

Sub-clause 3.1.12

Provides wiring requirements for external wiring and cables supplied with the power supply, and strain relief requirements.

Annex NAE (Sub-clause 3.2.2)

Provides connection requirements for constructions requiring NEC/CEC field wiring methods. Also, see Sub-clause 3.2.8.

Annex NAE (Sub-clause 3.2.8)

Requires compliance with NEC/CEC wire bending space/volume requirements for constructions requiring NEC/CEC field wiring methods.

Sub-clause 3.3.1

Terminal connections should be made by reliable methods, such as screws, nuts, etc.

Sub-clause 3.3.2

Soldered, welded, crimped and similar connections are permitted for connection of external conductors. However, consideration must be given to loose strands, broken conductors, temperature rise of connections, etc.

Annex NAE (Sub-clause 3.3.3)

Wire binding screws are not permitted to attach conductors larger than 10 AWG.

Annex NAE (Sub-clause 3.3.5)

Terminals are required to permit connection of a range of conductor sizes as specified in the sub-clause and the NEC/CEC.

RATIONALE:

The Guide Information for QQGQ indicates that Listed power supplies meet all requirements in this Standard. Therefore, it would be inappropriate to include a Condition of Acceptability that the suitability of wiring methods needs to be determined in the end product.

This Application Guideline summarizes the main requirements that are applicable to output wiring constructions. Compliance with the stated requirements will provide full compliance of the power supply to this Standard's wiring method requirements.

OTHER:

SEE RELATED PAG:

PAG No. 3.1.1:001

(Sub)CLAUSE/ANNEX NUMBER: 3.1.1

(Sub)CLAUSE/ANNEX HEADING: Wiring, Connections and Supply-General

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex NAE (3.1.1)

DESCRIPTION OF ISSUE:

Sub-clause 3.1.1 requires all internal wiring used in the distribution of primary power to be protected against over-current and short circuit conditions by suitably rated protective devices. The examples (Note) and Annex NAE (3.1.1) describe, or reference the NEC/CEC for overcurrent protection that is considered suitably rated for the application, but does not specify component requirements, other than ratings, for the protective devices.

Is a UL Component Recognized Supplementary Protector (QVNU2), which is marked with a rating equivalent to the value described in the Note, Annex NAE or NEC/CEC reference, a "suitably rated" protective device, or must the device be a UL Listed Circuit Breaker with a suitable rating?

APPLICATION GUIDELINE:

For protection of internal wiring, either a UL Listed Circuit Breaker or a Component Recognized Supplementary Protector may be used to meet the overcurrent device specifications outlined in the D1 Deviations of Sub-clause 3.1.1, Annex NAE (3.11) or the referenced NEC/CEC Section. Acceptability is based on the marked rating of the device.

When suitably rated Component Recognized Supplementary Protection is used in a circuit permitted by its Conditions of Acceptability, no additional end product testing will be required to determine compliance with Sub-clause 3.1.1.

RATIONALE:

The Notes of Sub-clause 3.1.1 and Annex NAE (3.1.1) summarize constructions, based on NEC/CEC considerations and field experience, that are considered to meet the intent of the first three paragraphs of the sub-clause. These constructions are provided to limit the amount of end product evaluation or testing required to determine compliance with the internal wiring overcurrent and short circuit protection requirement.

Although Component Recognized Supplementary protectors are not subjected to the same level of investigation (and Follow-Up) as UL Listed Circuit Breakers, they are subject to both construction and performance requirements. Although they may have less (or more) stringent breaking characteristics than Listed circuit breakers, the minimum level of investigation conducted on these devices is considered to meet the intent of the requirement.

Among the main considerations that support the UL Position are a) the BNWG Working Document, dated 7/28/95, states "it was clarified that the conductors provided with overcurrent protection in accordance with the NEC and CEC are considered to meet the requirements in Sub-clause 3.1.1, but it is not required that the overcurrent protection comply [i.e. be "Code-type"] with the NEC and CEC;" b) the protector is installed at the manufacturing location (not in the field); c) the type of equipment in which the Supplementary protector is installed is known and evaluated; and d) wiring that is protected by the Supplementary protector is located behind an electrical and fire enclosure.

OTHER:

SEE RELATED PAG:

PAG No. 3.1.3:001

(Sub)CLAUSE/ANNEX NUMBER: 3.1.3

(Sub)CLAUSE/ANNEX HEADING: Securing of Internal Wiring

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.3.3.1, 2.9.1, 3.1, Annex P

DESCRIPTION OF ISSUE:

Sub-clause 3.1.3, and other Sub-clauses within 3.1, require internal wiring to be routed, supported, clamped or secured so that wires are not damaged, conductors do not put strain on terminals and clearance/creepage distances are not reduced.

If a wire positioning device (e.g. wire tie, positioning mount, etc.) is used to assure that internal wiring meets the requirements in the Standard, what steps should be taken to determine that the device is suitable?

APPLICATION GUIDELINE:

All wiring positioning devices used to meet the requirements of the Standard shall be investigated for suitability.

The most straightforward and preferred method to determine suitability is through the use of Recognized Components (ZODZ2) evaluated to the Standard for Wire Positioning Devices, UL 1565. Devices meeting UL 1565 have been subjected to related constructional and performance requirements and have been deemed reliable for securing wires.

Non-Recognized devices may be used, but still are required to be suitable for the application. Since they are not Recognized, an end product engineering evaluation may be required. This evaluation to determine suitability may require a review of component specifications (e.g. temperature rating, maximum number of wires recommended, etc.) and consideration of component performance testing (e.g. Pull Test per Sub-clause 2.9.1). Additionally, the suitability of the device's adhesive properties may need to be determined.

Devices not UL Recognized, but required for compliance of the equipment to the Standard, will be individually controlled in the UL Report since they are critical components. A description of the construction, including manufacturer, type no., dimensions, adhesive material, may be required.

RATIONALE:

The Standard requires that wires should be held in place if a loose wire could lead to a hazard. For example, Method 1 (Sub-clause 2.3.3.1) may require wires to be separated permanently by "barriers, routing or fixing." If a wiring positioning device is used to meet this requirement, it should be reliable. Since UL has published requirements for wiring positioning devices, use of devices meeting UL 1565 is the most straightforward method of complying with the intent of the Standard.

However, since UL 1565 is not listed in Annex P.1, the use of Recognized UL 1565 devices is not mandated. Nevertheless, all devices should be investigated for suitability in the application if they are being provided for the construction to meet the requirements of the Standard.

OTHER:

SEE RELATED PAG:

PAG No. 3.1.12:001

(Sub)CLAUSE/ANNEX NUMBER: 3.1.12

(Sub)CLAUSE/ANNEX HEADING: Interconnecting Cables

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex NAE (3.1.12)

DESCRIPTION OF ISSUE:

What are the construction requirements for "jacketed appliance wiring material", 3.05 meters (10 feet) or less in length, which is described in the third paragraph (D1 Deviation) of Sub-clause 3.1.12?

APPLICATION GUIDELINE:

The cable should be a Recognized AWM (AVLV2) that is suitable for the electrical and thermal operating parameters of the circuit in which it is used. The cable jacket should be surface marked VW-1 (or FT-1) or separately tested for equivalent flammability, and the AWM Style Page should indicate that the cable is suitable for external use. There is no minimum jacket thickness requirement.

RATIONALE:

Because the described cable assemblies which are 3.05 meters or less in length may contain primary or non-power limited circuits, the cable assembly should be a Recognized Component AWM and should have been subjected to the minimum AWM requirements applied to external use cables. This position is consistent with the intent of the first paragraph of Sub-clause 3.1.12.

However, since there is a length requirement provided as part of the Deviation, the concern that the cable may be subjected to significant mechanical abuse is minimized. Therefore, a minimum jacket thickness is not specified.

OTHER:

SEE RELATED PAG:

PAG No. 3.3:001

(Sub)CLAUSE/ANNEX NUMBER: 3.3

(Sub)CLAUSE/ANNEX HEADING: Wiring Terminals for External Primary Power Supply Conductors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

If a terminal block is used as a field wiring terminal, what are the component requirements for the terminal block?

APPLICATION GUIDELINE:

In addition to meeting the requirements for terminals described in Sub-clause 3.3, the terminal block should comply with the component requirements in Annex P.

Technically, a terminal block used for field wiring does not need to be Component Recognized (XCFR2) to the Standard for Terminal Blocks, UL 1059, and be suitable for field wiring under its Recognition, because UL 1059 is in Annex P.2 and not Annex P.1.

However, Annex P.1 requires field wiring connectors (terminals) to comply with the Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors, UL 486A; Wire Connectors for Use with Aluminum Conductors, UL 486B; or Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E, which also is required by UL 1059. In addition, UL 1059 also addresses general performance, tightening, strength of insulating base, etc., which also are general Sub-clause 3.3 considerations.

Therefore, use of terminal blocks that meet UL 1059 field wiring requirements is beneficial because it allows determination of compliance with both the considerations for field for terminals outlined in Sub-clause 3.3, and the component requirements in Annex P.

RATIONALE:

Sub-clause 3.3.7 describes a number of considerations that apply to terminal blocks used for field wiring, including concerns with contact pressure, terminal loosening, insulation damage, etc. Compliance by mere inspection is very difficult.

Annex P contains component requirements for terminal blocks. Although UL 1059 is not a mandatory component standard, it contains requirements which address most of the considerations mentioned in Sub-clause 3.3, and also address the Annex P.1 mandatory component requirements. Therefore, use of Recognized Component (XCFR2) terminal blocks suitable for field wiring is encouraged for field wiring applications.

OTHER:

SEE RELATED PAG:

PAG No. 3.3.4:001

(Sub)CLAUSE/ANNEX NUMBER: 3.3.4

(Sub)CLAUSE/ANNEX HEADING: Termination of (Power Supply Cord) Conductors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 3.3, 4.3.9

DESCRIPTION OF ISSUE:

Sub-clause 3.3.4 indicates that for purposes of applying the requirements for power supply cords, "conductors connected by soldering are not considered to be adequately fixed unless they are held in place near to the termination, independently of the solder. However, "hooking in" before the soldering is, in general, considered to be a suitable means for maintaining the conductors of a power supply cord in position, provided that the hole through which the conductor is passed is not "unduly large."

For non-detachable power supply cord conductors, including protective earthing conductors, should it be considered that a conductor may break, and what is the definition of "hooking in" before soldering?

APPLICATION GUIDELINE:

Since 3.3.4 does not indicate that wires are assumed to break and since Sub-clause 3.3.4 specifically mentions "hooking in" as a suitable means of securement (whereas Sub-clause 4.3.9 does not), breaking of power supply cord conductors is not assumed.

If the hole through which the conductor is passed is not "unduly large," hooking in should entail, as a minimum, a 180 degree bend before soldering.

If the hole through which the conductor is passed is "unduly large," the conductor should be provided with a 360 degree bend before soldering.

Engineering judgement must be used to determine if a hole is "unduly large". However, most terminals have openings which are "unduly large" because they are designed to accept a variety of conductor sizes. Therefore, most power supply cord conductors should be mechanically secured with a 360 degree bend.

This position is also applicable to protective earthing conductors of non-detachable power supply cords.

RATIONALE:

Sub-clauses 3.3.2 and 3.3.4 clearly state that power supply conductors which are mechanically secured (hooking in) and soldered are a reliable connection. Considering that a power supply cord conductor may break does not make sense based on Sub-clause 3.3.4's emphasis on reliable mechanical securement (why require mechanical securement if it is assumed that the wire may break?). Additionally, there are other constructional and performance requirements for power cords [including conductor size (Sub-clause 3.2.4) and strain relief (Sub-clause 3.2.5)] that supplement the securement requirement.

Since the 2nd dash of Sub-clause 3.3.4 makes a distinction between conductors passed through holes which are and are not "unduly large," applying different sets of requirements to each condition is valid.

Although engineering judgment shall be used to make the ultimate decision, terminal openings that require significant manipulation to route the wire through them generally are not unduly large, and a 180 degree bend and soldering will adequately secure the wire. Terminal openings that are designed to allow a variety of wire sizes to be routed through them are more likely to have a wire slip out of them and, therefore, should require a 360 degree bend for more reliable securement.

Sub-clause 2.5.9 (earthing) references Sub-clause 3.3 for non-detachable power supply cord earthing termination requirements with no additional considerations. Therefore, the same level of requirements should apply to both supply and earthing connections.

OTHER:

SEE RELATED PAG: 4.3.9:001, 4.3.9:002, 4.3.9:003

PAG No. 4.2:001

(Sub)CLAUSE/ANNEX NUMBER: 4.2

(Sub)CLAUSE/ANNEX HEADING: Mechanical Strength and Stress Relief

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Does exposed platen glass when used as part of the electrical, fire or mechanical enclosure ever need to be subjected to Mechanical Strength Testing, i.e. Push, Impact?

APPLICATION GUIDELINE:

Sub-clause 4.2.4 specifically indicates that the Steel Ball Test is not applied to platen glass. Therefore, this test is not required. Depending on the hazard located directly behind the glass (e.g. hazardous voltage, Class III laser), consideration for requiring some level of testing (e.g. push test), or internal barriers, may be applicable in some cases.

RATIONALE:

The Standard is clear regarding application of the Steel Ball Test to platen glass, and absence of documented Field Incidents to date has shown this approach not to present a problem. As with all hazards, the level of requirements applied should be appropriate for the hazard involved. It is not unreasonable to expect platen glass to withstand a 30 N (3 lb) Steady Force Test.

OTHER:

SEE RELATED PAG: 4.4.4:001

PAG No. 4.2.8:001

(Sub)CLAUSE/ANNEX NUMBER: 4.2.8

(Sub)CLAUSE/ANNEX HEADING: Mechanical Strength of Cathode Ray Tubes

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.2.1

DESCRIPTION OF ISSUE:

Recognized CRTs complying with the Standard for Cathode-Ray Tubes, UL 1418, have a Condition of Acceptability that the UL 1418 Impact and Implosion Tests need to be repeated in the end use product since the mounting of the CRT may affect the test results achieved during Component Recognition.

Should UL 1418 Impact and Implosion Tests be repeated in investigations of ITE products with these components in them?

APPLICATION GUIDELINE:

The UL 1418 Impact and Implosion Tests do not need to be repeated in the end use ITE if conventional mounting and securement means are used.

RATIONALE:

For a number of years the UL 1418 Impact and Implosion Tests have not been repeated in the end use EDP/ITE. Continuing with this practice is not considered likely to increase the likelihood of a hazard being introduced into ITE. Engineering judgment can be used to decide whether to test questionable designs.

Note: The UL 1418 Impact Test addresses different concerns (i.e. implosion) than the Impact Test previously required by UL 114 and UL 478 to address mounting integrity.

OTHER:

SEE RELATED PAG: 4.2.8:002

PAG No. 4.2.8:002

(Sub)CLAUSE/ANNEX NUMBER: 4.2.8

(Sub)CLAUSE/ANNEX HEADING: Mechanical Strength of Cathode Ray Tubes

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.2.1

DESCRIPTION OF ISSUE:

Should a CRT Impact Test be conducted on monitors to determine if the CRT mounting method to the enclosure is suitable and has adequate mechanical strength?

APPLICATION GUIDELINE:

An Impact Test to determine the suitability of the CRT mounting means should not be conducted on monitors that use conventional mounting methods.

RATIONALE:

Although the test was part of UL 478, 5th Edition (para. 21.13), it was not included in this Standard because of lack of test failures and reported field failures. Consult the Subjects 478 (114) meeting report dated March 25, 1988 "White Book", Page B304, for additional rationale.

OTHER:

SEE RELATED PAG: 4.2.8:001

PAG No. 4.3.9:001

(Sub)CLAUSE/ANNEX NUMBER: 4.3.9

(Sub)CLAUSE/ANNEX HEADING: Termination of Conductors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 3.3.4

DESCRIPTION OF ISSUE:

Sub-clause 4.3.9 indicates that if Reinforced or Supplementary insulation clearance/creepage distances could be reduced by a loose wire, "wires connected by soldering are not considered to be adequately fixed unless they are held in place near to the termination, independently of the soldered connection."

When Reinforced or Supplementary insulation clearance/creepage distances could become reduced if an internal wire became loose by breaking, is it plausible to consider that a stranded wire may break at a termination (e.g. appliance inlet terminal, PWB connection), thus requiring another mechanical securement point other than the physical termination?

APPLICATION GUIDELINE:

For eyelet-style terminals and PWB connections associated with internal wiring, where a single conductor is wrapped (or threaded through an opening) and soldered, it is plausible to assume that a wire may break at a termination point if Reinforced or Supplementary insulation spacings could be reduced as a result of the breaking. Therefore, even a 180 degree bend and solder may not be adequate securement of a wire to a terminal if Reinforced or Supplementary spacings could be reduced by a broken wire.

The wire is assumed to break at the exact point of termination, typically at the outer surface of the terminal or connection.

Engineering judgement should be used to determine the extent of the movement associated with a broken wire. However, generally the wire should not be moved using unreasonable force and unrealistic manipulation.

For most applications, gravity should be the governing factor when determining the extent of movement associated with a broken wire. A broken wire may be moved to any point along an arc caused by gravity as though the wire were free swinging. Additionally, the wire should be moved to any point within 15 degrees on either side of the arc formed by the movement of the wire.

For some smaller gauge wires (e.g. 22 — 27 AWG), it may be appropriate to consider the influence of spooling (during original manufacturing) on the wire and the natural movement of a broken wire.

Additionally, all normal mounting positions of the equipment should be considered, and if the equipment may be operated in any one of several positions, the effect of gravity should be considered with the equipment in all positions.

For example, since power supplies used in PC's may be mounted in numerous positions, and since a PC may be used in a table top or tower configuration, the effect of gravity on broken wires in such power supplies should be considered for all probable positions.

It is not assumed that a wire to which a connector is double-crimped (crimped to both conductor and insulation) will break.

RATIONALE:

The intent of the requirement in Sub-clause 4.3.9 is to prevent Reinforced or Supplementary insulation from being compromised if internal wiring (not power supply cord conductors or earthing) becomes loose or falls out of position from a single means of securement.

Wires that are likely to break are single, smaller gauge, stranded conductors that are connected to eyelet-style terminals or PWBs. Because the procedure of stripping wire insulation and mechanically securing and soldering the wire to a termination may damage the wire's inherent mechanical strength, the concern with breaking is valid.

Since the third dashed paragraph of Sub-clause 4.3.9 indicates that "wires connected by soldering are not considered to be adequately fixed unless they are held in place near to the termination, independently of the soldered connection," and since the note does not mention "hooking-in" before soldering (as does Sub-clause 3.3.4), the position is considered consistent with the intent of the standard.

The position is also consistent with Sub-clause 2.3.8, which mentions "breaking," and is consistent with the Standard for Office Appliances and Business Equipment, UL 114, and the Standard for Information Processing and Business Equipment, UL 478 (5th Edition), requirements for Double-insulated products, where it was considered valid to anticipate the effects of a broken internal wire.

UL 478, 5th Edition, provided some good guidance for considering the movement of a loose wire based on gravity and this guidance may continue to be used.

Since equipment is often used or mounted in numerous positions, it is also valid to consider the effect of the equipment's operating position on the application of this requirement.

OTHER:

SEE RELATED PAG: 3.3.4:001, 4.3.9:002, 4.3.9:003

PAG No. 4.3.9:002

(Sub)CLAUSE/ANNEX NUMBER: 4.3.9

(Sub)CLAUSE/ANNEX HEADING: Termination of Conductors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Sub-clause 4.3.9 specifies considerations for internal wiring if a loose wire could become loose and bridge Reinforced or Supplementary insulation, but does not specify considerations if a loose wire could reduce Operational or Basic insulation.

If an internal wire is secured to a terminal or PWB and Operational or Basic insulation spacings could be reduced if the wire became loose, should it be assumed that the wire may break? If not, is the wire required to be mechanically secured and soldered to the terminal?

APPLICATION GUIDELINE:

There should not be a concern with a wire breaking if Basic or Operational insulation clearance/creepage distances could be reduced.

For clearance/creepage distances associated with Operational insulation, solder alone may be adequate for securing wires to a termination and another means of securement other than the solder generally is not required. (Thus, tack soldering may be acceptable.)

However, consideration should be given to the potential risk of fire if a soldered termination was to become loose. This consideration may be addressed by simulating potential faults as part of the Abnormal Operation test program. An unacceptable test conclusion (and construction) would result in risk of fire.

For clearance/creepage distances associated with Basic insulation, an unreliable termination could compromise a single level of protection against electric shock. Therefore, the termination of a wire to a terminal or PWB should incorporate a reasonable level of reliability. Although it need not be assumed that a wire may break at the termination, a sound means of wire securement is required, such as a 180 degree bend and soldering, or, as a minimum, the use of a closed-loop connector with a single crimp.

The mechanical securement of a wire to an eyelet should encompass no less than a 180 degree bend. The mechanical securement of a wire to a hole in a PWB should encompass a 90 degree bend, unless the hole is of such a minimal size that a wire would remain threaded in the hole if the solder was removed.

Power supply cords and permanent connections are subjected to a separate set of construction requirements that are outlined in Sub-clause 3.3.

Notes:

A 90 degree bend entails a right angle bend of a wire.

A 180 degree bend entails threading the wire through the opening and returning the wire towards the direction of the original threading motion.

A 360 degree bend entails threading the wire through the opening, returning the wire towards the direction of the original threading motion, and returning the wire once again in the direction of the original threading motion.

RATIONALE:

Operational insulation, by definition, does not protect against electric shock. Therefore, the main consideration associated with Operational insulation is that there should not be a risk of fire if a wire becomes loose. For wires that are not reliably secured (e.g. tack soldering), this concern may be addressed by simulating the bridging of Operational insulation during abnormal operation testing.

Because Basic insulation, by definition, provides a level of protection against electric shock, there is a minimum level of reliability associated with any construction that could compromise basic insulation. Since Basic insulation will have a second level of protection (i.e. earthing or Supplementary insulation) against electric shock, it is not considered necessary to assume that a wire may break. However, it is valid to require a 180 degree bend and solder for minimal mechanical securement.

OTHER:

SEE RELATED PAG: 3.3.4:001, 4.3.9:001, 4.3.9:003

PAG No. 4.3.9:003

(Sub)CLAUSE/ANNEX NUMBER: 4.3.9

(Sub)CLAUSE/ANNEX HEADING: Termination of Conductors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 3.3.4

DESCRIPTION OF ISSUE:

The third dashed paragraph of Sub-clause 4.3.9 indicates that "wires connected by soldering are not considered to be adequately fixed unless they are held in place near to the termination, independently of the soldered connection."

Application Guidelines 4.3.9:001 and 4.3.9:002 address the different needs for securement of wires when Supplementary/Reinforced Insulation could be compromised, or when Operational or Basic Insulation could be compromised, respectively. These Guidelines also address the possible breaking of wires.

When evaluating the mechanical securement of components to a printed wiring board when two or more leads are involved, should it be assumed that component leads may break, and do all component leads that are threaded through a PWB opening need to be bent 90 degrees before being soldered?

APPLICATION GUIDELINE:

For component leads (e.g. capacitors, transformers, etc.) it generally is not valid to consider that the component leads will break, regardless whether Basic, Supplementary or Reinforced insulation clearance/creepage distances could be reduced.

If the loosening of a component lead from a PWB termination would not result in a reduction of Reinforced or Supplementary insulation spacings by movement of the lead or component, the component lead does not need mechanical securement, other than the routing of the lead through the PWB opening before soldering.

If the loosening of a component lead could reduce Reinforced or Supplementary insulation, the component lead is required to have a minimum 90 degree bend, in addition to solder. However, unnatural manipulation of the lead is not required to make this determination. Again, the effect of gravity on the component should be the main consideration.

If the component or lead cannot be moved because the component is secured by three or more termination points, then the requirement is also met and a 90 degree bend is not required. Because transformers typically have multiple termination points, they are not required to have any leads bent 90 degrees before being soldered.

RATIONALE:

The intent of the requirement in Sub-clause 4.3.9 is to prevent Reinforced or Supplementary insulation from being compromised if a wire becomes loose or falls out of position from a single means of securement.

Since most component leads are solid wires of short length and have sufficient inherent mechanical strength, it generally is not valid to assume that a component lead may break.

If a component lead is mechanically secured with a 90 degree bend before being soldered, a deterioration of one of the means of securement will not result in the wire becoming loose and the required spacings being compromised.

Likewise, when a component is secured by three or more terminations, the design and mounting of the component generally will not permit the component to move if a single lead becomes loose. Therefore, none of the leads needs an additional means of securement other than routing through the PWB opening and soldering.

OTHER:

SEE RELATED PAG: 3.3.4:001, 4.3.9:001, 4.3.9:002

PAG No. 4.3.16:001

(Sub)CLAUSE/ANNEX NUMBER: 4.3.16

(Sub)CLAUSE/ANNEX HEADING: Openings in Sides of Enclosures

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.5, 4.4.6

DESCRIPTION OF ISSUE:

Polymeric fans are often provided adjacent to enclosure openings that do not strictly meet the Standard's bottom or side opening requirements. When located adjacent to a side enclosure, often the fan body is not recessed a distance (5 degree rule) that would prevent molten material from falling external to the enclosure. A strict interpretation of the Standard would require compliance with bottom opening requirements since material could exit the unit in the event of a fire.

What level of flexibility may be used when applying fire enclosure opening requirements when openings are required for fan airflow and when the fan has been subject to locked rotor testing?

APPLICATION GUIDELINE:

If the fan material is the only combustible material of concern with regard to exiting the unit in the event of a fire, flexibility can be used in applying enclosure opening requirements and a strict interpretation of the Standard is not required. However, accessibility requirements are still applicable.

RATIONALE:

Although most d.c. fans are not thermally or impedance protected motors (they typically have a sensing circuit), applying the locked rotor test provides some assurance that the fan will not start a fire due to overheating. Performance airflow requirements and lack of documented field problems provide additional support for allowing some flexibility.

Therefore, flexibility is permitted applying side and bottom fire enclosure requirement when the fan body and frame materials are the only combustible materials of concern that might exit the unit in the event of a fire. As long as internal material, locked rotor, and accessibility requirements are met, opening sizes exceeding fire enclosure limitations may be provided as needed for product air-flow requirements.

OTHER:

SEE RELATED PAG:

PAG No. 4.3.17:001

(Sub)CLAUSE/ANNEX NUMBER: 4.3.17

(Sub)CLAUSE/ANNEX HEADING: Mating Plugs and Sockets

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.3.4, 6.2.1.3

DESCRIPTION OF ISSUE:

Standard modular connectors (e.g. RJ-11, RJ-12, RJ-45) are used in ITE for a variety of functions, i.e. modem transmission, telecommunication input, data transmission, accessory interconnect, etc. What level of investigation is required to determine that the equipment meets the requirement of Sub-clause 4.3.17 (and the intent of Sub-clause 2.3.4), which requires that any misalignment of connectors in operator access areas shall not result in a hazard?

APPLICATION GUIDELINE

Consideration should be given to the mismating of modular connectors if:

a) Equipment has more than one modular connector, regardless of configuration, and one of the modular jacks is used for telecommunication purposes and the other is used for data transmission; or

b) A single modular connector is provided for data transmission and the equipment has capability for future expansion (e.g. personal computer cardcage).

If such a construction is evaluated, the requirement in Sub-clause 4.3.17 should be addressed by using one of the following approaches:

a) All modular connectors should be clearly marked to indicate the intended function of each (e.g. "TEL" or "Keyboard"); or

b) A simulated ringing voltage shall be introduced to the circuit associated with the modular connectors used for a function other than telecommunication transmission, similar to described in Sub-clause 6.2.1.3, to determine if any voltage due to mismating is transmitted to SELV circuits. Voltages in SELV circuits are to be monitored to determine that SELV levels are not exceeded. Since the mismating of connectors is considered an abnormal operating condition, a single level of protection is required to reduce or isolate the ringing voltage. An impedance or an isolating device may be used to accomplish this.

RATIONALE:

It is industry practice to use modular connectors for a variety of transmission functions, both telecommunication and data. Unfortunately, RJ-11 modular connectors easily mate with other configurations of modular connectors (e.g. RJ-12, RJ-45). Therefore, relying on configuration as a means of preventing mismating is unrealistic. The stated Application Guideline permits manufacturers to address the potential hazard associated with mismating either by a marking or a performance test.

OTHER:

SEE RELATED PAG:

PAG No. 4.3.18:001

(Sub)CLAUSE/ANNEX NUMBER: 4.3.18

(Sub)CLAUSE/ANNEX HEADING: Direct Plug-In Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex P (4.3.18)

DESCRIPTION OF ISSUE:

What options are available for UL certification of Direct Plug-In Units (DPIUs)?

APPLICATION GUIDELINE:

A DPIU intended for use with equipment covered by a variety of UL product categories should be Listed (EPBU) to the Standard for Class 2 Power Units, UL 1310, if supplied with Class 2 outputs, or should be Listed (QQFU) to the Standard for Power Units Other Than Class 2, UL 1012, if supplied with non-Class 2 outputs.

A DPIU intended for use with general ITE may be Listed (QQGQ) using this Standard under the category Power Supplies, Information Technology Equipment, Including Electrical Business Equipment.

A DPIU for use with a specific manufacturer's model of ITE that is shipped with equipment also may be Accessory Listed (NWGQ) using this Standard.

If Listed (QQGQ) or Accessory Listed (NWGQ), the DPIU will be investigated to significant requirements from other UL Standards that address considerations unique to DPIU constructions and that are not in this Standard. Mandatory Annex P.1, under Sub-clause 4.3.18, has references to the Standard for Attachment Plugs and Receptacles, UL 498, and Mechanical Assembly requirements in UL 1310.

DPIUs should not be Listed under NWGQ.

RATIONALE:

Since UL has general categories for DPIUs, DPIUs not intended for exclusive use with ITE should be evaluated to the appropriate UL standard that addresses stand-alone DPIUs, i.e. UL 1310 or UL 1012, as applicable. Note: Due to the disparity of requirements, if a Listed UL 1012 DPIU is submitted with ITE, additional UL 1950 considerations are applicable.

To address ITE manufacturers' needs, QQGQ Listing and NWGQ Accessory Listing have been made available as certification options for DPIUs.

Annex P.1 (4.3.18) indicates that a direct plug-in transformer shall comply with applicable requirements in the Standard for Class 2 Power Units, UL 1310 (and the Standard for Attachment Plugs and Receptacles, UL 498). UL 1310 addresses performance and construction requirements (e.g. weight/moment) that do not have similar requirements in this Standard. Therefore, even if a DPIU is Listed (QQGQ) or Accessory Listed (NWGQ), it shall meet the relevant requirements for DPIU constructions in UL 1310 (and UL 498).

OTHER:

SEE RELATED PAG:

PAG No. 4.3.21:001

(Sub)CLAUSE/ANNEX NUMBER: 4.3.21

(Sub)CLAUSE/ANNEX HEADING: Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.17

DESCRIPTION OF ISSUE:

Sub-clause 4.3.21 indicates that lithium cells "or batteries with similar hazards" shall be designed to prevent hazards due to mis-installation or faults in the protective circuitry.

Are nickel-cadmium batteries considered similar to lithium batteries, and are there any special considerations that should be given to their operation?

APPLICATION GUIDELINE:

Although Nickel-cadmium batteries generally are not considered to have the same potential for causing a hazard as lithium batteries, the general provisions of the Standard apply.

Consideration should be given to conducting abnormal operation (short circuit) testing on the battery (if removable), and testing per Sub-clause 4.3.21 on the battery charge/discharge circuitry in the equipment.

RATIONALE:

Field experience generally has not shown nickel-cadmium batteries to introduce the range of hazards posed by lithium cells. However, since some Ni-Cd constructions may have significant power availability, conducting abnormal operation testing of the individual batteries and their charge/discharge circuitry will address the basic concern that Ni-Cd batteries do not present a risk of fire in or out of the equipment.

OTHER:

SEE RELATED PAG: 1.7.17:001, 1.7.17:002, 4.3.21:002

PAG No. 4.3.21:002

(Sub)CLAUSE/ANNEX NUMBER: 4.3.21

(Sub)CLAUSE/ANNEX HEADING: Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.17

DESCRIPTION OF ISSUE:

May a Recognized Lithium Battery (BBCV2), which has not been evaluated as a rechargeable battery as part of its Recognition, or which does not contain all of the protection components specified in its Conditions of Acceptability, be used in charging applications within ITE evaluated to this Standard?

APPLICATION GUIDELINE:

Recognized Lithium Batteries may be used in applications outside of their Recognition if (a) the battery manufacturer designates (specifications, etc.) the battery a rechargeable type, and (b) the battery is subjected to the abnormal operation tests specified in 4.3.21 of this Standard.

Testing per 4.3.21 includes discharging and charging under single component fault conditions for a period of 7 hours. For applications where a battery is used outside of its Recognition, any component may be short-circuited, including current-limiting resistors.

RATIONALE:

Recognized Lithium Batteries (BBCV2) are classified as either rechargeable or non-rechargeable. **Non-rechargeable** lithium batteries require two blocking components (diode) or a blocking component and a current limiting component (resistor) in its circuit. A **rechargeable** lithium battery only requires a current limiting component. However, most ITE constructions with lithium batteries trickle-charge the battery and usually do not contain a blocking component. Also, there are few BBCV2 Lithium Batteries that have been evaluated as rechargeable.

Sub-clause 4.3.21 of this Standard states that circuits employing lithium batteries shall be designed to prevent forced charge and discharge if this would result in a hazard. Compliance is checked by inspection and "evaluation of data provided by the equipment manufacturer and battery manufacturer."

Recognized Lithium Batteries generally will not need testing if used within their Recognition, i.e. the Conditions of Acceptability are adhered to. This "data" satisfies us that the operation of the battery is safe. If the batteries are used outside of their Recognition, 4.3.21 permits additional considerations, i.e. end product performance testing.

This position is justified because (a) manufacturers sometimes design batteries as rechargeable, although they have not been tested as such per their Recognition; (b) there are very few Recognized Lithium Batteries that are suitable for recharging, especially since the UL requirements for rechargeable batteries are new; (c) it is ITE Industry practice to trickle charge batteries in ITE, mandating that UL consider such constructions if they can be shown not to present a hazard; and (d) internationally, there are no lithium battery standards or requirements other than what is specified in end product standards. The same Recognized Lithium Batteries when used internationally, are subjected to no component level requirements.

OTHER:

SEE RELATED PAG: 1.7.17:001, 1.7.17:002, 4.3.21:001

PAG No. 4.3.21:003

(Sub)CLAUSE/ANNEX NUMBER: 4.3.21

(Sub)CLAUSE/ANNEX HEADING: Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.2, 5.1, 5.6

DESCRIPTION OF ISSUE:

What are the construction and performance requirements for a battery charger (with battery packs) when the battery charger is evaluated under the Standard as part of either an end product investigation or part of an Accessory Listing investigation?

APPLICATION GUIDELINE:

Construction: The following considerations should be given to battery chargers (and packs) during the construction evaluation:

a) A marking should be provided on the battery charger indicating the specific model of ITE for which the battery charger is to be used;

b) The charger should be marked to indicate the battery pack (mfg./type/rating) for which the battery charger is to be used;

c) The battery charger and battery pack constructions should be controlled in the UL Follow-Up Procedure.

Performance: The following considerations should be given to the performance test program established for battery chargers:

a) For external stand-alone battery chargers that have the capability of supplying ITE with power, a Heating Test (Sub-clause 5.1) should be conducted with the battery charger supplying the ITE load. Discharged battery packs should be replaced with fully charged battery packs until thermal equilibrium is achieved;

b) For all battery charger circuits, a Heating Test (Sub-clause 5.1) should be conducted with the battery charger charging battery packs that have been fully discharged;

c) If the battery charging circuit is supplied by a transformer, a Transformer Overload (C1) Test should be conducted on the transformer that supplies the charging circuit;

d) An Abnormal Operation Test program (per Sub-clauses 4.3.21 and 5.4.6) should be designed anticipating possible foreseeable fault conditions, including a short circuit of the battery charger output (if user accessible) and reverse polarity testing of the charger input (if the battery charger input connector is not polarized).

RATIONALE:

Battery chargers evaluated under this Standard introduce some unique considerations into equipment evaluations. Battery chargers are typically designed for specific size (power) battery packs and use of battery packs other than that specified by the manufacturer could create a hazard. Therefore, it is prudent to require correlation marking between charger unit and battery pack.

Battery charger circuits typically are supplied power by a transformer. During the charging cycle, the transformer may be subjected to a different set of thermal conditions than experienced during other normal load testing, and it is more likely that a transformer supplying the charger circuit will be subjected to an overload condition. Therefore, requiring a transformer overload test.

OTHER:

SEE RELATED PAG: 4.3.21:004, P(1.5.2):001

PAG No. 4.3.21:004

(Sub)CLAUSE/ANNEX NUMBER: 4.3.21

(Sub)CLAUSE/ANNEX HEADING: Batteries

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.17, 5.4.6, 5.4.7, 5.4.8, 5.4.9

DESCRIPTION OF ISSUE:

For battery packs (e.g. nickel-cadmium (Ni-Cad), nickel-metal hydride (Ni-mh), alkaline, etc.) that may be removed from equipment and transported or stored, what is the level of investigation that should be conducted on the battery pack to determine that it does not contribute to a hazard when transported or stored outside of the equipment?

APPLICATION GUIDELINE:

Battery packs that can be removed from equipment and transported or stored should be subjected to an abnormal operating condition test simulating a short circuit of the battery terminals using the general parameters for conducting abnormal condition testing outlined in Sub-clauses 5.4.6 — 5.4.9. The test should be conducted on all removable battery packs, regardless of contact design.

While in a fully charged condition, the battery pack terminals should be subjected to a short circuit condition with a minimum length of No. 16 AWG (1.3 mm^2) copper wire.

The test should be conducted on a tissue paper covered soft wood surface and the sample should be covered with a single layer of cheesecloth.

The test should be conducted until a fire or explosion is obtained, or until the battery pack is completely discharged and the battery case ambient has returned to near ambient temperature.

If a thermal protector opens, it shall be controlled in the UL descriptive report. Component Recognition is the minimum requirement for the thermal protector, with no minimum cycling requirement.

RATIONALE:

Since battery packs may be stored or transported outside of equipment, it is valid to have a concern with the battery initiating a fire outside of the equipment.

Sub-clause 5.4.7 allows consideration of abnormal operation testing "that may be expected in normal use and foreseeable misuse." Testing parameters are adequately outlined in Sub-clause 5.4.9 (with additional consideration given to the battery short circuit test parameters outlined in the Standard for Lithium Batteries, UL 1642, which is used to test Recognized Component Ni-Cad batteries).

Also, references to both the Standard for Temperature-Indicating and -Regulating Equipment, UL 873; and the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, UL 1020, are in mandatory Annex P.1.

OTHER:

SEE RELATED PAG: 4.3.21:001, 4.3.21:003

PAG No. 4.4:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4

(Sub)CLAUSE/ANNEX HEADING: Resistance to Fire

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.3, 4.4.4, Annex A, Annex NAE (4.4.4)

DESCRIPTION OF ISSUE:

What are the flammability requirements for wood when used in ITE as an enclosure, decorative or internal part?

APPLICATION GUIDELINE:

Engineering judgement may be used to determine if wood, whether used as an enclosure, decorative or internal part, is required to be subjected to the flammability testing described in this Standard.

Constructions of hardwood and presswood of substantial thickness, which will obviously comply with Annex A testing, may be accepted without test. Other less substantial constructions of questionable nature with regard to flammability should be tested.

Additionally, flame-spread requirements are applicable for materials that have an exposed surface area greater than 0.93 m^2 or a single dimension larger than 1.83 m.

RATIONALE:

Precedence of allowing some wood constructions without test is established in several UL product categories (e.g. Audio/Video, Household and Commercial Furnishings). The practice within these categories, and similar precedence within the EDP and Office Appliance categories, has not indicated a problem.

Furthermore, most wood used in ITE is in a configuration and thickness not considered easily ignitable considering that it generally is difficult to ignite wood at a location other than at its edge.

For constructions with large surface areas, flame-spread is a valid consideration regardless of material type or thickness.

OTHER:

Most Certification Agencies require all wood to be subjected to Annex A testing.

SEE RELATED PAG:

PAG No. 4.4:002

(Sub)CLAUSE/ANNEX NUMBER: 4.4

(Sub)CLAUSE/ANNEX HEADING: Resistance to Fire

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex A

DESCRIPTION OF ISSUE:

For compliance with this Standard's flammability requirements, what level of importance is placed on the assigned Relative Thermal Index (RTI) of Recognized Component Plastics (QMFZ2) used either as internal parts or fire enclosures?

For example, what is the consequence of using a Recognized Component Plastic which exceeds its RTI when measured during an end product Heating test.

APPLICATION GUIDELINE:

Recognized Component Plastics with acceptable flame ratings (e.g. 94V-2 for internal parts) and used within their Recognized RTI (also considering Tmra) are not subjected to additional flammability considerations.

Recognized Component Plastics with appropriate flame ratings, but which are not used within their Recognized RTI, are subjected to additional flammability considerations and generally will have to be subjected to additional Annex A flame testing. This testing includes appropriate pre-conditioning based on the maximum measured temperature of the part.

RATIONALE:

A Recognized Plastic (QMFZ2) flame rating is valid if the material is used within its assigned RTI. A material used outside of its assigned RTI may not exhibit the same flammability characteristics that were assigned to it during the Recognition of the material.

However, since this Standard does not require the use of Recognized Component Plastics and does not consider a material's RTI into its Annex A flame requirements, if a Recognized material is used outside of its Recognition, it still may be accepted if it is subjected to additional Annex A flame testing to confirm compliance with this Standard's requirements. Annex A includes short term conditioning considerations; generally 7 day aging at a uniform temperature 10 K higher than the maximum temperature reached (also considering Tmra), or 70°C, whichever is higher.

OTHER:

SEE RELATED PAG:

PAG No. 4.4.3:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4.3

(Sub)CLAUSE/ANNEX HEADING: Flammability of Materials and Components

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.3.3

DESCRIPTION OF ISSUE:

What are the material flammability requirements for internal disposable parts constructed of polymeric or paper-product materials?

Examples of parts addressed in this application are dry/wet toner containers and cartridges, ink containers, compact disks, tape cartridges, etc.

APPLICATION GUIDELINE:

A disposable part is a part that is expected to be replaced periodically throughout the life of the product.

There are no minimum flammability requirements for disposable parts constructed of combustible materials if the parts are segregated from other parts in accordance with the guidelines provided in Sub-clause 4.4.3.3.

Summarizing the segregation guidelines in Sub-clause 4.4.3.3, the combustible materials should be separated from electrical parts (other than insulated wire and cables), which under fault conditions are likely to produce a temperature that could cause ignition, by at least 13 mm of air or by a solid barrier of material of flammability Class V-1 or better.

If the disposable part is a polymeric material and it is not provided with the minimum separation or a suitable barrier, the disposable part material should be rated V-2 or better.

If the disposable part is a paper product and it is not provided with the minimum separation or a barrier, a construction change likely will be required so that adequate separation or a barrier is provided.

The use of sheet or roll paper, such as that required for copiers and facsimile machines, is not restricted by these guidelines.

Note: All non-disposable parts should be evaluated to the level of requirements already specified in the Standard.

RATIONALE:

Although Sub-clause 4.4.3.3 states that containers for powders are required to be constructed of materials with a minimum HB flammability level, disposable parts often do not meet this requirement. For reasons related to recyclability and similar issues, these parts are constructed of low-grade materials that often are not UL Recognized and that do not meet HB flammability requirements.

Additionally, although an equipment manufacturer may manufacture the original disposable part, replacement parts produced by other manufacturers are available off-the-shelf. Considering that it is industry practice to have disposable parts produced by manufacturers outside of control of the end use manufacturer, there is no assurance that most disposable parts will be replaced with parts having equivalent flammability levels.

Considering the above, it is prudent to address this issue by concentrating on the location of the part in the equipment and the likelihood that it will catch fire, rather than applying strict flammability requirements.

Paper, itself, is not subjected to specific material or segregation requirements since the suitability of paper is determined by conducting abnormal operation testing, e.g. paper jam under a heater.

OTHER:

IEC 950, Third Edition, will propose to add an exemption to internal material flammability requirements for "supplies, consumable materials, media and recording materials."

SEE RELATED PAG: 4.4.4:003

PAG No. 4.4.4:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4.4

(Sub)CLAUSE/ANNEX HEADING: Materials for Enclosures and for Decorative Parts

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Although Sub-clause 4.4.4 indicates that heat-resistant, tempered, wired or laminated glass complies without test to the enclosure material requirements, it does not contain the same exception for ordinary glass if optical or flatness requirements call for its use. May ordinary glass be used in ITE products if optical or flatness requirements call for its use?

APPLICATION GUIDELINE:

Ordinary glass can be used in ITE products if optical or flatness requirements call for its use.

RATIONALE:

Although not presently acknowledged in the Standard, industry practice is to use ordinary glass in certain constructions where optical or flatness requirements call for its use. Therefore, consideration should be given to accepting this construction if there is no significant hazard presented when used.

OTHER:

IEC 950, Third Edition, proposes to exempt all "glass" from flammability considerations.

SEE RELATED PAG: 4.2:001

PAG No. 4.4.4:002

(Sub)CLAUSE/ANNEX NUMBER: 4.4.4

(Sub)CLAUSE/ANNEX HEADING: Materials for Enclosures and for Decorative Parts

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When considering a Recognized Component Plastic for compliance with the Class 5V material flammability requirement (for a stationary equipment fire enclosure), is a Recognized Component Plastic with a 94-5VA or 94-5VB flammability rating considered equivalent to a Class 5V material?

APPLICATION GUIDELINE:

A Recognized Component material with either a 94-5V, 94-5VA, or 94-5VB flammability rating is considered to meet the Class 5V material flammability requirement.

RATIONALE:

Although there are slightly different test parameters for the flammability classifications of 94-5V, 94-5VA and 94-5VB materials, all these ratings can be considered functionally equivalent to meet the Class 5V requirement of this Standard. The burn-through relaxation allowed for 94-5VB materials is not considered incompatible with ITE.

OTHER:

IEC TC74 is developing a proposal to clarify this issue.

SEE RELATED PAG:

PAG No. 4.4.4:003

(Sub)CLAUSE/ANNEX NUMBER: 4.4.4

(Sub)CLAUSE/ANNEX HEADING: Materials and Enclosures for Decorative Parts

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When establishing flammability requirements for ITE fire enclosures, are disposable parts considered into the equipment mass determination?

APPLICATION GUIDELINE:

Disposable parts are not considered into the equipment mass determination when establishing flammability requirements for ITE fire enclosures.

Therefore, paper and toner cartridges for copiers and fax machines, ink-jet cartridges for ink-jet printers, and coins and paper money for cash registers are not considered part of the equipment mass when establishing flammability requirements for ITE fire enclosures.

RATIONALE:

The 18 kg mass specification distinguishing when V-1 and 5V materials are required for fire enclosures is not an absolute number that is based on extensive research and technical data. Like much criteria contained in product safety standards, this specification was established during the consensus process of developing IEC 950 fire enclosure requirements.

Considering the above, it makes practical sense to adopt this position when making mass determination for ITE fire enclosure requirements.

OTHER:

The stated position is consistent with the position outlined in the answer to Question No. 23 (dated October 14, 1995) of the TC74 Chairman's Advisory Panel. IEC 950, Third Edition, proposes to clarify the Standard and adopt the same position.

SEE RELATED PAG: 4.4.3:001, 4.4.4:004

PAG No. 4.4.4:004

(Sub)CLAUSE/ANNEX NUMBER: 4.4.4

(Sub)CLAUSE/ANNEX HEADING: Materials and Enclosures for Decorative Parts

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When establishing ITE fire enclosure material flammability requirements, are the individual or combined masses of accessories used with the base ITE considered into the overall mass determination of the base ITE?

For example, if an accessory collator unit is attached to a copier that weighs less than 18 kg, does the fact that the combination of the copier and collator weighs more than 18 kg require the copier and collator to use 5V material for polymeric fire enclosures?

APPLICATION GUIDELINE:

If any accessory with an individual fire enclosure is attached to an end product with an individual fire enclosure, then the combined mass of the units is not important. The end product and accessory mass determinations should be based on the individual masses of the individual units.

There is one significant exception to this position. If, as part of the process of connecting/attaching the accessory to the end product, part of the end product fire enclosure has to be removed and be replaced by the accessory enclosure, the mass determination for the end product should also consider the added mass of the accessory. An example of this construction is a table top copier whose bottom fire enclosure is removed when attached to an accessory paper tray/feeder which sits under the copier. If the combination of the units exceeds 18 kg, both units should be constructed of 5V materials.

RATIONALE:

The 18 kg mass specification distinguishing when V-1 and 5V materials are required for fire enclosures is not an absolute number that is based on extensive research and technical data. Like much criteria contained in product safety standards, this specification was established during the consensus process of developing IEC 950 fire enclosure requirements.

Considering the above, it makes practical sense to adopt this position when making mass determinations for ITE fire enclosure requirements.

OTHER:

The stated position is consistent with the position outlined in the answer to Question No. 23 (dated 10/14/95) that was presented to the TC74 Chairman's Advisory Panel. IEC 950, Third Edition, proposes to clarify the Standard and adopt the same position.

SEE RELATED PAG: 4.4.4:001, 4.4.4:003

PAG No. 4.4.5:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4.5

(Sub)CLAUSE/ANNEX HEADING: Conditions for Fire Enclosures

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.4, 4.4.6

DESCRIPTION OF ISSUE:

May fault condition testing be used as a method to determine whether equipment is required to meet the fire enclosure material requirements of Sub-clause 4.4.4, the fire enclosure conditions of Sub-clause 4.4.5, the fire enclosure construction requirements of Sub-clause 4.4.6, and the overall intent of the Standard?

APPLICATION GUIDELINE:

In theory and, sometimes, in practice, a sufficient level of fault condition testing may be conducted on a construction to determine whether a fire enclosure is required around internal parts that could ignite the enclosure and the equipment supporting surfaces if the parts ignited.

However, any decisions to waive enclosure material or opening requirements must be made very carefully and should be based on very sound engineering judgment. Testing must be sufficient enough to determine that the construction meets the full intent of the Standard.

For example, a decision to engage in a performance-based evaluation to determine that a fire enclosure is not required around a keyboard PWB or a linear power transformer is considerably simpler than the same decision being applied towards a switching power supply. In fact, it may end up being impractical and very expensive to waive fire enclosure requirements around a component such as a switching power supply, which is complex in operation and contains numerous components affecting the decision-making process.

If a decision is made to proceed with a performance-based evaluation to determine whether a true fire enclosure is required, testing of all components that could potentially cause an abnormal operation condition need to be considered. This testing may include components which are normally considered reliable, e.g. resistors. Furthermore, in addition to simple component fault testing, consideration should be given to other less-obvious factors that may not normally be considered, such as reliability of component and part connections, the quality of manufacturing, the short circuit current of the supply source used to test the equipment during fault testing, etc.

Additionally, consideration should be given to propagation of flames inside an enclosure from areas that may not be directly associated with the area of immediate concern, such as areas other than directly over the bottom enclosure openings.

If a sufficient level of fault condition testing is conducted on the equipment, and if a sound engineering decision can be reached that there is not a risk of fire in the equipment due to all fault conditions, enclosure materials with V-1 or 5-V ratings, or a bottom enclosure construction with restricted size openings may not be required around the internal components and parts because they have been shown to be not capable of starting a fire.

If a performance option is chosen to address fire hazard concerns, tighter Follow-Up Service control of the construction is required. Depending on the level of concern with the construction, control of printed wiring board trace layouts, individual components (manufacturers/type), and the physical layout of internal parts and components may be justified.

RATIONALE:

Sub-clause 1.2.6.2 defines a fire enclosure as a part of the equipment intended to minimize the spread of fire or flames from within. Furthermore, Sub-clause 4.4.6 states that the bottom of a fire enclosure shall provide protection under all internal parts which "under fault conditions" could ignite material likely to ignite the supporting surface.

The above references imply that a fire enclosure is not required around components in equipment if it can be thoroughly shown (through a sound engineering evaluation) that under fault conditions there is not a risk of fire inside the equipment. As a result, there should be some acceptable level of performance testing that will permit a determination to be made that a particular construction meets the intent of the standard, even if it does not comply with the strict material and construction requirements.

This Application Guideline outlines criteria to consider when making such a decision, and is considered consistent with both the Standard and principles of safety. Additionally, placing tighter control of the construction for UL Follow-Up Service addresses traditional UL concerns that critical constructions continue to comply with UL's requirements.

OTHER:

IEC 950, Third Edition, proposes to specifically state and clarify that where 5.4.6 fault testing is used "exclusively" (Method 2), a fire enclosure is not required.

SEE RELATED PAG:

PAG No. 4.4.5.2:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4.5.2

(Sub)CLAUSE/ANNEX HEADING: Components Not Requiring a Fire Enclosure

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.1, 4.4.3.3, 5.4.6

DESCRIPTION OF ISSUE:

Is a 94HB or 94V-2 PWB (with components mounted on it) acceptable in a secondary circuit supplied by a Limited Power Source if the PWB is located in a separate casing other than the main fire enclosure and abnormal operation testing per third dashed paragraph of Sub-clause 5.4.6 is conducted? (An example of this type of construction is a mouse or a keyboard.)

APPLICATION GUIDELINE:

If the PWB supplied by a Limited Power Source is provided in a separate casing outside of the main fire enclosure, PWBs more flammable than 94V-1 are permissible if abnormal operation fault testing per Sub-clause 5.4.6 is done.

RATIONALE:

Since the PWB is located external to the main fire enclosure, the PWB is not likely to catch fire due to a fire propagating from another part of the unit. The abnormal operation component fault testing addresses the likelihood of a fire starting inside the device itself.

OTHER:

SEE RELATED PAG:

PAG No. 4.4.5.2:002

(Sub)CLAUSE/ANNEX NUMBER: 4.4.5.2

(Sub)CLAUSE/ANNEX HEADING: Components Not Requiring a Fire Enclosure

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.5

DESCRIPTION OF ISSUE:

Per Sub-clause 4.4.5.2, circuits supplied by a Limited Power Source and complying with the specified material requirements are not required to have a fire enclosure.

If electronic circuits within a product are supplied power by a Limited Power Source, may the circuits being supplied Limited Power transform the voltage levels beyond the Limited Power Source limits, yet still not require a fire enclosure?

[This application applies to many lap top computers and other ITE where a high voltage electronic circuit originates from a Limited Power Source, from which the voltage is stepped up.]

APPLICATION GUIDELINE:

If an electronic circuit is supplied power by a Limited Power Source, normally it does not require a fire enclosure, even if parts of the circuit are operating at voltage levels beyond the limits which make up the Limited Power Source definition. Experience with electronic ballast-type circuits in ITE has shown the circuits not to increase the risk of fire. Therefore, generally they do not require additional evaluation. Other non-common constructions may be accepted based on abnormal operation testing per Sub-clause 5.4.6, if questionable by engineering judgement from a fire initiation stand point.

Note: Although a fire enclosure may not be required, there usually will be a need to provide a suitable electrical enclosure. In such cases, all applicable requirements for electrical enclosures shall be applied.

RATIONALE:

Limited power sources are defined by the amount of power that they are able to deliver to other circuits. Compliance with the definition is based on maximum voltage and current levels at the source, and secondary circuits supplied by this level of power are not considered likely to initiate a fire. The outlined position is taken based on experience, and because if a passive electronic circuit is supplied by a limited power source, the overall power level cannot increase (due to conservation of power), even if the circuit parameters change. Therefore, once a limited power source is established, most types of circuits supplied by the source are not considered more likely to start a fire even if the operating characteristics of the circuit change.

The fact that Sub-clause 4.4.5.2 requires the PWB and wiring to meet stringent flammability requirements provides further confidence that the likelihood of a fire starting and spreading in such circuits is minimal.

SEE RELATED PAG:

PAG No. 4.4.5.2:003

(Sub)CLAUSE/ANNEX NUMBER: 4.4.5.2

(Sub)CLAUSE/ANNEX HEADING: Components Not Requiring a Fire Enclosure

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 4.4.5

DESCRIPTION OF ISSUE:

Some accessory devices which are to be individually certified, are designed for use with a variety of host computers and do not require power from the host equipment. Such accessories typically are powered by a battery or a Direct Plug-In Unit (DPIU) and all circuit interfacing is signal-level communication, i.e. there are no direct connections to the dc power supply output, only interface through driver devices. The use of HB enclosure materials often is desired for these constructions.

For accessory devices that can be connected to a variety of computers through standard (e.g. SCSI, serial) ports, if a manufacturer requests to use an HB enclosure for the accessory device, must it be determined that a Limited Power Source (LPS) is available from the host equipment (computer) by performance testing, or can other considerations be entered into this determination?

APPLICATION GUIDELINE:

Engineering judgement in lieu of testing may be adequate to determine whether power greater than Limited Power Source (LPS) levels are available from the host computer and can be utilized by the accessory equipment. When such a determination needs to be made, it should be based on (a) the function of the accessory device, (b) a review of the accessory device schematic diagrams and (c) communication with the manufacturer to determine the characteristics of the circuit to which the accessory has been designed to interface with.

If it can be determined from a sound engineering evaluation that the accessory can only interface with a host system on a signal level (i.e., all pins protected by high impedance driver circuits), or the accessory is designed so it can only accept signal level (not d.c. power bus), the circuit supplying the accessory can be assumed to be a LPS and no fire enclosure will be required for the accessory device. This consideration is valid although the manufacturer and model of a host computer system may not be known.

RATIONALE:

By reviewing the schematics of the accessory device, it usually can be determined whether the connections to the host system are for signal-only data transfer or are for signal and low voltage d.c. power transfer. Particular attention should be given to any 5 V or 12 V direct connection circuits in the accessory that are required for LED's, Vcc, etc. Direct d.c. power circuit connections from the host computer are the types of circuits that cannot be assumed to be power-limited because of the unknown characteristics of the host computer.

Pin configuration and signal protocol (such as RS-232 or D-Sub) are not adequate alone to make the above judgment because standard data transfer protocols have unused pin assignments that may be designed to transmit low voltage dc power signals. However, a review of the accessory schematics will generally confirm or negate this concern.

If there is any question about whether the accessory input is designed or is likely to be connected to a non-power limited circuit, the manufacturer of the accessory should be consulted in an effort to make a sound determination.

If sound rationale cannot be established for accepting an HB enclosure without testing the host computer, the accessory device should comply with all fire enclosure requirements.

OTHER:

See CCA Decision 95/24 on 4.4.4.

SEE RELATED PAG:

PAG No. 4.4.6:001

(Sub)CLAUSE/ANNEX NUMBER: 4.4.6

(Sub)CLAUSE/ANNEX HEADING: Fire Enclosure Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Constructions (e.g. monitor) sometimes have bottom enclosure openings located directly below a horizontally mounted, 94V-1 or less flammable PWB. Although all materials above the PWB are not rated minimum 94V-1, may the construction be accepted as complying with Sub-clause 4.4.6, considering the horizontally mounted 94V-1 PWB a suitable barrier?

APPLICATION GUIDELINE:

For equipment not exceeding 18 kg, if the 94V-1 or less flammable PWB (a) is horizontally (not vertically) mounted over the openings, (b) complies with Figure 11, and (c) has no components mounted on the underside of the board (PWB is solder-side down), the construction may be considered as meeting basic Fire Enclosure construction requirements per the second dashed paragraph of Sub-clause 4.4.6. An electrical or mechanical enclosure still may be required, and accessible requirements remain applicable.

For equipment greater than 18 kg, and for stationary equipment, if the 94V-1 or less flammable PWB (a) is horizontally (not vertically) mounted over 40 mm^2 or less openings, (b) complies with Figure 11, and (c) has no components mounted on the underside of the board (PWB is solder-side down), the construction may be considered as meeting the intent of the third dashed paragraph of Sub-clause 4.4.6.

RATIONALE:

The construction described above meets the intent of Sub-clause 4.4.6 because: (1) flammable material falling on a 94V-1 PWB does not make a 94V-1 PWB more flammable; and (2) if solder drips during an abnormal condition, it typically is not hot enough to cause ignition of external materials. Also Sub-clause 4.4.6 allows an internal barrier which itself complies with the requirements for a Fire Enclosure, or allows a V-1 barrier over openings not larger than 40 mm^2.

OTHER:

The UL position is different than the CCA Decision on 4.4.6 which allows V-1 barriers over openings of any size for equipment exceeding 18 kg. This CCA Decision is not justified by IEC 950.

SEE RELATED PAG: 4.4.6:002

PAG No. 4.4.6:002

(Sub)CLAUSE/ANNEX NUMBER: 4.4.6

(Sub)CLAUSE/ANNEX HEADING: Fire Enclosure Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When a Limited Power Source (as defined in Sub-clause 2.11) is established on a printed wiring board, is it possible to waive bottom enclosure opening size restrictions under the part of the PWB that is on the load side of the derived Limited Power Source?

APPLICATION GUIDELINE:

For equipment not exceeding 18 kg, if (a) the PWB is constructed of V-1 material, and (b) the solder-side of the PWB is horizontally facing the bottom openings, the PWB may be considered the fire enclosure per Sub-clause 4.4.6. An electrical or mechanical enclosure still may be required, and accessibility requirements remain applicable.

For equipment greater than 18 kg, if (a) the PWB is constructed of V-1 material, (b) the solder-side of the PWB is horizontally facing the bottom openings, (c) a 5 degree downward projection (i.e. per Fig. 11) of the non-Limited Power portion of the PWB complies with Sub-clause 4.4.6 (i.e. 40 mm^2 or less openings), and (d) components in each circuit are spaced minimum 13 mm from each other, bottom enclosure opening restrictions may be waived completely on the load side of the Limited Power Source.

RATIONALE:

Considering that Sub-clause 4.4.5.1 only requires a fire enclosure "up to the point where the limited power source output criteria are met," and considering that other Sub-clause 4.4 requirements address propagation of fire on the PWBs, the above position is considered to meet the intent of the Standard.

OTHER:

SEE RELATED PAG: 4.4.6:001

PAG No. 4.4.6:003

(Sub)CLAUSE/ANNEX NUMBER: 4.4.6

(Sub)CLAUSE/ANNEX HEADING: Fire Enclosure Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Many monitors have swivel bases, some of which are removable either for shipping purposes or for wider installation options. The swivel base is typically secured to the monitor through snap fit openings which are provided in the bottom of the monitor fire enclosure. Due to the size of the openings required for the base to snap into the monitor, the monitor's entire bottom enclosure often does not meet the strict definition of a fire enclosure unless the swivel base is attached.

What considerations are applicable for monitors with removable swivel bases?

APPLICATION GUIDELINE:

For removable swivel bases, if the base is shipped detached from the monitor for packaging considerations, and the User's Instructions instruct the User to attach the base to the monitor before operation, the fact that the bottom enclosure of the monitor does not meet the strict definition of a fire enclosure without the base attached is not a concern. Only the monitor/base combination is required to meet the bottom enclosure requirements.

However, if the User's Instructions indicate that the swivel base may be removed from the monitor to allow for wider installation options, it is justified to be concerned with the size of the bottom openings because there are openings under combustible parts. In such cases, the bottom openings should comply completely with the provisions of Sub-clause 4.4.6.

RATIONALE:

Monitors are typically provided with swivel bases to permit ergonomic viewing options. The swivel bases are often disassembled from the main monitor unit either for shipping purposes or to permit use of the monitor with or without the swivel base.

If the manufacturer intends that a swivel base be connected to the monitor before operation and this intent is communicated in the form of instructions, this intended use should be considered. The monitor and swivel base combination is acceptable, even if the monitor's bottom enclosure does not meet the strict definition of a fire enclosure without the swivel base.

However, when a manufacturer designs a monitor so that the monitor may be used without the swivel base, the manufacturer anticipates normal operation without the base. Because the operation of the monitor without the base exposes bottom openings which do not meet the fire enclosure requirements, thus presenting an increased risk of ignition of the supporting surface in the event of a fire, the monitor should be required to meet all applicable requirements for bottom enclosures without the base attached.

OTHER:

SEE RELATED PAG: 4.4.6:004

PAG No. 4.4.6:004

(Sub)CLAUSE/ANNEX NUMBER: 4.4.6

(Sub)CLAUSE/ANNEX HEADING: Fire Enclosure Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For a monitor with a swivel base made of HB material, if the swivel base is secured to the monitor through snap fit openings provided in the bottom of the monitor's fire enclosure, the entire bottom enclosure may no longer meet the strict definition of a fire enclosure because the bottom enclosure now comprises HB, and V-1 or 5V material.

May HB swivel base material be snapped into the openings of a monitor fire enclosure made of V-1 or 5V material?

APPLICATION GUIDELINE:

In most monitor constructions the fact that a swivel base is made of HB material and is snapped into the bottom of a monitor's fire enclosure should not be a significant concern. Therefore, swivel base units generally will not be required to be rated V-1 or 5V just because a small portion of it may be used to form part of the bottom fire enclosure of a monitor.

Engineering judgement should be used to consider the relation of the size of the HB material to the larger V-1 or 5V material size. As a general rule, concern increases as the amount of HB material exceeds 40 mm^2, although the total amount of HB material does not necessarily have to be limited to 40 mm^2.

RATIONALE:

Monitors are typically provided with swivel bases to permit ergonomic viewing options. The swivel bases are often disassembled from the main monitor unit for shipping purposes, or to permit the use of the monitor with or without the swivel base.

When a small amount of HB material is introduced into relatively small openings of a bottom fire enclosure, the introduction of this small amount of material that is more flammable than V-1 or 5V into the small openings is unlikely to significantly compromise the overall integrity of the bottom fire enclosure. Therefore, a practical position is that such a construction generally should be permitted.

OTHER:

SEE RELATED PAG: 4.4.6:003

PAG No. 4.4.6:005

(Sub)CLAUSE/ANNEX NUMBER: 4.4.6

(Sub)CLAUSE/ANNEX HEADING: Fire Enclosure Construction

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For data storage devices, such as disk, tape and CD-ROM drives, when are front bezels considered fire enclosures?

APPLICATION GUIDELINE:

The front bezel is considered a fire enclosure if a portion of the front bezel is intersected by a 5 degree downward projection from any combustible internal components or assemblies, which, under fault conditions, could emit material likely to ignite the supporting surface.

When determined to be a fire enclosure, front bezels should be rated 5-V or less flammable to permit installation in the widest variety of end products, i.e. all movable and stationary equipment.

Alternatively, for Component Recognized devices, a V-1 (or equivalent) material may be used if a restrictive Condition of Acceptability is added to the UL Report indicating that the component may only be used in portable or stationary equipment weighing 18 kg or less. Such constructions do not qualify for Accessory Listing, only Component Recognition.

Enclosure bezels with materials more flammable than V-1 (i.e. V-2 or HB) should be discouraged. If persistent, the manufacturer should be made aware of all the implications of using such a bezel. Since it cannot be used in any equipment unless supplied by a Limited Power Source, the manufacturer may have no market for a drive with an HB or V-2 bezel.

RATIONALE:

Since most component data storage devices have a printed wiring board mounted adjacent to the front bezel, and since it is unknown during the component investigation whether the component will be supplied by a Limited Power Source, front bezels of most component data storage devices are fire enclosures.

Once determined to be such, the use of a 5V material should be encouraged as being advantageous to the component manufacturer and the component manufacturer's customers.

OTHER:

SEE RELATED PAG:

PAG No. 5.1:001

(Sub)CLAUSE/ANNEX NUMBER: 5.1

(Sub)CLAUSE/ANNEX HEADING: Heating

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

When conducting heating testing on potted, encapsulated or impregnated isolation components, such as transformers, what steps should be taken to determine that the measured internal insulation temperatures are accurate?

APPLICATION GUIDELINE:

Thermocouples should be applied by the manufacturer to the internal insulation before potting, encapsulation or impregnation. After testing, the thermocouple locations shall be checked for suitability and accurate placement.

During the heating test a reference temperature should be taken at an external location (e.g. heat sink or core), and this temperature value should be included in a Condition of Acceptability so that continued compliance may be determined in the end use.

RATIONALE:

When components are potted, encapsulated or impregnated, it is often difficult to obtain accurate internal insulation temperatures without applying thermocouples to the insulation before treatment. To obtain accurate temperature measurements, these components should be given special consideration.

A reference temperature taken external to the potted component and added as a Condition of Acceptability to the Recognized Component report will help provide a means of determining suitability and compliance with requirements during the end-use investigation.

OTHER:

Due to material handling and disposal concerns, and possible discrepancies with actual manufacturing practices, UL should avoid potting, encapsulating or impregnating samples at our facilities using raw materials.

SEE RELATED PAG:

PAG No. 5.1:002

(Sub)CLAUSE/ANNEX NUMBER: 5.1

(Sub)CLAUSE/ANNEX HEADING: Heating

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5.1, 1.5.2, 2.11, Annex P

DESCRIPTION OF ISSUE:

Negative Temperature Coefficient (NTC) devices are sometimes used as part of fan controller circuits in ITE power supplies. The NTC device senses the temperature of the air in the equipment and changes its resistance accordingly. Based on the resistance of the NTC device, the voltage to the fan changes allowing more air flow at a higher voltage and less air flow at a lower voltage.

What are the component requirements for NTC devices used in this application?

APPLICATION GUIDELINE:

NTC devices employed in this application should be determined to be reliable. Therefore, they should comply with either IEC 730-1, or preferably, should be Recognized Component — Thermistor Type Devices (XGPU2), under the Standard for Thermistor-Type Devices, UL 1434.

Exempt from this requirement are applications where the equipment complies with the heating test with the device not actively controlling the fan. For example, if a power supply complies with the Heating Test with the fan operating at its lowest air-flow rating, then the NTC device is not used in the product to meet the requirements of the Standard and the device is not required to comply with relevant component requirements.

If the product does not comply with Heating Test requirements with the fan operating at its lowest air-flow rating, then the device is required to comply with relevant component requirements, preferably a Recognized Component — Thermistor Type Device (XGPU2).

RATIONALE:

In the application described above, the NTC device is being used as a temperature controller. Under normal operating conditions, if the characteristic curve of the NTC device changes (drifts), the NTC device will sense a temperature different than the actual air temperature, and the fan will supply an air flow different than it was designed to provide. Components in the power supply may be subjected to temperatures beyond the permitted limits.

As part of the XGPU2 Recognition program, UL tests the reliability of NTC characteristic curves and assures that the curves do not change after conditioning and cycling tests. Since UL has a component category for NTC devices and the reliability of NTC device is critical, NTC devices used to meet the requirements of this Standard should be UL component Recognized under the product category Thermistor Type Devices (XGPU2) and subjected the requirements outlined in UL 1434, or should meet a similar level of component requirements in an IEC Standard.

This position is justified by Sub-clauses 1.5.1 — 1.5.2, and by sound engineering judgment.

OTHER:

SEE RELATED PAG:

PAG No. 5.4.2:001

(Sub)CLAUSE/ANNEX NUMBER: 5.4.2

(Sub)CLAUSE/ANNEX HEADING: Motors

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): Annex B, Annex P.1(5.4.8)

DESCRIPTION OF ISSUE:

When conducting Annex B secondary motor overload or locked rotor testing, if a sensing circuit disconnects power from the motor before excessive temperatures are achieved, does the sensing circuit need to be evaluated for reliability (e.g. single component faults during locked rotor testing), or may the results achieved during the overload or locked rotor tests be solely relied upon?

APPLICATION GUIDELINE:

When conducting Annex B overload or locked-rotor testing, if the sensing circuit disconnects power to the motor in a relatively short time after the introduction of the test condition, then the sensing circuit may be accepted without further evaluation for reliability. Generally, current sensing circuits will disconnect power in a relatively short time.

If the sensing circuit is of a design that relies upon temperature monitoring (e.g. thermistor connected to a secondary monitoring circuit) and the sensing circuit does not operate until the motor achieves an elevated temperature, consideration should be given to conducting single component faults, or requiring Recognized Component thermal protection.

If a sensing circuit is relied upon for a secondary motor to comply with Annex B testing, the Test Record should indicate how the test was terminated, but the specific components of the sensing circuit generally do not need to be described. However, if a Recognized Component is used in lieu of component fault testing, the Recognized Component should be described.

RATIONALE:

The fifth dashed item of the explanatory note to Sub-clause 5.4.2 indicates that a sensing circuit may be used to comply with the requirement that motors shall not create a hazard due to overheating.

Most sensing circuits for secondary motors are current sensing types and react immediately upon an overload condition. These sensing circuits meet the intent of the fifth dashed item of this explanatory note, which describes a sensing circuit that "disconnects power from the motor in a sufficiently short time."

Sensing circuits that monitor temperatures typically consist of several discrete components (e.g. thermal cutoff, thermistor, IC, etc.) and, unless proven otherwise, may be unreliable. Therefore, they should be given additional consideration. Both UL 873, Temperature-Indicating and -Regulating Equipment, and UL 1020, Thermal Cutoffs for Use in Electrical Appliances and Components, are in mandatory Component Annex P.1.

OTHER:

SEE RELATED PAG:

PAG No. 5.4.4:001

(Sub)CLAUSE/ANNEX NUMBER: 5.4.4

(Sub)CLAUSE/ANNEX HEADING: Operational Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.1, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

Sub-clause 5.4.4, Item c), provides a method for evaluating operational insulation when suitable clearances and creepages per Sub-clause 2.9 are not provided. Does actual short-circuit testing always need to be conducted when applying Sub-clause 5.4.4 to secondary circuit PWBs?

APPLICATION GUIDELINE:

Generally, short-circuit testing will not be required if:

a) The insulation on the PWBs with deficient clearance/creepage distances, including insulation on the supply side of the deficient creepage/clearance distances that maybe overheated by a fault, is minimum V-1, and

b) All supplementary and reinforced insulation on the supply side of deficient clearance/creepage distances that may be overheated by a fault has been evaluated by Overload testing (in accordance with Annex C) and Abnormal Operation testing (in accordance with Sub-clause 5.4.6) to demonstrate that the insulation is not degraded by overheating. Typically, transformers and power supplies have these tests conducted as part of the performance evaluation of the product.

The above guidelines are general in nature. There may be situations where engineering judgment may determine that testing is necessary, i.e. the insulation affected is in a high-power circuit, IC chips of unknown flammability are heavily populated on the V-1 PWBs, etc.

RATIONALE:

Sub-clause 5.4.4(c) specifies that if the affected insulation is V-1 and Reinforced or Supplementary insulation is not adversely affected by an overload, then it does not require testing. PWBs are typically rated V-1 or better and transformers that have been subjected to Annex C testing have already been tested to determine that their insulation will not be degraded due to overloading.

OTHER:

SEE RELATED PAG: 5.4.4:002

PAG No. 5.4.4:002

(Sub)CLAUSE/ANNEX NUMBER: 5.4.4

(Sub)CLAUSE/ANNEX HEADING: Operational Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.9.1, 5.4.6

DESCRIPTION OF ISSUE:

Sub-clause 5.4.4, Item c) provides a method for evaluating Operational insulation when minimum clearances and creepage distances per Sub-clause 2.9 are not provided.

Application Guideline 5.4.4:001 indicates that most short circuit testing of Secondary circuit Operational insulation spacings may be waived when the insulation that may be affected is V-1 (or better) and when Overload testing per Annex C has been conducted.

What level of investigation is required for evaluating operational insulation in Primary circuits?

APPLICATION GUIDELINE:

Primary circuit Operational insulation spacings that do not meet the minimum spacing requirements per Sub-clause 2.9 should be evaluated using Sub-clause 5.4.4, option (b) or (c).

Generally, compliance to Sub-clause 5.4.4 Item (b) or (c) for primary circuits must be determined by test.

To reduce the amount of testing that will be required to determine compliance, the test program, if consisting of short-circuiting the deficient spacings, should be conducted in conjunction with the Abnormal Operation testing conducted for Sub-clause 5.4.6.

RATIONALE:

The considerations previously given to Operational insulation spacings in Secondary circuits are not applicable to Primary circuit spacings.

In Secondary circuits, transformer and output connector overload testing is conducted on the same Secondary circuit, thus Sub-clause 5.4.4 is being addressed by considering both the written requirement and related tests.

For Primary circuits, the consequence of deficient Operational insulation spacings is not directly or indirectly addressed by other tests. Since the deterioration of Operational Insulation spacings in Primary circuits could negatively affect higher levels of insulation (e.g. Basic), conducting testing per Items (b) and (c) of Sub-clause 5.4.4 is valid. The second dashed paragraph of Sub-clause 5.4.4(c), indicates that thermal damage to Basic insulation should be considered as a consequence of inadequate Operational insulation spacings.

Since many of the short-circuit tests that are required to determine the consequence of deficient spacings are similar to, or are redundant with, the tests required by the test program of Sub-clause 5.4.6, conducting the tests required by Sub-clause 5.4.4 in conjunction with the test program required by Sub-clause 5.4.6 will limit the amount of overall testing and help avoid redundant testing.

OTHER:

SEE RELATED PAG: 5.4.4:001

PAG No. 5.4.6:001

(Sub)CLAUSE/ANNEX NUMBER: 5.4.6

(Sub)CLAUSE/ANNEX HEADING: Simulation of Faults

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.11

DESCRIPTION OF ISSUE:

Sub-clause 5.4.6, 4th dashed paragraph, contains a requirement that connectors and terminals that deliver power or signal outputs from equipment shall be subjected to an Overload Test.

Considering the number of external connectors (and corresponding pins) that are often found on information technology equipment, what engineering considerations should be given for limiting the amount of testing that needs to be conducted on secondary circuit signal and power output connectors?

APPLICATION GUIDELINE:

Overload testing is conducted on these types of connectors and circuits only when it is reasonable to assume that an overload condition could contribute to a hazardous condition. The following should serve as a guide to making this determination:

(a) If the connector circuit is supplied at its origin by a Limited Power Source (e.g. PWB supplied by an LPS), the test does not need to be conducted;

(b) If the connector circuit is supplied at its origin by a non-Limited Power Source, steps should be taken to first identify redundant circuits so testing only needs to be conducted on one representative circuit type. Once redundant circuits are identified:

  (1) If there is 10 kohm impedance in the circuit (between the power supply output and the connector pin output) the test does not need to be conducted;

  (2) If there is no more than 12.5 mA available from the connector pin output, the test does not need to be conducted.

(c) When subjecting a circuit to the Overload Test, it generally can be concluded after 0.5 hour if there is no evidence of overheating or other destructive result.

Applying the above considerations to the connector overload test requirement should greatly limit the amount of testing that is required.

RATIONALE:

The intent of any abnormal operation test is to determine if a reasonable abnormal overload condition can contribute to a hazard within the equipment. If the likelihood of a hazard is minimal or non-existent, the test should not be conducted.

Generally, circuits supplied by a limited power source (as defined by Sub-clause 2.11) are not considered likely to start a fire, therefore, additional consideration can be given to waiving tests conducted on these connector circuits. Since the transformer supplying the limited power circuit is subjected to an overload test, the likelihood of the connector overload condition overheating the transformer is minimal.

Circuits exiting information technology equipment are often redundant. Sub-clause 5.4.6 allows testing to be conducted on single circuits if they represent redundant circuits.

If the circuit has 10 kohm impedance between it and the power supply output, the D2 Deviation allows the test to be waived.

Also, 12.5 mA is the maximum theoretical current that would be available in a 125 V circuit with 10 kohm series impedance (125 V/10 kohm = 12.5 mA). The Standard provides instructions for waiving tests on circuit outputs limited to this amount of current.

OTHER:

SEE RELATED PAG: C.1:001

PAG No. 5.4.6:002

(Sub)CLAUSE/ANNEX NUMBER: 5.4.6

(Sub)CLAUSE/ANNEX HEADING: Simulation of Faults

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Sub-clause 5.4.6 contains a D2 Deviation that states that if the abnormal operation testing of a circuit is interrupted by the opening of a component the test is to be repeated twice (three times total) using new components as necessary.

Are there instances when an abnormal operation test that is interrupted by the opening of a component does not need to be repeated twice (three times total)?

APPLICATION GUIDELINE:

If the abnormal operation test is interrupted by the opening of a reliable component (e.g. Listed/Recognized fuse, Recognized fusing resistor), the test does not have to be repeated.

If the test is not interrupted or terminated by the opening of a reliable component, but is terminated by the opening of an unreliable component or component of questionable reliability, the test should be conducted three times total unless there is solid rationale for doing otherwise.

Any decision made not to conduct the test three times should be based on solid engineering judgment, and the rationale should be documented on the Test Data Sheet. It may be possible to limit the extent of repeat testing if the engineer is able to consider such factors as circuit design, manufacturer supplied test information, results of the initial abnormal condition test, time for component to open, temperature of affected component, etc.

RATIONALE:

As stated in the Subjects 478 (114) meeting report "White Book" dated March 25, 1988, "the compliance of a circuit with the abnormal test should not be dependent upon the single failure of (an unreliable or questionable) component." The requirement was added as a D2 Deviation to this Standard because component tolerances and other factors add a level of doubt to the repeatability of tests when single components are relied upon to terminate tests.

Although it is often inconvenient to repeat abnormal operation tests due to the number of samples required, this rationale, by itself, is not sufficient for making a decision not to conduct repeat testing.

If a high level of confidence exists that similar results will be achieved during repeated trials of a test terminating with the opening of an unreliable or questionable component, engineering judgment may be used to limit the amount of repeat testing required. This type of decision normally cannot be made without consideration of circuit design, initial test results, manufacturer's supplied test information or other factors. The decision should be made on a case-by-case basis.

OTHER:

SEE RELATED PAG:

PAG No. 5.4.9:001

(Sub)CLAUSE/ANNEX NUMBER: 5.4.9

(Sub)CLAUSE/ANNEX HEADING: Compliance Criteria for Abnormal Operating and Fault Conditions after the Tests

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Sub-clause 5.4.9 indicates that an Electric Strength Test shall be conducted after the abnormal operation tests of Sub-clauses 5.4.4 — 5.4.8 when (a) clearances or creepage distances relied upon to maintain the integrity of critical insulation have been reduced, (b) insulation shows visible signs of damage, or (c) insulation cannot be inspected.

Since it is almost always very difficult to inspect individual insulation after conducting abnormal operation testing, is the Electric Strength Test required to be conducted after each and every abnormal condition test (e.g. after each open or short condition)?

APPLICATION GUIDELINE:

The Electric Strength Test does not have to be conducted after each individual abnormal operation test. However, the test should be conducted after "significant" events (e.g. components exploding) that are likely to affect or cause damage to insulation.

If the Electric Strength Test is not conducted after each individual test, it should be conducted on the overall sample before concluding the abnormal operation test program on the sample.

RATIONALE:

Since often it is very difficult to determine if insulation is likely to be damaged after an abnormal operation test, a strict interpretation of the Standard might require an Electric Strength test to be conducted after each individual abnormal operating condition.

However, for practical purposes the amount of Electric Strength Testing during the course of the Abnormal Operation Test program can be limited as long as it can be determined that the sample complies with the requirements after all testing has been completed.

OTHER:

SEE RELATED PAG: 5.4.9:002

PAG No. 5.4.9:002

(Sub)CLAUSE/ANNEX NUMBER: 5.4.9

(Sub)CLAUSE/ANNEX HEADING: Compliance Criteria for Abnormal Operating and Fault Conditions after Tests

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.6

DESCRIPTION OF ISSUE:

Sub-clause 5.4.9 requires an Electric Strength test to be conducted after the Abnormal Operation tests of 5.4.4 — 5.4.8.

If the opening of a fuse, or the opening of a fuse in combination with the damaging of components, terminates an Abnormal Operation test, is the Electric Strength test conducted before or after the damaged fuse is replaced with a new fuse?

APPLICATION GUIDELINE:

After Abnormal Operation testing, the Electric Strength test should be conducted before a damaged fuse is replaced with a new fuse.

So that the entire Primary circuit is energized during Electric Strength testing, one of the set of leads of the Dielectric Voltage Withstand Tester should be connected to a common connection with both the Line and Neutral terminals/leads of the Primary bonded. The other lead should be connected to dead metal or the Secondary circuit, as appropriate.

For constructions with dual or multiple fuses, the same method of conducting the test as described above should be employed. However, if all fuses opened, making it impossible to energize the entire Primary circuit, one of the fuses should be short-circuited before conducting the Electric Strength test, with special care being taken not to disturb any consequences of the abnormal operating condition which may indicate a non-compliant result (e.g. disturbing carbon tracks).

RATIONALE:

The stated Guideline is the most straightforward method of consistently determining compliance with Sub-clause 5.4.9. Conducting the Electric Strength test after replacing the damaged fuse with a new fuse could miss some non-compliant results (e.g. by dislodging carbon tracking) and would also require consideration of replacing all damaged components before conducting the test, which would be impractical.

OTHER:

SEE RELATED PAG: 5.4.9:001

PAG No. 6.1:001

(Sub)CLAUSE/ANNEX NUMBER: 6.1

(Sub)CLAUSE/ANNEX HEADING: Connection to Telecommunication Networks — General

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.14.7, 6.2

DESCRIPTION OF ISSUE:

Note 1 to Sub-clause 6.1 indicates that the Standard assumes that measures have been taken outside of the equipment to reduce overvoltages exceeding 1.5 kV peak from reaching the equipment through the Telecommunication Network.

Overvoltages on telecommunication networks in the United States are typically reduced to a 600 V level, not a 1.5 kV level. May it be assumed that overvoltages in the U.S. will be limited to 600 V peak instead of 1.5 kV peak?

APPLICATION GUIDELINE:

It should not be assumed that overvoltages on telecommunication networks in the U.S. will be limited to 600 V peak. The 1500 V peak limit stated in the Standard should be used.

RATIONALE:

Although practice in the U.S. is to limit overvoltages on telecommunication networks to 600 V peak, this practice is not mandated by a Code and, therefore, the more conservative value presented in IEC 950 should be used.

OTHER:

UL 1459 (Standard for Telephone Equipment) considers U.S. networks limited to 600 V peak.

SEE RELATED PAG:

PAG No. 6.1:002

(Sub)CLAUSE/ANNEX NUMBER: 6.1

(Sub)CLAUSE/ANNEX HEADING: Connection to Telecommunication Networks — General

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.2.7, M.3.1

DESCRIPTION OF ISSUE:

What criteria is used for determining working voltages of TNV-3 circuits?

APPLICATION GUIDELINE:

If the equipment generates a ringing signal and the circuit connects to a Telecommunication Network, the working voltage should be measured in accordance with Sub-clause 2.2.7 and Annex M.3.1 to determine maximum peak, rms and/or dc values.

If the equipment is connected to a Telecommunication Network and receives incoming analog telecommunication signals (e.g. from Central Office), assume the following maximum working voltages (TNV-3) for purposes of determining required clearances, creepage distances and electric strength test values:

(a) peak: 200 V
(b) rms: 120 V

The peak value is used for clearance and electric strength determinations, and the rms value is used for creepage distance.

RATIONALE:

Annex M (normative) describes maximum voltage levels associated with Telecommunication Signals that comply with FCC Part 68. The maximum peak value specified is 200 V referenced to earth. Since UL 1950 working voltages are typically measured to earth, this value should be considered the maximum peak value.

Although Annex M does not contain a corresponding rms value, 120 V rms is an approximation of a composite 56.5 V dc and 300 Vp-p signal. Also, Sub-clause 6.2.1.3 uses 120 V rms to simulate externally generated operating voltages. Therefore this value should be used for investigation to this Standard.

OTHER:

Note: The Standard for Telephone Equipment, UL 1459 (Section 48), also uses 120 V rms as a suitable representation of a maximum rms Telecommunication Signal.

SEE RELATED PAG:

PAG No. 6.2.2.1:001

(Sub)CLAUSE/ANNEX NUMBER: 6.2.2.1

(Sub)CLAUSE/ANNEX HEADING: Protection Against Contact with TNV Circuits — Accessibility

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1.1, 2.9.6, 2.9.7, 4.2.2

DESCRIPTION OF ISSUE:

Assuming accessibility of a TNV circuit by an operator does not comply with the D3 Deviation (first dashed exemption) associated with Sub-clause 6.2.2.1, if a TNV circuit is prevented from being accessed by an operator by potting or encapsulation of the circuit, what level of investigation should be conducted on the construction to determine compliance with Sub-clause 6.2.2.1?

APPLICATION GUIDELINE:

The construction should be subjected to the performance program for encapsulated parts per Sub-clause 2.9.7 with the following additional considerations:

(a) An additional pre- and post-conditioning test should be added to the Sub-clause 2.9.6 conditioning sequence that consists of the application of a 30 N Steady Force (per Sub-clause 4.2.2) to parts of the TNV circuit that are likely to be accessed. Multiple applications of the force to different areas of the "enclosure", i.e. encapsulated circuit, may be required;

(b) The electric strength test required by Sub-clause 2.9.6 should be conducted between TNV circuits and conductive foil wrapped around the encapsulation or potting material.

The construction is acceptable if there is no insulation breakdown between TNV circuits and the conductive foil.

RATIONALE:

Manufacturers are exploring different methods of designing products to meet Sub-clause 6.2.2 accessibility requirements, in particular for international certifications where the D3 Deviation of Sub-clause 6.2.2.1 is not permitted. One method being used to prevent access to TNV circuits and provide an "electrical" enclosure is to encapsulate TNV circuits with an insulating material.

Since this Standard already has a test procedure established for evaluating encapsulated parts, it should be used, with additional considerations to address possible mechanical abuse of the part.

Applying the 30 N Steady Force Test, which is required for internal electrical enclosures, is considered an adequate method of addressing mechanical abuse.

OTHER:

SEE RELATED PAG: 1.7:003, 6.2.2.1:002

PAG No. 6.2.2.1:002

(Sub)CLAUSE/ANNEX NUMBER: 6.2.2.1

(Sub)CLAUSE/ANNEX HEADING: Protection Against Contact with TNV Circuits — Accessibility

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1.1

DESCRIPTION OF ISSUE:

Accessory Modem cards with TNV-3 circuits can have non-SELV circuits accessible during ringing conditions. Does this "hazard" require any special accessibility considerations during an investigation of the modem card as a user-installed Listed Accessory?

APPLICATION GUIDELINE:

Accessory Modem cards should be subjected to all applicable Clause 6 requirements for equipment with telecommunication circuits.

However, by nature of Application Guideline 1.7:003 and the D3 Deviation associated with the first dashed exemption in Sub-clause 6.2.2.1, Accessory Modem cards do not need to be provided with an integral electrical enclosure around the TNV-3 circuit if (a) the User installation instructions specify that the modem card is to be installed in UL Listed equipment that allows for user installation of accessories in its instructions, and (b) the TNV circuit connector is to be disconnected before installation.

RATIONALE:

The D3 Deviation associated with Sub-clause 6.2.2.1 allows access to TNV circuits if the interior of the equipment is protected by a cover intended for occasional removal by the operator, provided that installation instructions include directions for disconnection of the TNV circuit connector before removing the cover.

This Guideline extends the intent of this Deviation to Listed Accessory Modem cards, if the same level of safety is provided by the provision of additional instructions with the Modem card.

OTHER:

IEC 950 does not contain the relaxation allowed by the D3 Deviation in 6.2.2.1.

SEE RELATED PAG: 2.1:001

PAG No. 6.4.1:001

(Sub)CLAUSE/ANNEX NUMBER: 6.4.1

(Sub)CLAUSE/ANNEX HEADING: Separation Requirements

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 6.2.1.2

DESCRIPTION OF ISSUE:

Sub-clause 6.4.1 requires "electrical separation" between TNV-1 or TNV-3 circuits and the other parts of the product identified in Figure 18. The "electrical separation" must comply with the test requirements of Sub-clause 6.4.2.

Other than meeting the test requirements of Sub-clause 6.4.2, are there any particular constructional requirements (e.g. operational/basic insulation) for the "electrical separation"?

APPLICATION GUIDELINE:

Generally, there are no specific requirements for the "electrical separation" described in Sub-clause 6.4.1 other than compliance with the test requirements of Sub-clause 6.4.2. Basically, a construction may be accepted that successfully meets the test compliance criteria. Typical components that may be used to provide separation include transformers, optical isolators, relays and IC's. Component Recognition is not a requirement.

However, the exception is plain enamel coating on winding wire. A D2 Deviation under Sub-clause 6.4.1 states that "Enamel coating on winding wire is not considered to be electrical separation." UL only is willing to consider enamel coating on winding wire "electrical separation" if it is subject to special considerations. These considerations are (a) it is used in TNV-1 circuits only; (b) it is Recognized Component Magnet Wire (OBMW2), and (c) the construction is subjected to the application of a 1000 Vac Factory Production Line Electric Strength Test on 100 percent of production.

Note: Other Clause 6 requirements (6.2.1.2/Table 19) may require higher levels of insulation between the same circuits (e.g. Basic insulation between SELV and TNV-3). Thus the "electrical separation" of Sub-clause 6.4 in reality also may be a defined insulation level and the component supplying the "electrical separation" may be required to be evaluated to more onerous requirements.

Other than magnet wire subjected to special considerations, isolation or limiting components providing separation need not be controlled in the UL Report, unless they are also acting as a level of insulation, Basic or higher, or there is other engineering-based rationale for doing so.

RATIONALE:

If the sub-clause required "electrical separation" to be equivalent to an insulation level, it would state such. Since there is no mention of an insulation level associated with "electrical separation", one should not be assumed.

For magnet wire, the basic rationale associated with the D2 Deviation is documented in the Subject 1950 BNWG Meeting Report, dated February 3, 1997. The stated special considerations are based on Section 30 of the Standard for Telephone Equipment, UL 1459.

OTHER:

SEE RELATED PAG:

PAG No. 6.4.1:002

(Sub)CLAUSE/ANNEX NUMBER: 6.4.1

(Sub)CLAUSE/ANNEX HEADING: Separation Requirements

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For purposes of determining the appropriate impulse or electric strength test voltage, should telephone keypads on desk top phones be considered case a) or b) of Sub-clause 6.4.1 and Figure 18?

APPLICATION GUIDELINE:

Telephone keypads on desk top phones should be considered case b) of 6.4.1 and Figure 18. Therefore, such constructions should be subjected to either 1.5 kV Impulse or 1.0 kV Electric Strength testing between the telecommunication network connection and the telephone keypad.

RATIONALE:

Telephone keypads on desk top phones are not subjected to holding or continuous touching during normal use, certainly not at the level that telephone handsets and keyboards are. Therefore, they do not need to be subjected to the more stringent impulse and electric strength voltage levels that keyboards and telephone handsets are subjected to.

OTHER:

A member of IEC TC74/WG7 has confirmed the intent of the Working Group was not to include keypads on desk top phones as a case a) condition, and will pursue a revision to IEC 950 to clarify this issue.

SEE RELATED PAG:

PAG No. 6.4.2:001

(Sub)CLAUSE/ANNEX NUMBER: 6.4.2

(Sub)CLAUSE/ANNEX HEADING: Protection of Equipment Users from Overvoltages on Telecommunication Networks — Test Procedure

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5.2, Annex P(1.5.2)

DESCRIPTION OF ISSUE:

When conducting Impulse or Electric Strength testing between the TNV circuits and hand-held parts (e.g. telephone handset, keyboard, etc.), is the conductive foil wrapped around the hand-held parts only, or is the foil wrapped around hand-held parts and the telephone handset cord connecting the hand-held parts to the equipment?

APPLICATION GUIDELINE:

If the telephone handset cord is required to comply with the Standard for Communication Circuit Accessories, UL 1863 (see Application Guideline P(1.5.2):007), the conductive foil should only be wrapped around the actual hand-held parts and not the cable connecting the hand-held parts to the equipment.

If the telephone handset cord is not required to comply with UL 1863, then it should be tested per Sub-clause 6.4.2 and the conductive foil should be wrapped around both the actual hand-held parts and the cable connecting the hand-held parts to the equipment.

RATIONALE:

Telephone handset cords complying with UL 1863 are subjected to a level of construction and performance requirements that is considered adequate without additional Clause 6 considerations.

Telephone handset cords that are not required to comply with UL 1863 should be subjected to the performance testing (Sub-clause 6.4.2) contained in Clause 6 because these cables may be held in the hand at the same time as the actual hand-held parts.

OTHER:

SEE RELATED PAG: P(1.5.2):007

PAG No. B.6:001

(Sub)CLAUSE/ANNEX NUMBER: Annex B.6

(Sub)CLAUSE/ANNEX HEADING: Running Overload Test for DC Motors in Secondary Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.2, Annex B

DESCRIPTION OF ISSUE:

May the Running Overload Test be waived for d.c. spindle motors typically found in component disk drives?

APPLICATION GUIDELINE:

A Running Overload Test is not required for d.c. spindle motors found in component disk drives including floppy, hard, CD-ROM, etc. No specific verification of motor supply circuit or documentation in the Engineering Considerations is required.

RATIONALE:

Annex B6 requires a Running Overload Test for dc motors only if the possibility of an overload occurring exists. Additionally, the test specifications of Annex B.6 statement indicate that motors with electronic drive circuits are examples of motors that do not require the test. Due to the inherent operational requirements of drive spindle motors, an electronic drive circuit is typically provided and an overload condition is not considered likely.

OTHER:

SEE RELATED PAG: B.7:001

PAG No. B.7:001

(Sub)CLAUSE/ANNEX NUMBER: Annex B.7

(Sub)CLAUSE/ANNEX HEADING: Locked-Rotor Overload Test for DC Motors in Secondary Circuits

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.2, Annex B

DESCRIPTION OF ISSUE:

May the d.c. locked rotor test be waived for spindle motors found in component hard disk drives, i.e. hard disk drives typically used in personal computers?

APPLICATION GUIDELINE:

The d.c. locked rotor test may be waived for component hard disk drives. Detailed documentation explaining why the test was waived is not required.

RATIONALE:

The spindle motors found in component hard disk drives are typically located in hermetically sealed metal casings and are part of low power pulsed d.c. circuits that are monitored with electronic circuitry. Also, the likelihood that a locked rotor condition might occur is virtually impossible. Considering these constructional features and past experience with these drives, the test may be waived and detailed documentation explaining why the test was waived is not considered necessary.

OTHER:

SEE RELATED PAG: B.6:001

PAG No. C.1:001

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

When switching transformers are being subjected to the Overload Test requirements in Annex C, what is a suggested method to meet the intent of the requirement, and the related requirement in the 2nd dashed paragraph of Sub-clause 5.4.6, to avoid a lengthy and costly evaluation?

APPLICATION GUIDELINE:

To address both Annex C.1 and the 2nd dashed paragraph of Sub-clause 5.4.6, the overload test for switching transformers should be applied immediately after the secondary circuit rectification components. While conducting the overload test, all windings, other than the winding under test, should be loaded to their rated output. Tolerances of the supply voltage do not need to be considered for the test, unless temperature results at nominal voltages are close to pass/fail limits.

When applying the overload condition, the transformer should be overloaded in an incremental manner while monitoring the transformer temperature as the test progresses. When a point is reached where the power supply shuts down, either by design or by destruction of components, the ultimate temperature result should be considered to be achieved and the recorded temperature should be used to determine compliance with Annex C (Table C.1).

Engineering judgment should be used to determine the rate of the incremental increase of the load for the overload test. If the normal operating temperature of the switching transformer is low and incremental increases of the load are not significantly increasing the temperature of the transformer windings closer to the temperatures limits defined in Table C.1, the incremental increase may be relatively constant.

If the normal operating temperature of the switching transformer is high, and incremental increases of the load are causing the transformer temperature to approach the allowable maximum limits, a slower rate of increase will be called for and more careful consideration should be given to the rate of the incremental increase of the load.

RATIONALE:

The intent of the Transformer Overload Test is to determine if a reasonable overload condition will lead to a hazardous condition due to high insulation temperatures. Although switching transformers are not specifically addressed in the requirement, the concern with overheating is still valid.

The related requirements in the 2nd dashed paragraph of Sub-clause 5.4.6 is to determine that faults in any component could not adversely affect supplementary or reinforced insulation.

Switching power supplies have feedback and control circuitry to monitor overload conditions. However, this circuitry is not evaluated and controlled in sufficient detail to completely rely upon it for transformer overload protection. Therefore, special consideration should be given to switching transformers in switching power supplies when conducting the test.

The fact that a power supply overload test (per Sub-clause 5.4.6) is also conducted on the output of the power supply provides further assurance that a complete evaluation of both the switching transformer and associated output regulatory circuitry is being conducted.

OTHER:

SEE RELATED PAG: 5.4.6:001, C.1:003, C.1:005, C.1:006

PAG No. C.1:002

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

Does Annex C.1 apply if a transformer is supplying a Limited Power Source per Sub-clause 2.11?

APPLICATION GUIDELINE:

Annex C.1 applies regardless of the power available from the output of the transformer.

RATIONALE:

A transformer that is part of a Power Limited Source may still overheat. The Overload Test (C.1) specifically addresses overheating of the transformer.

OTHER:

SEE RELATED PAG:

PAG No. C.1:003

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

If steps are taken during the design of a power supply to suitably insulate transformer secondary leads, to provide adequate clearances and creepages, and to provide overcurrent protection in the secondary circuit to prevent excessive current from being available from the transformer, may the Overload Test of the transformer (per Annex C.1) be modified accordingly, or possibly waived, considering these additional features?

APPLICATION GUIDELINE:

Conceivably, a power supply could be designed with a construction that would allow the transformer not to have to be subjected to a worst case Overload Test. However, relevant considerations, like the calibration and ratings of the overcurrent protection must be considered.

RATIONALE:

Annex C.1 indicates that testing may not be applicable for all constructions, particularly if a short circuit or overload of a secondary winding cannot occur or is unlikely to cause a hazard. Also, it indicates that the effect of any protection device provided should be taken into account. Thus, if a manufacturer incorporates design features that reduce or eliminate the likelihood of a transformer overload condition, it should be permitted to reduce, or possibly eliminate testing. The descriptive control of the construction will increase and, if additional overcurrent protection is employed, an Overload Test based upon the fuse rating and calibration (i.e. 135% of the fuse rating for one hour) will be considered.

OTHER:

SEE RELATED PAG: 5.4.6:001, C.1:001, C.1:005, C.1:006

PAG No. C.1:004

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

Although Annex C.1 is titled "Overload Test", the test method specified is not an Overload Test as UL typically defines the test; the sub-clause indicates secondary circuits should be "short-circuited", not increasingly overloaded.

For linear transformers, should a true "UL" Overload Test be performed, loading the secondary circuit to a point just before any overcurrent or thermal protection opens, or should a direct short be applied?

APPLICATION GUIDELINE:

As stated in the sub-clause, the secondary of the linear transformer should be short-circuited and temperatures monitored. Overload testing is more applicable when evaluating the overall unit under Sub-clause 5.4. If accurate temperatures cannot be monitored with thermocouples, the Change of Resistance Method should be considered.

RATIONALE:

For linear transformers, the sub-clause specifically describes a short-circuit test method (which is a form of an Overload Test). Accurately monitoring transformer insulation temperatures while short-circuiting the secondary windings will allow the determination of the maximum winding temperature before external overcurrent or internal temperature protection opens. This result is the purpose of the test. The option of performing additional "overload" testing while monitoring transformer temperatures is available as part of the testing of the complete unit covered under Sub-clause 5.4.6.

OTHER:

SEE RELATED PAG: 5.4.6:001

PAG No. C.1:005

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

When evaluating switching transformers to the Overload Test requirements in Annex C, is there an alternative to conducting the traditional overload test described in Annex C.1?

APPLICATION GUIDELINE:

If requested by the manufacturer, sufficient secondary circuit component fault testing may be conducted as an alternative to conducting the traditional Transformer Overload Test until it is determined that it is reasonable to assume that any fault in the secondary circuit will not overload the transformer to a point where a hazard is likely.

If this alternative is chosen, the transformer insulation should be thermally monitored during the short and open circuit testing of secondary components, and the limits outlined in Table C.1 should be used for determining the acceptability of the construction.

The complete test program should be documented in the Test Record and the descriptive control of the secondary circuit should be increased to a level that significant changes made to the secondary circuit will require additional retesting to determine continued compliance.

Note: This option is not viable for Recognized Component switching power supplies without (a) conducting additional overload testing on the power supply output terminals to simulate overload conditions on the load side of the power supply, or (b) adding a Condition of Acceptability that additional secondary component fault testing external to the power supply (while monitoring the switching transformer) needs to be conducted in the end use product.

RATIONALE:

The intent of the Transformer Overload Test is to determine if a reasonable overload condition on a transformer will lead to a hazardous condition due to high insulation temperatures.

If it can determined through an extensive abnormal operation condition test program that any abnormal operation condition in the secondary circuit of the power supply and equipment is not likely to overheat the transformer (beyond Table C.1 limits), then it has been determined that the construction meets the intent of the requirement.

Although the option of conducting extensive abnormal condition testing of the secondary circuit is available, it is not considered preferable and cost time effective. Not only is an extensive abnormal operation test program on secondary components required, but the descriptive control of the secondary circuitry in the UL descriptive reports also needs to be increased.

OTHER:

SEE RELATED PAG: 5.4.6:001, C.1:001, C.1:003, C.1:006

PAG No. C.1:006

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

When considering incremental overload testing of switching power supplies, when may the overload test be conducted at the output of the power supply instead of after the rectification components?

APPLICATION GUIDELINE:

If it can be determined that the power supply design controls output circuit current by primary circuit (not secondary circuit) sensing, and if there are no current limiting impedances between the secondary rectifier components and the power supply output, the overload test may be conducted at the output of the power supply instead of after the transformer rectification.

In such cases, a single overload test can be conducted to meet requirements in Annex C.1, and Sub-clause 5.4.6, 2nd and 4th dashes.

RATIONALE:

Some designs of simpler switching power supplies control output power levels by monitoring primary circuits rather than by monitoring secondary circuits. For such designs, if limiting impedances are not provided in the secondary circuits, conducting an overload test at the output of the supply achieves similar results to conducting the test after the secondary rectification. Therefore, a single test is possible to meet Annex C.1 and Sub-clause 5.4.6.

[Most switching power supplies are designed with secondary circuit monitoring and secondary-primary feedback control, thus are not exempt from the general preference to conduct overload testing after the secondary rectification components.]

OTHER:

SEE RELATED PAG: 5.4.6:001, C.1:001, C.1:003, C.1:005, C.1:006

PAG No. C.1:007

(Sub)CLAUSE/ANNEX NUMBER: Annex C.1

(Sub)CLAUSE/ANNEX HEADING: Transformer Overload Test

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 5.4.3, 5.4.6, Annex C

DESCRIPTION OF ISSUE:

Is an Electric Strength test required on a transformer after it has been subjected to the Transformer Overload Test required by Sub-clause 5.4.3 and Annex C.1?

APPLICATION GUIDELINE:

An Electric Strength Test outlined in Sub-clause 5.3 and Annex C.3 should be conducted on any transformer that has been subjected to transformer overload testing per Annex C.1. The test should be conducted on any insulation that is likely to have been damaged by the overload test, including Basic, Supplementary or Reinforced insulation, and the test should be conducted after the insulation has cooled to room temperature.

RATIONALE:

Sub-clause 5.4.3 indicates that transformers shall be protected against overload conditions and indicates that compliance is determined by the applicable tests of Annex C.1. Although Annex C.1 specifies maximum temperature limits for transformer windings, it does not specifically indicate that an Electric Strength Test should be conducted after the Overload Test.

Since it is possible that transformer insulation may be damaged by the Transformer Overload Test, even if the transformer complies with the specified thermal limits, and since it is difficult to directly inspect transformer insulation for damage, any insulation that is likely to be damaged by a Transformer Overload Test should be subjected to the Electric Strength requirements specified in Annex C.3 and Sub-clause 5.3.

The test should be conducted after the insulation has cooled to room temperature because the transformer overload test is an abnormal operation test, and electric strength testing after other abnormal operation testing is conducted after the insulation has cooled to room temperature (per Sub-clause 5.4.9).

OTHER:

SEE RELATED PAG:

PAG No. C.2:001

(Sub)CLAUSE/ANNEX NUMBER: Annex C.2

(Sub)CLAUSE/ANNEX HEADING: Transformer Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Annex C.2 requires that all transformer windings shall have the end turns retained by a "positive means." What is considered a "positive means" of retaining an end turn of a winding?

APPLICATION GUIDELINE:

An end turn of a winding is considered retained by a "positive means" if "margin tape" or some other form of physical barrier is provided to prevent the winding from moving or shifting and reducing clearances and creepage distances.

Fully encapsulated and potted transformers by their inherent construction are considered having windings maintained by a positive means.

Transformers may not rely solely on varnish to provide a positive means of retention.

RATIONALE:

The intent of the requirement is to prevent reduction of clearances and creepage distances due to winding displacement. Most physical barriers incorporated in the transformer should accomplish this purpose. Windings in potted and encapsulated transformers will be prevented from moving due to the potting compound.

Because of the varying and inconsistent results achieved by the process, varnishing is not considered a reliable means of providing positive retention. Therefore, varnish alone is not acceptable for compliance.

OTHER:

SEE RELATED PAG: C.2:002

PAG No. C.2:002

(Sub)CLAUSE/ANNEX NUMBER: Annex C.2

(Sub)CLAUSE/ANNEX HEADING: Transformer Insulation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

For transformers, Annex C.2 requires that precautions be taken to prevent displacement of windings or their turns, and all "windings" are required to have their end turns retained by a positive means. Traditional transformers with magnet wire typically use margin tape to meet the intent of this requirement. However, switching transformer technology has evolved to where metal foil is being used as winding material instead of traditional magnet wire.

Are transformer windings made of metal foil required to have the same types of winding retention as transformer windings made of magnet wire?

APPLICATION GUIDELINE:

A manufacturer of a transformer with metal foil windings shall take precautions to prevent displacement of the metal foil windings. However, metal foil windings are not required to have physical and positive means of retaining the winding.

Compliance with Annex C.2 for metal foil windings may be determined by confirming (a) compliance with the Standard's clearance and creepage distance requirements, and (b) that proper manufacturing quality control techniques are taken by the manufacturer to assure compliance with the intent of Annex C.2, i.e. non-displaced metal foil windings.

No special Follow-Up Service documentation, including documentation of quality control steps to address the concern, is required for determining continued compliance with this requirement. However, the UL Report description should specify the minimum creepage requirements in the transformer (e.g. metal foil centered on polyester insulation, minimum 3.5 mm from edge of foil to outer edge of polyester insulation), and a statement should be added to the Engineering Considerations that quality control procedures are in place to address concerns with foil winding spacings.

RATIONALE:

The "positive retention" requirement is part of Annex C.2 because magnet wire windings are likely to shift during production or normal operation if there is not a means provided to prevent such shifting.

A metal foil winding is different than magnet wire because, technically, there are no "end turns." Because metal foil is a solid material that is wrapped upon itself, it is much less likely to shift during manufacturing or operation if proper quality control measures are employed during manufacturing. The metal foil windings can be considered to inherently meet the intent of Annex C.2 if basic quality control procedures are in place to assure adequate centering of the foil on the interlayered insulation.

To satisfy the concern with sound manufacturing of this type of construction, the manufacturer should be asked to summarize the manufacturing steps that are taken to assure consistent centering of the foil on the insulation. A short statement added to the UL Report's Engineering Considerations can serve to document this special engineering consideration.

OTHER:

SEE RELATED PAG: C.2:001

PAG No. H:001

(Sub)CLAUSE/ANNEX NUMBER: Annex H

(Sub)CLAUSE/ANNEX HEADING: Ionizing Radiation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Annex H only considers measurement of ionizing radiation under normal operating conditions. Does there need to be any consideration for measurements under abnormal operating conditions?

APPLICATION GUIDELINE:

Measurements should be made with the equipment under test operating under the following abnormal operating conditions, as applicable:

- A maximum supply voltage of 130 V if the equipment has a nominal voltage rating between 110 V and 120 V;

- A maximum supply voltage of 110% of the equipment nominal if the nominal is not between 110 V and 120 V;

- Under conditions identical to those which result from that component or circuit malfunction which maximizes x-radiation while maintaining the equipment operative for normal use.

RATIONALE:

The stated requirements are based on 21 Code of Federal Regulations (CFR), Part 1020, Section 1020.10.

In the BNWG Working Document dated July 28, 1995, Deviation No. 365 states the requirement associated with the 3rd dashed paragraph above should have been incorporated in Regulatory Annex NAE. In error, it was not. It will be pursued to be included in Annex NAE, along with the 1st and 2nd dashed paragraphs.

OTHER:

SEE RELATED PAG: H:002

PAG No. H:002

(Sub)CLAUSE/ANNEX NUMBER: Annex H

(Sub)CLAUSE/ANNEX HEADING: Ionizing Radiation

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable):

DESCRIPTION OF ISSUE:

Considering the need to conduct measurements for ionizing radiation under abnormal operating conditions, what are some practical considerations?

APPLICATION GUIDELINE:

1. During "normal" condition testing, any operator control may be adjusted to produce a "normal" picture, and any service control may be adjusted to improve or fix uncorrected factory mis-adjustments.

   For "abnormal" condition testing, any operator or service controls that are not provided with a means of preventing or discouraging adjustment may be adjusted, including those inside the equipment. However, the equipment shall remain "operative for normal [viewing] use." Because this is an "abnormal" operation condition, there is some flexibility permitted when judging if a picture is "normal."

   Adjustments should not be made on "factory preset" controls, such as those provided with "dots" of adhesive, epoxy or paint on the control, intended to prevent or discourage adjustment.

2. There are three basic methods that may be used to determine compliance with ionizing radiation requirements under abnormal operating conditions: (a) application of an external voltage to the CRT Secondary Anode to produce a reduced screen approximating 80% of normal viewing (i.e. 80% of the original viewing area); (b) application of an external voltage to the B+ circuitry (which supplies the flyback transformer) to produce a reduced screen approximating 80% of normal viewing; and (c) component or circuit malfunctions which maximize x-radiation emissions while maintaining the equipment operative for normal use.

   Since methods (a) and (b) are "simulations" of component or circuit malfunctions, a non-compliant test result [i.e. ionizing radiation exceeding 36 pA/kg (0.5 mR/h)] should be considered non-conclusive until the results can be repeated using method (c), (i.e. the exact method specified in the standard).

   If non-compliant results are achieved using methods (a) and (b), and can be repeated using method (c), the equipment does not meet the ionizing radiation requirements.

3. If considered appropriate by the evaluating engineer, a product may be tested under "abnormal" operating conditions and this may be considered representative of testing under "normal" operating conditions. Therefore, a single set of tests may represent "normal" and "abnormal" conditions. However, if testing under "abnormal" operating conditions yields noncompliant test results, the "normal" operating condition tests should also be conducted.

RATIONALE:

1. Annex H allows operator and service controls to be adjusted to determine the maximum x-radiation from a product. It is reasonable to require that any adjustment can be made to produce a "normal" picture, especially if the equipment under test was not properly adjusted before leaving the factory. Furthermore, during "abnormal" condition testing, it is reasonable to make adjustments of controls that may be located internal to equipment and which may not be normally expected to be adjusted. "Factory set" controls, such as those which have adhesive placed on them, are not intended to be adjusted by service personnel (unless specifically mentioned in the service manual). Therefore, they should not be adjusted for the tests in Annex H.

2. Experience has shown that determining compliance with abnormal x-radiation requirements by conducting component and circuit fault testing can be time consuming and expensive. An engineer requires a solid understanding of the monitor control circuitry to be able to develop a test program that covers fault conditions which produce likely worst case results. Generally, the practice has been to simulate abnormal operating conditions by one of either two methods. These methods simulate faults in the monitor circuitry which produce higher B+ voltages, thus a higher screen intensity and density. A 20% reduction in normal screen size generally has been accepted as a condition which maintains "the equipment operative for normal use," while also considering the effects faults and mis-adjustments. However, these "simulated" conditions are not always achievable when actual component or circuit malfunctions take place in the monitor. Often the internal monitor circuitry will shut down or otherwise re-adjust itself when such abnormal conditions actually occur. Therefore, although the use of the simulated test conditions may be used for the sake of time and cost efficiency, and may be accepted as conclusive if they produce compliant results, they should be considered inconclusive if they achieve non-compliant results. In such cases, testing as described in the standard will need to be conducted to determine if fault testing produces a true non-compliant test result.

3. "Abnormal" operating conditions will generally cause a CRT to produce greater amounts of ionizing radiation than "normal" operating conditions. Since the same 36 pA/kg (0.5 mR/hr) limit applies to both "normal" and "abnormal" operating conditions, allowing "abnormal" operation testing to represent "normal" operation testing is reasonable and will allow investigations to be conducted more efficiently.

OTHER:

SEE RELATED PAG: H:001

PAG No. L:001

(Sub)CLAUSE/ANNEX NUMBER: Annex L

(Sub)CLAUSE/ANNEX HEADING: Normal Load Conditions for Some Types of Electrical Business Machines

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.2.1

DESCRIPTION OF ISSUE:

Annex L indicates that for copiers a rest period of 3 minutes may be introduced after 500 copies (500 sheets = ream of paper), if compatible with the design of the machine.

(a) For small copiers that have trays that hold less than 500 sheets, can a 3 minute rest period be introduced after a tray of paper even if the tray holds less than 500 sheets?

(b) For large copiers with trays or paper bins larger than 500 sheets, should a complete tray or bin, which may be more than 500 sheets, be cycled before allowing a rest period of 3 minutes?

APPLICATION GUIDELINE:

(a) A 3 minute rest period can be introduced after less than 500 sheets of paper if the design of the equipment indicates that this condition is reasonable.

(b) If a tray or bin holds more than 500 sheets, the equipment should be run continuously until the complete tray or bin is empty.

RATIONALE:

Annex L is intended to provide examples of normal load conditions. However, these conditions should be adjusted if the design of the machine dictates that they may not be representative of actual conditions.

OTHER:

SEE RELATED PAG:

PAG No. L:002

(Sub)CLAUSE/ANNEX NUMBER: Annex L

(Sub)CLAUSE/ANNEX HEADING: Normal Load Conditions for Some Types of Electrical Business Machines

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.2.1

DESCRIPTION OF ISSUE:

For fax machines and similar equipment for which a maximum normal load condition is affected by percentage of black/white shades that make up the test pattern being printed/transmitted, what is a typical test pattern that can be considered a normal load condition during performance testing?

APPLICATION GUIDELINE:

When trying to determine a typical test pattern for this type of electrical business machine, copying or transmitting a page full with text from this Standard can be considered a typical normal load.

Other conditions (e.g. 75% black page) that are not likely to be used for extended periods of time can be considered as part of the abnormal operation test program.

Additional considerations may need to be given to equipment that is designed for special purposes, e.g. color, or that can be expected to be used for printing/transmitting unusual materials for an extended time.

RATIONALE:

For fax machines and similar equipment, the Standard does not provide an example of a normal load condition. Since the standard is not specific in this area, there are multiple conditions that could be considered normal load conditions. When in doubt, use a published page of full text from this Standard for a straightforward, standardized method of testing.

If a 50/50 black white, checkerboard, etc., was specified, this type of condition would be harder to consistently duplicate without having a test pattern example in the standard.

OTHER:

See CCA Decision EA(FI)3/91 on 5.1.

SEE RELATED PAG:

PAG No. L:003

(Sub)CLAUSE/ANNEX NUMBER: Annex L

(Sub)CLAUSE/ANNEX HEADING: Normal Load Conditions for Some Types of Electrical Business Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.2.2.1, 1.7.3, 5.1

DESCRIPTION OF ISSUE:

What are the normal load conditions for paper shredders?

APPLICATION GUIDELINE:

When determining compliance of a paper shredder to the standard, there are two options:

1. For general-purpose paper shredders, 20 lb pound bond weight paper is fed continuously into the shredder until temperatures stabilize. The number of sheets of paper shredded at a time should be the maximum intended load as specified by the manufacturer, i.e. per a marking or instructions. Consideration should be given to size of the paper feed slot, the number of sheets which can be shredded at one time, etc.

   A reasonable period of time is permitted between loads of shredded paper to simulate the time required to dispose of shredded paper. The time required to dispose of any shredded material should be based on the size of the equipment. Generally, a 3 — 5 minute "rest" period is a reasonable interval, although longer periods may be valid based on the specific equipment type and its intended use.

   A dynamometer may be used to simulate the shredding action.

2. For office-type paper shredders for use with small, portable waste containers and intended for Intermittent Operation, they should be tested similarly, except consideration may be given to the Rated Operating Time and the marked number of sheets recommended by the manufacturer to be shredded at one time. The unit shall be prominently marked with a short duty cycle according to sub-clause 1.7.3, and the ratio of rated resting time to Rated Operating Time shall not exceed 2:1. Such paper shredders also shall be marked with the number of sheets recommended by the manufacturer to be shredded at one time.

RATIONALE:

Deviation 371 in the Bi-National Working Document dated July 28, 1995 states that the requirements for paper shredders, which were D2 Deviations in previous editions of the Standard, "will not be included in the bi-national standard, but will continue to be used." Option 1 of this Application Guideline provides guidance, based on the previous requirements in previous editions of this Standard. Option 2 provides requirements originally proposed in the November 9, 1995 Subject 1950 IAC Meeting Report, and which are being pursued through IEC TC74.

OTHER:

SEE RELATED PAG: 1.7.3:001

PAG No. P(1.5.2):001

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Battery Chargers)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 1.7.17, 4.3.21

DESCRIPTION OF ISSUE:

ITE powered by battery packs are becoming more prevalent. Most battery packs require a battery charging circuit, which is located either inside the ITE, inside a stand-alone power supply, or inside a stand-alone battery charger external to the ITE/power supply.

What are the component requirements for battery chargers designed to charge battery packs used in or with ITE?

APPLICATION GUIDELINE:

If the battery charger is a stand-alone device that may be used with a variety of equipment types and product categories, the battery charger should be Listed to the Standard for Class 2 Power Units, UL 1310, or the Standard for Power Units Other Than Class 2, UL 1012 (or the CSA equivalent), as appropriate.

Alternately, a battery charger intended for use with engine-starter batteries may be Listed to the Standard for Battery Chargers for Charging Engine-Starting Batteries, UL 1236.

If such a battery charger is Listed under one of these categories and it is submitted as part of a Listed system under this Standard, additional investigation may be required on the battery charger to determine compliance with the Standard (e.g. interconnection (SELV) requirements).

If the battery charger is a stand-alone type designed exclusively for use with ITE and will be shipped with a specific ITE product, the battery charger may be evaluated as part of the end product and subjected exclusively to the requirements in this Standard.

If the battery charger is a stand-alone type designed exclusively for use with a variety of ITE products and/or will be shipped separately from a Listed ITE product, the battery charger should be provided with Accessory Listing and should be subjected to the requirements of this Standard.

If the battery charger is an integral (internal) part of a specific ITE product, the battery charger should be evaluated as part of the end product and should be subjected to the requirements of this Standard.

RATIONALE:

Several UL standards allow battery chargers to be evaluated to them, including the Standard for Battery Chargers for Charging Engine-Starting Batteries, UL 1236; the Standard for Class 2 Power Units, UL 1310; and the Standard for Power Units Other Than Class 2, UL 1012. Stand-alone battery chargers designed for a variety of equipment should be evaluated to one of these standards to permit the widest variety of uses.

Although this Standard does not contain all of the same requirements for battery chargers that the above-referenced standards contain, the Standard has requirements that ultimately address similar performance concerns as the other standards. Therefore, with some additional consideration given to battery charger designs, hazards associated with battery chargers may be addressed by this Standard and it may be used to investigate a battery charger circuit.

OTHER:

SEE RELATED PAG: 4.3.21:003

PAG No. P(1.5.2):002

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Surge Suppressors)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5

DESCRIPTION OF ISSUE:

What are the component requirements for transient voltage surge suppression (TVSS) and similar devices (e.g. gas-tube, MOVs, etc.) located in primary circuitry?

APPLICATION GUIDELINE:

For TVSS devices used in line-to-earth applications, the components should either comply with the Standard for Transient Voltage Surge Suppressors, UL 1449, and be (XUHT2) Recognized, or, unless used to achieve Overvoltage Category 1, comply with CSA Certification Notice No. 516.

For TVSS devices used in across-the-line applications, either a Recognized Component, Transient Voltage Surge Suppressors, (XUHT2), a Recognized Component, Across-the-Line Capacitors, Antenna Coupling and Line-by-Pass Components, (FOWX2), or a device complying with CSA Certification Notice No. 516 may be used.

RATIONALE:

The Standard for Transient Voltage Surge Suppressors, UL 1449, and CSA Certification Notice No. 516 are listed in Annex P.1. A TVSS device used in the primary circuit could contribute to a hazard (e.g. exploding) if not suitably investigated, and therefore, should meet applicable component requirements.

Components evaluated under (FOWX2) are considered having an equivalent level of safety for across-the-line applications.

OTHER:

Most European Agencies have specific requirements for transient voltage surge suppressors, which are outlined in the CCA Decisions EA(FI) 1/91 and EE(Chm) 1/94 under Sub-clause 1.5.1.

SEE RELATED PAG:

PAG No. P(1.5.2):003

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Telephone Handsets)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 6

DESCRIPTION OF ISSUE:

Some Information Technology Equipment is supplied with fully functional telephone handsets that can be plugged into standard modular wall jacks outside of the equipment and operate like normal telephones. Other information technology equipment have integral telephone handsets, but they are not functional when disconnected from the equipment. A fax machine is an example of this type of equipment, which may be supplied with either a fully functional, or equipment-dependent handset.

What requirements should be applied to telephone handsets used with information technology equipment?

APPLICATION GUIDELINE:

If a telephone handset is fully functional when separated from the information technology equipment, the telephone handset shall comply completely and separately with the requirements of this Standard.

If a telephone handset is not functional when separated from the information technology equipment, the telephone handset is required to comply with this Standard, but it may be evaluated in conjunction with the equipment, and any protection/operational features associated with the equipment.

RATIONALE:

A telephone which can be disconnected from information technology equipment and which can operate independently of the equipment may present hazards to the operator that normally would not be present if the device was connected to the Listed equipment. Therefore, this type of handset should be evaluated to the appropriate requirements that address all associated hazards for its use and foreseeable misuse.

If the handset cannot be used independently of the information technology equipment, the potential hazards are reduced and an evaluation in combination with the information technology equipment is considered adequate for addressing the potential hazards.

OTHER:

SEE RELATED PAG: Annex P(1.5.2):007

PAG No. P(1.5.2):004

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Flexible Printed Wiring)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 4.4.3

DESCRIPTION OF ISSUE:

Annex P.1(1.5.2 — Printed Wiring Boards) requires printed wiring to comply with the UL Standard for Safety for Printed Wiring Boards, UL 796.

However, Flexible Printed Wiring Boards may be UL Component Recognized as:

a) Wiring, Printed — Flexible Material Constructions (ZPXK2);
b) Wiring, Printed (ZPMV2);
c) Appliance Wiring Material (AVLV2).

When do flexible Printed Wiring Boards need to be Recognized Component (ZPXK2), (ZPMV2), or (AVLV2)?

APPLICATION GUIDELINE:

If the flexible printed wiring board is part of a hazardous voltage circuit or is located in such a location that supplementary or reinforced insulation spacings could be reduced if the PWB was to become de-laminated, the flexible printed wiring board should be Recognized Component (ZPXK2), (ZPMV2), or (AVLV2).

If the flexible printed wiring board is part of an ELV or SELV circuit and the PWB is located in an area that supplementary or reinforced insulation spacings could not be reduced if the PWB became de-laminated, a flexible printed wiring board constructed of V-2 materials (e.g. 94V-2, 94VTM-2), or of PVC, TFE, PTFE, FEP, or neoprene insulation is considered acceptable for the application.

RATIONALE:

Flexible printed wiring boards that contain hazardous voltage circuits, or that could contribute to a hazard if they became de-laminated, should be evaluated to the component requirements (i.e. the Standard UL 796) that have been established for flexible PWBs. Therefore, they should be Recognized Component (ZPXK2), (ZPMV2), or (AVLV2).

If flammability of materials is the only concern, PWBs constructed of materials complying with internal part/wiring flammability requirements are considered acceptable.

The flammability of the laminating material used in most flexible PWBs is not considered a significant concern due to the limited amounts of laminating material used in typical constructions. However, special consideration may need to be given to large applications with large surface areas or components.

OTHER:

SEE RELATED PAG:

PAG No. P(1.5.2):005

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Insulation Systems)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 2.2.2, 5.1, B.3, C.1

DESCRIPTION OF ISSUE:

What are the component requirements for insulation systems, other than Class A (105), that are relied upon for protection against electric shock?

APPLICATION GUIDELINE:

All insulation systems other than generic Class A (105) insulation systems should comply with the published requirements and intent of either UL 1446, Systems of Insulating Materials; CSA C22.2 No. 0, General Requirements — Canadian Electrical Code, Part II; or IEC 85, Thermal Evaluation and Classification of Electrical Insulation. Systems evaluated to UL 1446 should be Recognized (or Unlisted Component) under the component category Electrical Insulation Systems (OBJY2).

RATIONALE:

Insulation systems operating at a temperature above Class A should be evaluated to one of the listed Standards because individual material ratings are insignificant when individual insulation materials are combined into an insulation system. In fact, 2.1.2 of IEC 85 states "The description of an electrotechnical product as being of a particular thermal class does not mean, and must not be taken to imply that each insulating material used in its construction is of the same thermal capability. The temperature limit for an insulation system may not be directly related to the thermal capability of the individual materials included in it. In the system, the thermal performance of the insulating materials may be improved by the protective character of the materials used with them. On the other hand, problems of incompatibility between materials may decrease the appropriate temperature limit of the system below that for the individual materials. Such problems should be investigated by functional tests." Both UL 1446 and CSA C22.2 No. 0 have similar statements in them.

Since UL 1446 and CSA C22.2 No. 0 are located in Annex P.2 of this Standard, the non-mandatory component Annex, they are considered acceptable alternative standards to IEC 85. For temperature levels above Class A, an evaluation of an insulation system to the requirements and full intent of any of these standards is acceptable.

OTHER:

Most Certification Agencies do not apply IEC 85 correctly, ignoring the guidance statement in 2.1.2 and the Thermal Evaluation Requirements in Clause 3, which state "it is the responsibility of the manufacturer to devise and execute tests where standardized tests do not exist." Wrongly, individual material ratings within a system are accepted without considering incompatibility issues.

SEE RELATED PAG: Annex P(1.5.2):008

PAG No. P(1.5.2):006

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Internal Wiring)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 3.1, 4.4.3.4

DESCRIPTION OF ISSUE:

For secondary circuit internal wiring that functions as operational insulation, is the wiring required to be Recognized/Certified to either the Standard for Rubber-Insulated Wires and Cables, UL 44; Standard for Thermoplastic-Insulated Wires and Cables, UL 83; Desk Standard for Appliance Wiring Materials, UL 758; (or CSA 16; CSA 35; CSA 116; CSA 127 or CSA 210.2); or is non-Recognized/Certified wiring acceptable if the insulation can be identified (by manufacturer's certifications) as PVC, TFE, PTFE, FEP or neoprene?

APPLICATION GUIDELINE:

If compliance with flammability requirements is the only requirement for the individual secondary wiring, the wiring does not need to be Recognized/Certified to one of the Standards listed in Annex P.1 (3.1). However, it should have suitable conductor insulation (i.e. PVC, TFE, PTFE, FEP or neoprene insulated), which may be controlled generically.

If there is a concern that the wiring insulation is not reliable, fault testing (per Sub-clause 5.4.4) may be conducted on the circuit (i.e. operational insulation) to determine that the use of non-Recognized/Certified wiring does not lead to risk of fire.

Primary wiring or wiring that is used as basic, supplementary, double or reinforced insulation shall be a Recognized/Certified Component.

RATIONALE:

If wiring is used as a level of protection against electric shock, safety is clearly involved, and it shall be reliable. Thus, requiring the wiring to meet the applicable UL or CSA Component Standard is sound. On the other hand, wiring that is used as operational insulation is not required to have the same level of reliability (because this Standard permits other options to evaluate spacings) and the use of non-Recognized wiring is acceptable if flammability concerns are addressed.

This Standard permits wiring to meet generic material requirements (e.g. PVC — without flame testing) to address flammability concerns. If wiring is acting as operational insulation, its insulation is not a level of protection against electric shock and use of certifications is adequate to determine compliance with generic material requirements.

OTHER:

SEE RELATED PAG:

PAG No. P(1.5.2):007

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Telephone Handset Cord)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5.2, 6.4

DESCRIPTION OF ISSUE:

Is a telephone handset cord required to meet the requirements in the Standard for Communication Circuit Accessories, UL 1863 (or the Standard for Cords and Cord Sets for Communication Systems, CSA 233, and the Standard for Plugs, Receptacles, and Connectors for Communication Systems, CSA 182.4)?

APPLICATION GUIDELINE:

If the telephone handset cord is detachable at both ends, or if one end is attached to a handset and the other end is detachable, the telephone cordset should meet the requirements in UL 1863 (or CSA 182.4 and CSA 233).

If a telephone handset cord is not detachable from the equipment, the telephone handset cord is acceptable without further investigation if (a) it is Recognized Component — AWM (UL 758) and the Style Page(s) indicate that it is suitable handset or telephone line cord, and (b) it complies with either the Impulse Test, Sub-clause 6.4.2.1, or the Electric Strength Test, Sub-clause 6.4.2.2.

RATIONALE:

Telephone handset cords that are detachable at both ends, or that have a handset at one end and are detachable at the other end, may be disconnected from the equipment and be connected, or attempt to be connected to the telecommunication network supplied through similar connectors (e.g. household telephone jacks).

Therefore, these constructions should meet all UL 1863 (or CSA equivalent) requirements because UL 1863 addresses these safety related considerations.

UL 1863 (or CSA 182.4 and CSA 233) are contained in mandatory Component Annex P.1.

If the telephone handset cord is attached to the equipment, it is not possible to use the cordset on circuits other than that for which it is designed. Therefore, requiring AWM "external use" wiring is a suitable level of investigation.

OTHER:

SEE RELATED PAG: Annex P(1.5.2):003

PAG No. P(1.5.2):008

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Insulation Systems)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5.2, 2.2.2, 5.1, B.3, C.1

DESCRIPTION OF ISSUE:

When UL Recognized Component Insulation Systems (OBJY2) evaluated to UL 1446 are used to comply with this Standard, may they be tested and described generically in end product evaluations, or must individual constructions be evaluated and described?

APPLICATION GUIDELINE:

Specific individual constructions within Recognized Component Insulation System (OBJY2) designations should be tested and described individually in end product ITE evaluations. In the insulation system description, the CCN, manufacturer, specific insulation system designation, and the individual materials tested during the Standard's performance evaluation should be described.

RATIONALE:

The OBJY2 Guide information states "End product constructional details and tests performance are not covered by the Recognition; such evaluations are found in the Standards under which the products are examined and tested."

Most manufacturers of Recognized Component Insulation Systems (OBJY2) have multiple materials and constructions covered under each insulation system designation, not all which may meet this Standard's requirements, even if one of the constructions within the designation does. Since the Recognition only addresses thermal considerations above Class 105 (A) temperatures, and not spacings, electric strength, etc., specific combinations of materials used within each designation need to be tested to meet this Standard's requirements and need to be described individually in the end product.

OTHER:

SEE RELATED PAG: Annex P(1.5.2):005

PAG No. P(1.5.2):009

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Class 2 Power Supplies)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.5, 1.5.3

DESCRIPTION OF ISSUE:

Annex P.2 permits the use of UL 1310, Class 2 Power Units, (or CSA C22.2 No. 223, Power Supplies with Extra-Low Voltage Class 2 Outputs) in lieu of Power Supplies Evaluated to the Bi-National Standard.

When evaluating products incorporating UL 1310 (or CSA 223) power supplies (including direct plug-in transformer units):

a) May the power supply output be considered (and described in the UL descriptive report) as "SELV?"

b) What information will be controlled in the UL descriptive report?

APPLICATION GUIDELINE:

a) The output may be described as SELV.

b) Direct Plug-In Unit [or Power Supply] — (SELV) Listed, Direct Plug-In and Cord Connected Class 2 Power Units, Input Rated: ____, Output Rated ____. [or similar]

RATIONALE:

The rationale in the Subjects 478 (114) meeting report ("White Book") dated March 25, 1988 for Sub-clause 1.5.3 considers Class 2 outputs equivalent to SELV for purposes of applying the Standard. If power supplies evaluated to UL 1310 (or CSA 223) are to be accepted in ITE for the U.S. and Canada, such an assumption needs to be made in order to be able to apply the other requirements in the Standard, such as accessibility.

OTHER:

SEE RELATED PAG:

PAG No. P(1.5.2):010

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (Power Supplies)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 2.1, 2.11, 3.1, 3.2, 3.3

DESCRIPTION OF ISSUE:

What are the output circuit characteristic requirements for Listed (QQGQ) ITE power supplies?

APPLICATION GUIDELINE:

Output circuits of Listed (QQGQ) ITE power supplies may have low voltage, hazardous voltage or hazardous energy levels as long as they meet all UL 1950 accessibility and wiring requirements.

However, by nature of the (QQGQ) Guide Information restrictions, if the power supply has a low voltage output circuit (i.e. voltage not exceeding 42.4 Vp or 60 V dc), the output circuits must meet SELV requirements.

Also, per the (QQGQ) Guide Information, Listed (QQGQ) ITE power supplies will be evaluated for compliance with the requirements for Limited Power Source — "LPS" (2.11). If the output meets the criteria per 2.11, it shall be marked "LPS."

Non-SELV output circuits must meet appropriate requirements for the circuit type, including requirements for accessibility and wiring methods. Suitable non-SELV circuit constructions include:

a) Permanent (field wired) connections complying with Sub-clause 3.2, Sub-clause 3.3, and the NEC,

b) Standard supply outlets, and

c) Convenience receptacles.

Listed (QQGQ) ITE power supplies requiring installation by qualified service personnel should be provided with proper instructions stating so.

Power supplies with non-SELV low voltage output circuits, or high voltage or high energy output circuits which do not meet all UL 1950 accessibility and wiring requirements, will be evaluated as Recognized Components (QQGQ2) or Accessories (NWGQ) as appropriate.

RATIONALE:

Circuits in end product (Listed) equipment connected to Listed Power Supplies (QQGQ) may or may not be accessible. Since UL may not have the opportunity to investigate the combination of a Listed power supply and an end product, low voltage output circuits of Listed Power Supplies (QQGQ) should comply with all UL 1950 accessibility requirements for low voltage circuits, i.e. SELV. Other output circuits need to be designed to allow an operator or service personnel to connect equipment to the device in a safe manner.

Marking and instruction requirements for Listed (QQGQ) power supplies, in particular power supplies with hazardous voltage or energy levels, help assure that Listed power supplies are provided with sufficient information about the circuit characteristics.

Furthermore, power supplies meeting the Limited Power Source (LPS) Definition may be wired per Article 725 of the National Electrical Code (NEC), ANSI/NFPA 70, so they should be marked "LPS" to allow this. It is assumed that the end product user and/or service personnel will be able to determine the suitability of the combination of power supply and end product based on the supplied information.

Evaluation as a Recognized Component (QQGQ2) or as a Listed Accessory (NWGQ) remain viable options for power supplies not meeting the above restrictions.

OTHER:

SEE RELATED PAG:

PAG No. P(1.5.2):011

(Sub)CLAUSE/ANNEX NUMBER: Annex P(1.5.2)

(Sub)CLAUSE/ANNEX HEADING: Evaluation and Testing of Components (TNV Connectors)

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 6, Annex P

DESCRIPTION OF ISSUE:

Are TNV connectors required to comply with the Standard for Communication Circuit Accessories, UL 1863 (or the CSA equivalent), if they do not have contacts that are accessible with the Figure 19 test finger or if they are only accessible during disconnection?

APPLICATION GUIDELINE:

All connectors containing TNV circuits, whether accessible or not, shall comply with the Standard for Communication Circuit Accessories, UL 1863 (or the CSA equivalent).

RATIONALE:

Compliance with UL 1863 is a component requirement and is not directly based on compliance with Sub-clause 6.2.2. Since UL 1863 is in mandatory component Annex P.1 under the reference to Communication Circuits (Sub-clause 6.6), it is a required standard and is applicable when safety is involved.

UL 1863 is a required standard because it considers (a) strain relief, (b) current handling capacity to coordinate with communication circuit limits, (c) proper mating of connectors, and (d) dielectric withstand value and leakage current of the connector insulation.

This position is consistent with the rationale for Deviation 304 in the Working Document for the Bi-National Standard, dated July 28, 1995.

OTHER:

SEE RELATED PAG:

PAG No. NAE (2.7.1):001

(Sub)CLAUSE/ANNEX NUMBER: Annex NAE (2.7.1)

(Sub)CLAUSE/ANNEX HEADING: Branch Circuit Protection for Receptacles

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.11, 2.7.1

DESCRIPTION OF ISSUE:

What is a working definition of the term "standard supply outlet" specified in Annex NAE (2.7.1)?

APPLICATION GUIDELINE:

A working definition of a "standard supply outlet" is a primary power outlet in common use that is used for supplying primary power to other information technology equipment.

Outlets addressed by this definition include those found in IEC 83 (Plugs and Sockets for Domestic and Similar General Use), which includes all household NEMA configurations.

Also included in this definition are the outlets found in IEC 320 (Appliance Couplers for Household and Similar General Purposes) and IEC 320-2-2 (Interconnection Couplers for Household and Similar Equipment). The common hooded type IEC outlet found on many personal computers is defined in IEC 320-2-2 and is considered a standard power supply outlet.

RATIONALE:

Requirements that apply to standard power supply outlets are intended to prevent hazards from arising when Listed/Listed Accessory equipment is connected to the standard power supply outlets. Since non-NEMA outlets are often "standard" constructions by nature of their common use, the same concern exists with these outlets as with NEMA configurations.

OTHER:

SEE RELATED PAG:

PAG No. NAE (2.11):001

(Sub)CLAUSE/ANNEX NUMBER: Annex NAE (2.11)

(Sub)CLAUSE/ANNEX HEADING: NEC Class 2

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): NAA (3.3.9), NAE (1.7.2)

DESCRIPTION OF ISSUE:

What is a working definition of an "NEC Class 2" circuit as it applies to investigations to this standard?

APPLICATION GUIDELINE:

An NEC Class 2 circuit is a secondary circuit supplied by a power source complying with Article 725, Part C of the National Electrical Code (NEC), ANSI/NFPA 70. Since minimal performance requirements are specified in the NEC, the power source should meet applicable performance requirements for Class 2 circuits described in the Standard for Class 2 Power Units, UL 1310, fourth edition.

The applicable parts of UL 1310, fourth edition, are:

a) Output Current and Power Test Section 28;
b) Calibration of Overcurrent Protection Devices Test, Section 29;
c) Endurance Test on Overcurrent- and Overtemperature Protective Devices, Section 33; and
d) Abnormal Operation/Component Breakdown Test, Section 38.6.

The circuit parameters should be measured using the values specified in UL 1310, which are based on Article 725 and Chapter 9, Tables 11(a) and 11(b) of the NEC.

RATIONALE:

Although numerous UL 1950/CSA 950 sub-clauses make reference to NEC Class 2 circuits, neither UL 1950, nor the NEC contain guidelines for determining the extent of evaluation that is required to determine if a circuit complies with the NEC Class 2 definition. Since UL 1950 allows relaxation of some requirements for circuits and constructions being supplied by an NEC Class 2 circuit, there is a need to associate performance requirements with the NEC Class 2 definition.

The applicable ANSI/UL Standard for evaluating NEC Class 2 circuits is UL 1310, fourth edition. Since it is designed to investigate constructions similar to those submitted under UL 1950, it should be used when making the NEC Class 2 determination.

OTHER:

SEE RELATED PAG:

PAG No. NAE (3.2.4):001

(Sub)CLAUSE/ANNEX NUMBER: Annex NAE (3.2.4)

(Sub)CLAUSE/ANNEX HEADING: Cord Connected Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.2, 3.2

DESCRIPTION OF ISSUE:

What are the requirements for ITE intended for use with a detachable power supply cord when either supplied, or not supplied with the cord?

APPLICATION GUIDELINE:

If ITE marked with the UL Mark is not supplied with a detachable power supply cord when it is shipped from the manufacturer facility, UL will not require any further markings or instructions on cord selection to be provided with the equipment.

If ITE marked with the UL Mark is supplied with a detachable power supply cord when it is shipped from the manufacturing facility, the power supply cord shall meet the certification requirements for the country of destination, whether the U.S., Canada or foreign.

The UL Report will only contain a description of the U.S./Canadian power supply cord. The suitability of a foreign cord set will be determined during Follow-Up Service. The manufacturer's responsibility is to supply the UL Field Representative with sufficient documentation and/or information that allows the Representative to verify that the products are intended to be sold outside of the U.S.A. or Canada and the cord is appropriately certified for use in the destination country.

RATIONALE:

The Guide Information for Information Technology Equipment, Including Electrical Business Equipment (NWGQ) in the Electrical Appliance and Utilization Equipment (Orange) Directory states "When Listed equipment intended for use with a detachable power supply cord is not provided with such a cord, a cord suitable for the connection of the equipment to the branch circuit is to be separately provided." Therefore, a detachable power supply cord, or instructions for selection of a detachable power supply cord, are not required to be supplied with ITE if the equipment is not supplied with a detachable power supply cord.

However, if a detachable power supply cord is shipped with ITE marked with the UL Mark, the power supply cord should meet the applicable certification requirements for the country of destination because the UL Mark signifies that UL has determined the suitability of the equipment, including the power supply cord.

During UL Follow-Up Service, UL will devote minimal effort determining whether power supply cords shipped to foreign destinations meet foreign certification requirements. The main responsibility rests with the manufacturer to supply the required documentation/information.

OTHER:

SEE RELATED PAG: Annex NAE (3.2.4):002

PAG No. NAE (3.2.4):002

(Sub)CLAUSE/ANNEX NUMBER: Annex NAE (3.2.4)

(Sub)CLAUSE/ANNEX HEADING: Cord Connected Equipment

OTHER RELEVANT
(Sub)CLAUSES/ANNEXES
(as Applicable): 1.7.2, 3.2

DESCRIPTION OF ISSUE:

If a product with a dual rating is shipped with a detachable power supply cord, is a second detachable power supply cord or instructions detailing selection of cords for ratings other than the cord shipped with the product required?

For example, if a product is rated and marked 120/240 V and is shipped with a detachable power cord rated 125 V, must the manufacturer either supply another cord rated 250 V or supply instructions detailing how to select a 250 V rated cord?

APPLICATION GUIDELINE:

When a manufacturer supplies a power supply cord, only a single power supply cord is required to be shipped with the product. Additional power cords or instructions for selection of power cords at other ratings are not required.

RATIONALE:

If a detachable power supply cord is supplied with the ITE, the acceptability of the supplied cord will be determined. Additional detachable power supply cords or instructions are not required for dual rated equipment. Also, the NWGQ Guide Information states "When Listed equipment intended for use with a detachable power supply cord is not provided with such a cord, a cord suitable for connection of the equipment to the branch circuit is to be separately provided."

OTHER:

SEE RELATED PAG: Annex NAE (3.2.4):001

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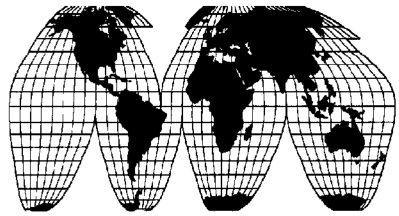

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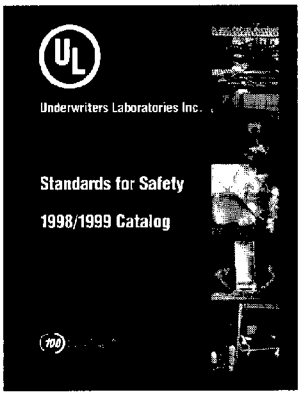

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