Electrical Test Information for Power Line, HEMP, Tempest, Data, Telephone, Control & Signal Line Filters

EEP
European EMC Products
Technical Datasheet

It is important when manufacturing filters that we get it right first time. Therefore, we apply many testing techniques to which we believe sets us apart from many others. Here is a list of some of the tests we undertake on our filters.

Our testing can include but not be limited to the following:

- Continuity of all Phases and Lines
- Insulation Resistance Test
- Flash Testing
- Discharge Resistance Testing
- Voltage Drop Testing
- Inductance Testing
- Inductance Cancelling Testing
- Capacitance Testing
- Dissipation Factor Testing
- Insertion Loss Testing
- Load Testing

We categorise and purposely prioritise testing in a particular order to conform to safety obligations and to work in accordance with regulative statutory and non-statutory guidance.

For safety reasons, we prioritise the following tests to ensure basic safety of our filters. This includes but is not limited to:

- Continuity of all Phases and Lines
- Insulation Resistance Testing
- Flash Testing
- Discharge Resistance Verification & Test
- Voltage Drop Verification & Test

Where applicable, to check against Certificate of Conformities, we check the following:

- Inductance of Inductor Components
- Capacitance of Capacitor Components Including Polarised and Non-Polarised Capacitors
- Dissipation Factor of Capacitors
- Resistance of Discharge Resistors Designed and Made in House

NB: This datasheet contains proprietary information only and are NOT instructions on how to test filters provided by EEP Filters Limited.

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The comprehensive testing we undertake on our filters ensure we pass specific criteria and meet our own safety obligations. Listed below are the tests we complete on each filter and why we undertake such tests.

Continuity of all Phases and Lines

Continuity is a direct line test which helps identify the connection from the supply to the load. Although this test is basic, it is a general safety test to ensure phases such as: L1, L2, L3, Neutral & Earth are connected correctly.

We check this to ensure the power supplies configuration is not changed or misidentified, as failure to identify the correct rotation of the supply, especially on three phase, will cause the phase rotation to change the output configuration of the equipment.

Insulation Resistance Testing

The purpose of an Insulation Resistance Test is to verify the insulation of conductors provide adequate electrical insulation, that it is not damaged, and that live conductors or protective conductors are not short-circuited.

Insulation resistance is a general safety test to check the integrity of the dielectric (insulation) against any metallic surfaces or return cables. The filter has a voltage applied that is normally twice of the nominal voltage the filter will see in its working life.

Test voltages will vary from filter to filter and against the design. For informational purposes, please see below table 4Ab which in accordance with electrical standards (BS7671:2018), Insulation resistance is recommended, that the DC voltage applied is:

Reference to table 64 of BS7671:2018 (Minimum values of insulation resistance)		
Circuit Nominal Voltage (V)	Test Voltage DC (V)	Minimum Insulation Resistance (MΩ)
SELV and PELV	250	0.5
Up to and including 500 V with the exception of the above systems	500	1.0
Above 500 V	1000	1.0

Please keep in mind, the above figures are direct to installations that are new and for continued use, whereas manufacturers figures will differ depending on design and construction. This therefore implies that manufacturing figures will not directly relate to the above but is generally good guidance to be made aware about.

NB. Due to our filters being fitted with discharge resistors, the reading of insulation resistance will be false. This is because of the internal safety resistors fitted. You can no longer gain an effective insulation resistance reading unless the safety discharge resistors are completely removed or isolated from the filter.

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Flash Testing

HI-POT Voltage Test is a manufacturing only test to ensure the filters are safe when subjected to a high voltage. A HI-POT / Flash Test is not a measurement test and is generally a procedure to ensure that the operator is not exposed to danger. Like Insulation Resistance Testing, the HI-POT / Flash Test is used solely to check the insulation between the live conductors against the metallic surfaces / chassis earth potential enclosure.

We use DC voltages as DC is more consistent compared to AC voltages. This is because DC voltages can continuously provide a stable charge, and therefore will charge the capacitors to a voltage maximum depending on the design.

These voltages can range anywhere between 1.5kV up to and beyond 5kV DC depending on the design criteria or filtering supply requirements.

It is also important that the voltages introduced into the filter are not continuous. This is due to the fact the insulation will degrade if subject to voltages exponential to what it may see during manufacturing or through its working life. Generally, high voltages are subject to specific design requirements, but we typically range from 1 to 5 seconds ramp up and charge time before determining a pass or fail, this is based upon the time constant and ramp up voltage times.

We use special machinery which can ramp filter voltages up to 40kV to ensure we have full capacity for any design either being for low voltage or high voltage applications.

NB. It is important that no internal discharge resistors are fitted during the HI-POT or High Voltage Flash Test. This is because the power introduced into the filter will immensely heat up the resistors which may cause internal damage and potentially disable the functionality of the safety discharge resistors. An exemption to this is if the discharge resistors have been designed to withstand the power of such a high voltage when introduced to the filter.

Discharge Resistance Testing

Discharge Resistance is a manufacturing test that is used to check the values of the internal resistors fitted. The purpose of this test is to ensure the filter remains discharged through transit and after being de-energised.

In addition, this is the filters main safety feature, as once installed and powered up, should the filter need to be de-energised for any reason, the capacitors internally will have the voltage reduced over a period of time depending on the time constant characteristics for the design of the filter.

NB. Where discharge resistors are not fitted for specified applications, testing for discharge resistance may show an open circuit.

SAFETY NOTE:

NEVER assume that the filter terminals have been isolated, discharged, or are safe to touch when the power has been de-energised. Always prove the terminals are dead by checking for residual voltage. Voltage should be checked with and approved, calibrated voltage indicator accompanied with an approved, calibrated proving unit to ensure the functionality of the voltage indicator is still working correctly.

Due to the use of capacitors, voltage may still be present, failure to identify this may result in serious or fatal injury.

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Voltage Drop Testing

Voltage Drop is a manufacturing verification test. This test verifies the connections within the circuit itself is correct to the theoretical design figures, as voltage drop reduces the overall energy efficiency.

We use a Voltage Drop Test to observe the following:

1) There are no high resistance readings on connections.
2) The power efficiency loss can be reduced as much as possible.
3) The measured value of the voltage drop is lower than the calculated value.

Voltage Drop should be as such that it does not impair the proper and safe functioning of installed equipment, and as guidance from BS7671:2018, that:

Reference to table 4Ab of BS7671:2018 (Voltage Drop)		
	Lighting	Other Uses
(i) Low voltage installations supplied directly from a public low voltage distribution system	3%	5%
(ii) Low voltage installations supplied from private LV supply (*)	6%	8%
(*) The voltage drop within each final circuit should not exceed the values given in (i) Where the wiring systems of the installation are longer than 100m, the voltage drops indicated above may be increased by 0.005 % per meter of the wiring system beyond 100m, without this increase being greater than 0.5 %. The voltage drop is determined from the demand of the current-using equipment, applying diversity factors where applicable, or from the value of the design current of the circuit.		

NB. Although this is guidance, manufacturing filters and design requirements may fall out of scope with these requirements. This is permissible due to the nature of design and that the filters may be subject to additional standards / regulatory requirements / theoretical design. It is however always ensured that we work as close to guidance and statutory regulations where and when available.

Inductance Testing

Inductance Testing is a manufacturing test which is completed once the component has been built or is to be used. Inductance is measured in Henry's and typically can range at any value depending on the design.

Inductance is measured for the sole purpose to check there is the correct number of turns, and in turn checks the inductance is not over or under specification.

It is important during manufacture to check inductance as the filter may degrade in performance and / or saturate if incorrect inductors are selected for the application.

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Inductance Cancelling Testing

Inductance Cancelling is a manufacturing only test where the inductor is checked for leakage. This is only conducted on common mode inductors (chokes) where there needs to be a balance of inductance for every line within the filter.

This can be done for single phase or three phase filters where the common mode inductor will have the same number of turns, being the same distance apart, and share the one individual core. We are actually measuring the differential mode inductance which is done by shorting out one of the inductors legs which in turn will give a leakage inductance reading.

The reason we gain a differential mode leakage inductance is due to the fact the flux on the core is not 100%, otherwise if the flux was perfect, it would cancel out as per Lenz's law.

Capacitance Testing

Capacitance Testing is a manufacturing test which is completed once the component has been built or is ready to be used. Capacitance is measured in Farads and typically can range at any value depending on the design. We normally test capacitors at 1 kHz at approximately 1 V which is our machines output and works best to identify the readings of capacitors.

Capacitors are measured for the sole purpose of checking there is the correct number of plates on the capacitor. Capacitors are made from many materials which can range from Ceramic, Electrolytic, Polyester (Mylar (PET)), Polypropylene (BOPP), Aluminium etc...

In addition, we use a non-polarised capacitor which allows us to design filters in many ways depending on our customers' requirements.

Dissipation Factor Testing

Dissipation Factor Testing is a quality test undertaken during the manufacturing of filters. This test is completed at component level and within the filters circuit as well. It is important to check the dissipation factor as this tells us the effectiveness of the capacitors.

Capacitors tend to have ESR within the circuit which may limit the dissipation factor reading once installed. However, taking the ESR into consideration we can accurately gain a dissipation factor figure to allow us to see the quality of the capacitor.

Dissipation factor is not normally checked once the filter has been installed and remains a manufacturing test only.

Insertion Loss Testing

Insertion Loss is a manufacturing and verification test which is signal attenuation that is measured in dB and Hz. Insertion loss is measured using a network analyser which can measure from as low as 1 Hz up to and past 40 GHz. Ranging from 0 dB up to and past 100 dB.

Depending on the design parameters, cut off frequencies can vary where different attenuations may differ depending on the filter type, performance model and components selected. Thus, allowing for a symmetric or asymmetric signal or graph to be calculated based on the impedance specific to the application.

Impedances play an important part of the insertion loss, as it is the base for component value selection, and can vary for applications.

For example, telephone and data line filters generally use an impedance from 300, 600 or 900 Ohms.

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Load Testing

Load Testing is a design and manufacturing test which provides information on the performance of the filters when a true load has been attached.

By conducting Load Testing this allows our team to evaluate the power consumption, voltage, and current usage, and correctly identify the power factor of the filter when in installation.

Load Testing can also tell us what power in watts the filter will consume, giving an accurate power consumption rate determining how efficient the filter will be in installation.

Reference

DC - Direct Current
AC - Alternating Current
dB – Decibel
Hz - Hertz
HI-POT Flash Test - High Potential Voltage Test ≥1.5kV DC ≥600V AC
1Ph - Single Phase (Line & Neutral)
2Ph - Two Phase (L1 & L2 Generally used in DC applications)
3Ph - Three Phase (L1, L2, L3 & Neutral)
ESR - Equivalent Series Resistance
H - Henry
F - Farad

About Us

Established in 1996, European EMC Products (EEP) are an established British company whose experience and understanding of the science of shielding makes it an ideal partner in whom you can place your trust with confidence. The purpose of installing EEP shielding systems is to protect people and equipment against the threats posed by electromagnetic and radio frequency (RF) interference, radiation, magnetic fields and electromagnetic pulses. Our diverse range of turnkey products and services, including design, project management, testing and consultancy are delivered across multiple sectors to an international client base.

Quality

European EMC Products Limited are registered to BS EN ISO 9001:2015, Certificate Number FS38901.
Registered Scope: The design, assembly, installation, servicing and testing of RF Shielded Structures and equipment including EMI Shielding, Blast Doors, Gas Tight Doors and specialised mobile Electromagnetic Pulse Protection (EMPP) containers.
Radio Frequency, Magnetic Shielding and Quench systems for MRI (Magnetic Resonance Imaging) scanners.
The design, assembly and installation of Ionising Radiation Protection facilities.
The design, manufacture and installation of LED lighting systems for medical applications.
EEP Filters Limited are registered to BS EN ISO 9001:2015, Certificate Number FS38901.
Registered Scope: The design, manufacture, management of installation and testing of high performance EMC and EMP Power and Data Line Filters.

Disclaimer

NB: All the information provided within this datasheet is for reference only. Product specifications are subject to change without notice.