BOTTER Designs

HIGH VOLTAGE INSULATION METERS

APPLICATION NOTE 4

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V1.00

CURRENT AND POWER LIMITED - WHY ?

CURRENT LIMITED OUTPUT

Output current of all our High Voltage Insulation Meters is **limited to a safe level which does not kill personnel, destroy material, damage faults or create insulation failure**.

NON DESTRUCTIVE METERS

To check the quality of insulation (Insulation Resistance), a DC High Voltage is applied on the insulation to measure.
In that insulation to measure, there is a number of free electrons, which accelerates under this applied DC High Voltage.

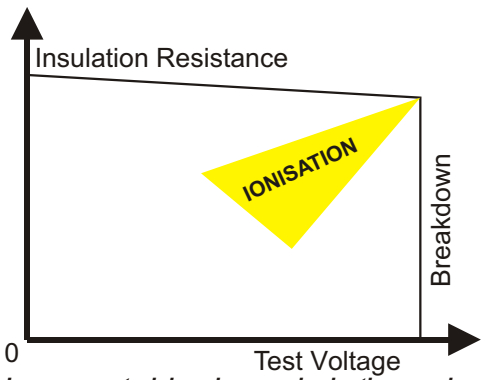
A small current start flowing in the material.
This is called the leakage current of that material.

The Leakage Current is the ratio between the DC High Voltage applied on that insulation and the Insulation Resistance of that material.

If the DC High Voltage exceeds a certain limit , the free electrons will gain velocity and energy to such an extend, that they will be able to create more free electrons.

That limit is the ***Ionisation Phenomenon***.

When ionisation occurs, the number of free electrons rises exponentially with time.
If the output current was not limited, the current would become so high, that the insulation material would be destroyed.



In some materials, where no ionisation can be detected, the breakdown point is sharp and occurs without warning.

INSULATION BREAK-DOWN

Mainly, Insulation failure is resulting of ageing. Many causes are responsible for insulation failure.
Some of them could be destruction by:

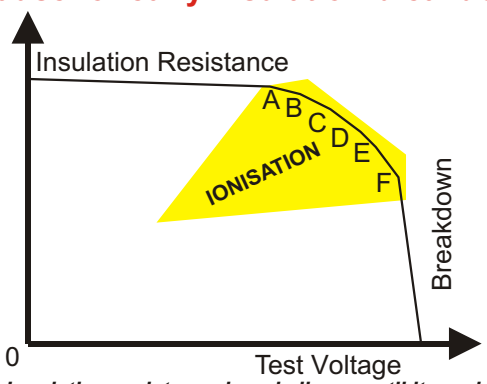
- Electrolysis
- Chemical reaction
- Absorption of moisture
- Physical damage
- Dirt excess contamination
- Metallic dust contamination
- Surface damage
- Mechanical strain
- High temperature
- Temperature shocks
- Ultra violet light
- Sun burn
- Etc...

To check the quality of insulation, DC High Voltage testing give you a more quantitative analysis by reading the Insulation Resistance directly on the display.

Insulation Resistance is a good indicator of the quality of insulation and therefore a good indication of predicting maintenance over time.

When insulation breakdown, the failure takes place at the defective place and **it is important not to destroy the fault so that the fault can be located.**

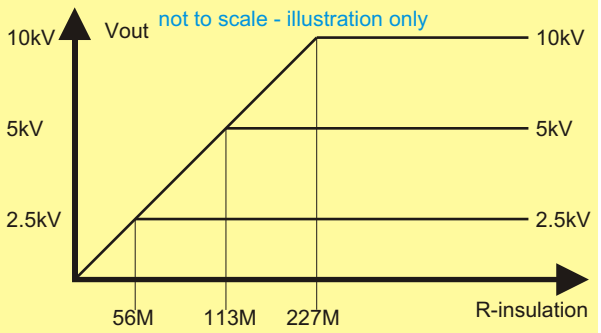
Over voltage, spikes, transients, lightning, etc... are all a very likely cause for early insulation breakdown.



Insulation resistance is only linear until it reach ionisation (A). Ionisation rises and insulation resistance decreases until breakdown (F). The knee points (B to E) are not always well defined but experience helps.

6200IN & 6201IN - Fixed Limit

The current limit of those two Analog High Voltage Insulation Meters based on the ohm-meter principle are limited by hardware with a fixed value of 44µA, whichever the voltage selected.



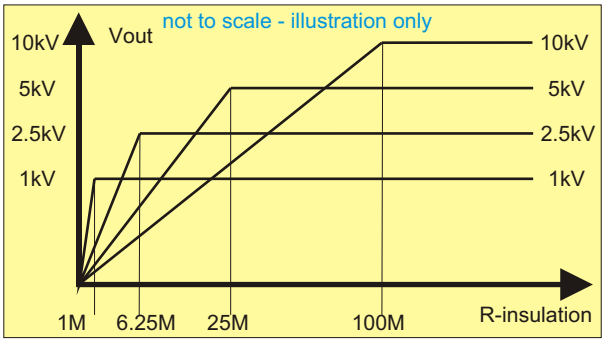
2 Voltages for 6200IN & 6201IN

6200IN:
- 2.5kV
- 5kV

6201IN:
- 5kV
- 10kV

DYNAMIC POWER LIMIT @ 1W

The 6210IN, 6211IN and 6212IN are using power limit technology instead of pure current limit. They have an output power limited at 1W. 6210IN and 6211IN are using the same limitation algorithm. Their dynamic power limit system is using the selected voltage for the calculation. For example, at 10kV, the limited current would be 100µA, at 5kV it would be 200µA, for 2500V it would be 400µA and at 1kV it would be 1mA.



1W or LESS for 6212IN

6212IN uses a simplified power limitation algorithm between the main voltages selection, the power output is lower than 6210IN and 6211IN.
The 6212IN uses only four voltage reference for the power limitation ouput:
10kV, 5kV, 2.5kV and 1kV.

10kV is used from 5.5kV to 10kV
5kV is used from 3kV to 5kV
2.5kV is used from 1.5kV to 2.5kV
1kV is used from 500V to 1kV

For example:
voltage selected = 9500V. current limit same as for 10kV, so 100µA.
At 9500V, the minimum insulation resistance for a good voltage regulation would be 9500V / 100µA=95M .
voltage selected = 7000V. current limit same as for 10kV, so 100µA.
At 7000V, the minimum insulation resistance for a good voltage regulation would be 7000V / 100µA=70M .
voltage selected = 5500V. current limit same as for 10kV, so 100µA.
At 5500V, the minimum insulation resistance for a good voltage regulation would be 5500V / 100µA=55M .
voltage selected = 500V. current limit same as for 1kV, so 1mA.
At 500V, the minimum insulation resistance for a good voltage regulation would be 500V / 1mA=500k . but the display is indicating LOW M because it is under the value normally capable for the 6212IN to display.