

High voltage testing for equipment or components is based on the probable or expected transients which can, or may, occur for a given working voltage. These are quoted from standards such as IEC664 or DIN VDE0109.

The standards quoted in this note are UL1950, UL1577, UL 3101-1 (IEC1010-1 or IEC61010-1), and VDE0884.

**Type Testing:** These are the tests employed to determine if the product is suitable for the working voltage quoted and are considered destructive. The equipment or components tested in this manner are generally not recommended for sale.

- UL1950      Makes no distinction between Type testing and production testing. But allows a 1s test for production, without making recognition of possible damage caused by Type testing.
- UL1577      Makes no distinction either. But requires testing at 120% of rated voltage for shorter durations in production testing.
- UL3101-1    Recognizes that damage may be caused by Type testing, and recommends that equipment, or components, used for Type testing should not be subject to further Type testing once they have left the manufacturer.
- VDE0884    Recognizes that Type tests are "not non-destructive".

**Production Testing:** These are shortened tests to verify that the manufactured items meet the working voltages of the relevant standards, and are defined by each standard.

- UL1950:      1s at 100% of dielectric withstand test for rated working voltage.
- UL1577:      1s at 120% of dielectric withstand test for rated working voltage
- UL3101-1:    2s at 100% of dielectric withstand test for rated working voltage.
- VDE0884:    1s at 160% of working voltage. No more than 5pC partial discharge allowed.

UL1950, UL1577, and UL3101-1 are only concerned with breakdown. They emphasize that breakdown must not occur but "corona effects and similar phenomena are disregarded".

Table 1 shows the test voltages for different working voltages, and also the creepage and clearance distances. This table is taken from UL3101-1, which corresponds to IEC1010-1 and IEC61010-1.

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.

Linear interpolation of values for clearance and creepage is allowed. Linear interpolation of values for test voltage is not allowed.

### Partial Discharge Testing: VDE0884\*

**Type Testing:**  $U_{INITIAL}$  (barrier dielectric withstand voltage) is determined by the service class and working voltage. For example, for  $300V_{RMS}$  working voltage and Class III,  $U_{INITIAL} = 4000V_{peak}$ . (See Table 2)

$U_{INITIAL}$  is determined from the desired working voltage ( $U_{IORM}$ ) and the Service Class of operation. (See Table 2.)

2.)  $U_e$  is the partial discharge extinguish voltage, and should not be less than  $1.2 \times U_{IORM}$ .

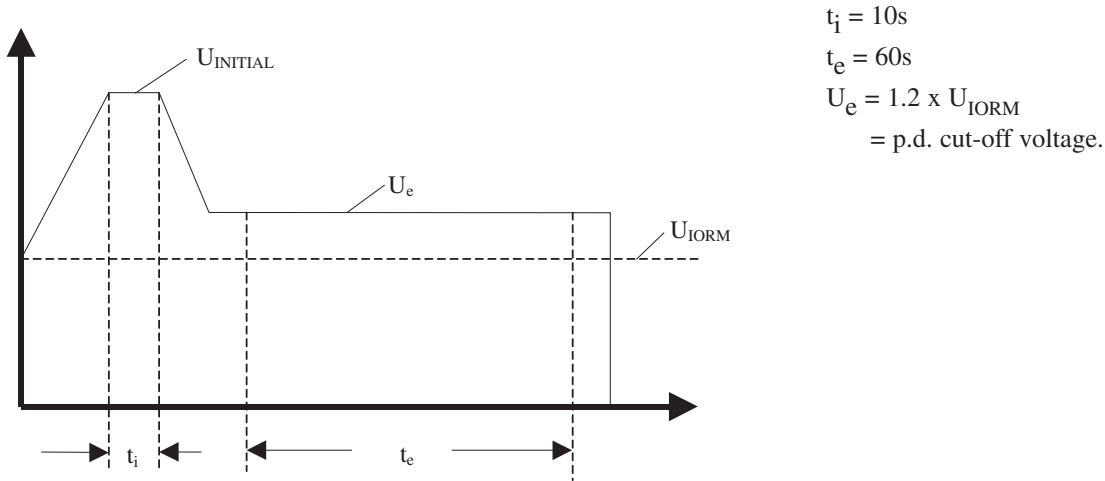


Fig.1 Type Testing and Random Testing. - Destructive Test.

The TYPE testing and Random sample testing is conducted as shown in Fig.1. The voltage is ramped at  $100V/s$  from a value below the partial discharge cut-off point to  $U_{INITIAL}$  and maintained for 10s. Partial discharge is allowed to occur at this voltage, but not breakdown. The voltage is then decreased at  $100V/s$  after 10s to the voltage at which partial discharge ceases  $U_e$ .  $U_e$  must be greater than or equal to  $1.2 \times U_{IORM}$ . Values of not less than  $5pC$  are specified as criteria for the presence of partial discharge. *Example:* If the desired working voltage is  $300V_{RMS}$  and Service Class 3 is called for, partial discharge must have ceased at  $300 \times 1.2 = 360V$  ( $U_e$ ) for this working voltage to be acceptable. If not, the working voltage must be lowered.

### Routine or Production Testing: VDE0884

For Routine, or Production testing, the time for monitoring for partial discharge may be reduced to 1s. The test voltage  $U_{pr}$  is now raised to  $1.6 \times U_{IORM}$ . The partial discharge test criteria is that the device should exhibit less than 5 discharges, each less than  $5 pC$  in magnitude, in a time of 1 second. Routine testing is deemed non-destructive.

$U_{IORM}$ RMS	Insulation Test Voltage for Service Class - $U_{INITIAL} = AC_{peak}$			
	I	II	III	IV
50	330	500	800	1500
100	500	800	1500	2500
150	800	1500	2500	4000
300	1500	2500	4000	6000
600	2500	4000	6000	8000
1000	4000	6000	8000	12000

Table 2. Insulation Test Voltages. (from DIN VDE 0109)

\* To date NVE has not applied for VDE0884 approval.

## Conclusions:

For most products, including IsoLoop®, the maximum working voltage is determined from the appropriate standard by the package creepage and clearance distances. If we are approved by a standard, the testing requirements of that standard are mandatory unless a waiver, or alternative method, is approved in writing.

As stated earlier, only VDE0884 stipulates testing by partial discharge. The other standards are concerned only with breakdown, not corona phenomenon or flashover. To date NVE has not applied for VDE0884 approval. The requirements of VDE0884 are supplied only for information purposes since it is an often quoted approval for optocouplers.

Table 3 shows the comparative production test times for each standard for the working voltages given. The service class, or insulation category, must be considered before the final table can be constructed. This table is based on the most likely categories for the IsoLoop® devices, and is only intended to show the relative testing parameters.

Standard	Qualified or Working Voltage	Test Voltage	Production Test Time	Pass Criterion
UL1577	2500VRMS (1min)	3000VRMS	1s	No breakdown
IEC61010-1	400VRMS	3700VRMS	2s	No breakdown
VDE0884	300VRMS	679Vpeak	1s	<5pC

Table 3. Comparative Requirements of Standards