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Electrical Safety Testing eyePower PDU

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THIS UNIT MUST BE EARTHED

Electrical Safety (Portable Appliance) Testing

This document refers to in-service electrical safety testing of eyePower Limited intelligent Power Distribution Units (PDU). Typically known as Portable Appliance Testing (PAT) in the UK, electrical safety testing for Class 1 (earthed) equipment includes visual checks and measurement of protective earth conductor resistance. Insulation testing often follows but where considered unsuitable this may be optionally substituted with the measurement of operational protective conductor (earth leakage) current.

Manufacturer guidance for electrical safety testing of eyePower PDU is to omit insulation testing because it is not suitable and perform the following tests:

	Test	Test Value	Expected Result	Test Duration	
1.	Visual Test				
2.	Earth Bond	25A~	<0.20Ω	5 sec	
3.	Leakage	230V~	<1.50mA	10 sec	Alternative to insulation test

Further background to explain the omission of insulation testing is given below.

All pluggable electrical equipment must conform to a product standard and eyePower Limited intelligent PDU conform to EN62368. Many mains distribution units on the market do not conform to a product standard as required, some when inspected are clearly dangerous.

EN62368 is several hundred pages long and full compliance is a challenge. In contrast UK guidance on electrical safety testing covers a wide range of equipment conforming to many standards and documentation is relatively basic. The simple instructions for electrical safety testing cannot possibly cover all designs and this is made clear in the IET Code of Practice for In-service Inspection and Testing of Electrical Equipment (4th Ed). When testing equipment, manufacturer's guidance must be followed because conformance with product standards is a legal requirement, whereas conformance with PAT testing manuals is not.

The default assumption when safety testing Class 1 (earthed) equipment is earth leakage should be no greater than 3.5mA and this agrees with EN62368. eyePower Limited intelligent PDU have an earth leakage of approximately 1mA, similar to a PC, with exact value depending on specification and are therefore well within limits. The limit of 3.5mA is low in case the earth connection is lost and touch current flows through a human body.

An obvious concern with PDU is leakage of connected loads, for example fourteen loads each having 3.5mA earth leakage sums to approximately 50mA total earth leakage. However, PDU fitted with powerCON professional type inlets are referred to as "Pluggable Equipment Type B", expected to be used in an environment where the protective earth is known to be good and leakage may be 5% of the connected load with appropriate labelling. A supplementary earth bonding post is also provided where earthing via the power inlet may not be guaranteed.

If 3.5mA earth leakage is acceptable on a running test, and this is the true danger to the human body, then logically the optional insulation resistance test between live/neutral and earth would have a pass level of

$$R = V/I = 230/0.0035 \approx 66k\Omega$$

Instead, the default pass level for DC insulation resistance is 15 times higher at 1MΩ, with neither the test nor test limit mentioned in product standard EN62368. The insulation test often does not power large parts of a unit under test and is of limited value compared with the leakage test, which is considered an alternative where appropriate.

The suggested 1MΩ DC insulation limit only represents a best guess by the electrical test community. It assumes a correctly insulated power supply with components such as transformers that offer no DC path. Where filtering is fitted, often generating high levels of leakage and interference when running, this filtering will only offer an AC path and no DC current flows when insulation tested. There would normally be no point having a purely resistive DC path to earth, it would have no filtering capability and would only be useful for measuring the supply.

Since the 1990s eyePower Limited intelligent PDU have indeed measured mains live and neutral with a resistive path to earth. In a professional environment, earth can be relied upon as reference to measure live and neutral. This technique also massively reduces component count offering increased reliability, with the added benefit of much lower power consumption than would be possible with isolated live detection. Each measurement circuit passes only microamps to earth but the cumulative current of multiple measurement circuits to earth is approximately 1mA with effective resistance of less than 1MΩ. Total 1mA current to earth is also normally enough to check earthing is not phantom and a number of installations have discovered earthing problems or live/neutral reversal using eyePower Limited PDU with earth referenced measurement.

Possible reasons for omitting the insulation test are included in the IET Code of Practice, for example filtering or transient suppression. The Code of Practice cannot be expected to list the reason in this particular case, i.e. the mains unit is measuring the very supply which it is distributing. Most equipment will not measure the mains supply to which it is connected, and certainly not multiple times such as with eyePower. The lower insulation resistance is exactly as would happen when using a voltmeter to make the same measurements.