

This application note is intended as a guide to the safety standards to which the IsoLoop® products have been qualified or approved. Only the areas of those standards which are applicable to IsoLoop® are addressed. Also included is an overview of partial discharge testing and VDE0884.

## **Standards: IsoLoop® products are approved to the following standards:**

**UL1577** Standard for Safety for Optical Isolators.

**IEC61010-01** Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.

### **UL1577**

The requirements of this safety standard cover only the insulation properties of the isolation barrier, and do not cover the electrical properties of the separate circuits on either side of the isolation barrier. Neither does this standard place any restrictions on creepage and clearance. UL1577 states, "The external spacings between input and output circuits shall be based on the end product spacing requirements." Since the isolation barrier is encapsulated, the device need only be subjected to the dielectric voltage-withstand tests.

#### **Dielectric Voltage-Withstand Tests:**

Immediately following the conditionings 1 through 4 listed below, each sample shall be capable of withstanding, for a period of 60s, a potential equal to the rated dielectric insulation voltage applied between input and output. For IsoLoop® devices this is 2500VRMS

1. Six samples are tested in the "as-received" condition.
2. Six samples are exposed to the maximum rated junction temperature for 7 hours before testing.
3. Six samples are exposed to 85% relative humidity at  $32.0 \pm 2.0^{\circ}\text{C}$  for 24 hours before testing.
4. Six samples are exposed to  $0.0 \pm 2.0^{\circ}\text{C}$  for 7 hours before testing.

Separate sets of samples are used for each conditioning 1 through 4.

#### **Manufacturing and Production-Line Test:**

UL1577 mandates a production test of 120% of the rated withstand voltage for a period of 1s. This 3000VRMS test is performed for 1s on all IsoLoop®.

### **IEC61010-01**

This standard specifies general safety requirements for electrical equipment intended for professional, industrial process, and educational use, including equipment and computing devices for measurement and test, control, laboratory use, and accessories intended for use with the equipment. It does not cover medical equipment.

The object of this standard is to ensure the design and methods of construction of the equipment provide adequate protection for the OPERATOR and surrounding area against electric shock or burn.

This standard applies to equipment intended for operation under the following conditions:

- Indoor use
- Altitude up to 2000m unless otherwise specified.
- Temperature  $5^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ .
- Maximum relative humidity 80% up to  $31^{\circ}\text{C}$  then decreasing linearly to 50% at  $40^{\circ}\text{C}$ .
- Mains supply voltage fluctuation maximum of  $\pm 10\%$  nominal voltage.

**Environmental Condition for Tests:**

Unless otherwise specified the following environmental conditions shall exist for the tests. They should not conflict with those specified for intended equipment operation.

- Temperature of 15°C to 35°C
- Relative humidity of not more than 75%
- Air pressure 75kPa to 106kPa (100kPa = 14.50377psi)
- No dew, frost, rain etc.

Equipment approved under this standard is categorized by three main areas; insulation class, exposure to pollution, and installation category (overvoltage category). These areas are explained in Glossary of Terms.

The requirements under which the IsoLoop® products are tested are shown in Table 1.

Working Voltage (RMS or DC) up to V	Pollution Degree II Installation Category (Overvoltage Category) II								
	Clearance mm	Creepage Distance mm					Test Voltage V		
		In Equipment			On Printed Wiring Board		Peak Impulse	RMS 50/60Hz	DC or 50/60Hz peak
		Material Group			Not Coated CTI>175	Coated CTI>100			
		I CTI>600	II CTI>400	III CTI>100			1.2/50us	1 min.	1 min.
50	0.2	1.2	1.7	2.4	0.4	0.12	850	510	720
100	0.4	1.4	2	2.8	0.4	0.4	1360	740	1050
150	1.6	1.6	2.2	3.2	1.6	1.6	2550	1400	1950
300	3.3	3.3	4.2	6	3.3	3.3	4250	2300	3250
600	6.5	6.5	8.5	12	6.5	6.5	6800	3700	5250
1000	11.5	11.5	14	20	11.5	11.5	10200	5550	7850
1500	16	16	21	30			13600	7400	10450
2000	21	22	28	40			17000	9300	13150
2500	26	28	36	50			20400	11100	15700

**Table 1. Double Insulation or Reinforced Insulation.**

The test voltage used may be either the peak impulse, RMS, or DC value according to Table 1. There is no requirement to test using all three values. These test voltages, which are derived from IEC664, take into account the possible transient over-voltages which may occur in systems with the working voltages shown in Table 1.

The working voltages for the qualified IsoLoop® products are shown in Table 2.

Model	Pollution Degree	Material Group	Working Voltage	Package Type			Production Test Voltage (AC RMS)
				16 – SOIC	8 – PDIP	8 – SOIC	
IL710-2	II	III	300VRMS		*		3000V / 2 sec
IL710-3	II	III	150VRMS			*	
IL711-2, IL712-2	II	III	300VRMS		*		
IL711-3, IL712-3	II	III	150VRMS			*	
IL715, IL716, IL717	II	III	400VRMS	*			3700V / 2 sec
IL485	II	III	400VRMS	*			

**Table 2. Maximum Working Voltages for IsoLoop Products**

**Partial Discharge Testing**

Partial discharge, as defined by ASTM (American Society for Testing and Materials), is a type of localized discharge resulting from transient ionization in an insulating system when the voltage stress exceeds a critical value. Partial discharge level has a profound effect on the life of the insulator. Deterioration of stator windings in H.V. motors and generators is one of the predominant causes of failure. Test results have shown that machines with deteriorated windings have partial discharge activity at least 30 times higher than those with good windings. It is therefore a fair assessment of the condition, or suitability, of an isolator to withstand a voltage by measuring its partial discharge activity. Standards such as VDE0884 use partial discharge methods for assessing an isolator’s operating voltage.

As the voltage stress across an isolation barrier is increased, anomalies in the barrier will result in partial discharge or corona inception. This activity will increase with increasing voltage until final breakdown of the barrier. However, if the voltage stress is reduced corona extinction will occur. If the barrier operating voltage is below the corona extinction voltage, i.e. no partial discharges, it is unlikely to break down due to the applied voltage stress, or working voltage. VDE0884 uses 1.6 x Working Voltage as the manufacturing test voltage, and requires an accumulated partial discharge of <5pC in 1s for a pass criterion in production testing. The Type-test voltages in VDE0884 are derived from DIN VDE0109 and differ from those values stated in UL1577 and IEC61010-1.

## Glossary of Terms

The terms used in this section are those used in IEC61010. Some categories, such as pollution degree or installation category, may vary depending on the standard being used.

<b>Primary Circuit</b>	An internal circuit which is directly connected to the external supply mains or other equivalent source which supplies the electric power.
<b>Secondary Circuit</b>	A circuit which has no direct connection to primary power and derives its power from a transformer, converter or equivalent isolation device, or from a battery.
<b>Creepage Distance</b>	The shortest path between two conductive parts, or between a conductive part and the BOUNDING SURFACE of the equipment, measured along the surface of the insulation.
<b>Clearance</b>	The shortest distance between two conductive parts, or between a conductive part and the BOUNDING SURFACE of the equipment, measured through air.
<b>Insulation.</b>	
<i>Operational insulation</i>	Insulation needed for the correct operation of the equipment.
<i>Basic insulation</i>	Insulation to provide basic protection against electric shock.
<i>Supplementary insulation</i>	Independent insulation applied in addition to Basic insulation in order to ensure protection against electric shock in the event of a failure of the Basic insulation.
<i>Double insulation</i>	Insulation comprising both Basic and Supplementary insulation.
<i>Reinforced insulation</i>	A single insulation system which provides a degree of protection against electric shock equivalent to Double insulation under the conditions specified in this standard.
<b>Pollution Degree.</b>	
<i>Pollution Degree 1</i>	No pollution, or only dry, non-conductive pollution occurs. The pollution has no influence.
<i>Pollution Degree 2</i>	Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
<b>Installation Category</b> <b>(overvoltage category)</b>	This section is directed at insulation co-ordination by identifying the transient overvoltages which may occur and assigning 4 different levels as indicated in IEC664.
<i>I:</i>	Signal Level. Special equipment or parts of equipment.
<i>II:</i>	Local Level. Portable equipment etc.
<i>III:</i>	Distribution Level. Fixed installation
<i>IV:</i>	Primary Supply Level. Overhead lines, cable systems.

Each category should be subject to smaller transients than the category above.