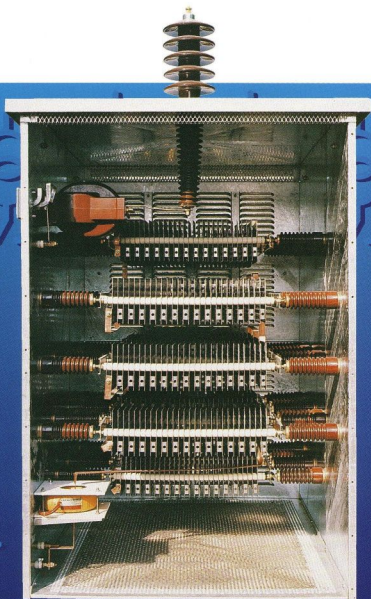


Power resistors

NEUTRAL EARTHING RESISTOR



METAL DEPLOYE RESISTOR

LET US KNOW YOUR RESISTORS PROBLEMS
WE PROVIDE SOLUTIONS

SYSTEM EARTHING

The general purpose of earthing is to protect life and property in the event of 50/60 Hz faults (short circuit) and transient phenomena (lightning switching operations).

The question of how a system shall be earthed is governed by regulation.

The regulation that one point of every system shall be earthed is designed primarily to preserve the security of the system by ensuring that the potential on each conductor is restricted to such a value as is consistent with the level of insulation applied.

The choice of the earthing method is based on the following criteria :

- **Voltage level** : the insulation level of material must be in accordance with the induced voltage at the time of fault
- **Insulation co-ordination**
- **Limitation of fault current** : to reduce the electrodynamic stresses on material, to limit the induced voltage on telecommunications lines and over voltage on LV components.

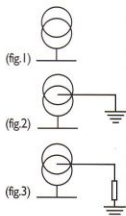
There are 3 methods of neutral earthing :

- Insulated neutral system (fig.1)
- Direct earthing or solidly earthed (fig.2)
- Impedance earthing (fig.3)

The purpose of this method is to limit the current for greater safety.

There are 3 type of impedance earthing :

- Earthing through reactance
- Earthing through ARC - Suppression coil
- Earthing through resistor.



EARTHING THROUGH RESISTOR

This is the most common, economical and sufficient solution. It is used when the neutral of the supply transformer is available and its own impedance is not enough to limit the fault current.

There are different resistance material used to build a Neutral Earthing Resistor :

- cast iron resistance elements : fragile, no corrosion resistance
- liquid resistor : old technology, maintenance problems due to evaporation or freezing of electrolyse.
- Neutral Earthing Resistors made from stainless steel are the best technical and economical solution.



GRIDEX N



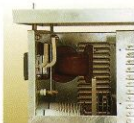
GRIDEX U



GRIDEX G

Founded in 1902, Métal Déployé S.A. has designed and developed several technologies based on expanded stainless steel metal grids to meet clients needs on neutral earthing resistors.

Métal Déployé neutral earthing resistors Gridex supplied all over the world are known for their solidity, reliability, performance and low maintenance requirement.



Neutral Earthing Resistor with Current Transformer



Neutral Earthing Resistor with On Load Disconnector 12 kV

Range

◆ Electrical criteria :

- Rated fault current : from 5 to 5000 A
- Rated voltage : from 0.38 to 500 kV
- Rated time : from 1 sec to continuous time rating.

◆ Mechanical criteria

- Direct connection or through top or side mounted bushing
- Protection degree of housing : from IP 00 to IP 54 (recommended IP23)
- Finishing : hot dip galvanised, painted or stainless steel housing.

◆ Options

- current transformer HV or LV
- ON or OFF load disconnecting switches
- space heater
- elevating stands.



Neutral Earthing Resistor 1000 A, 12kV

Special construction :

To meet the client requirements, we have designed and supplied disconnecting and change over switch cabinets comprising disconnectors and current transformers for direct earthing through the Neutral Earthing Resistor.

CALCULATION OF NEUTRAL EARTHING RESISTOR

Three parameters are needed to specify the earthing resistor :

- 1) U : Rated voltage line to line voltage or system voltage (kV)
- 2) I_f : Rated fault current (A)
- 3) T s : Rated time (Sec) - Duration of the fault

$$\text{Resistance value} : R = \frac{U}{I_f \sqrt{3}}$$

When the flow of an electric current through a resistor is relatively short, dissipation is negligible and the heating temperature of that resistor depends on its capacity to store the electric energy (i.e. its heat value itself) in proportion to the mass and specific heat of the material used.

The rise in the resistor's temperature will be provided by the relation :

$$\Delta\theta = \int \frac{R I_f^2 dt}{mC}$$

C : specific heat of the material (joule/kg/°K) ;

I : effective current in amperes (A) ;

R : mean value of the resistance (Ω) for an intermediate temperature between cold and hot.

Δθ corresponds to the temperature rise of the resistor

$$\Delta\theta = \theta - \theta_0 (^{\circ}\text{K}) ;$$

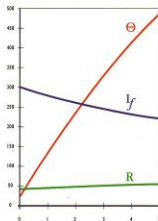
θ₀ = Temperature of resistor after rated time (°K)

θ = ambient temperature (°K)

When large-scale masses and energies are involved, the real resistance value of the resistor is taken into account, because it varies with the temperature which itself depends on the current flow time.

With that method of calculation we can determine the exact dimensions of the resistor to be built.

For resistors heating adiabatically, masses as high as possible are therefore required.



CALCULATION OF HOT RESISTANCE VALUE

(Resistance value after rated time)

The resistance of resistor element changes to extent with temperature after rated time. The change may be calculated from the temperature coefficient of resistivity .

$$R_t = R_1 (1 + \alpha \Delta\theta)$$

R_t = Hot resistance value (Ω)

R₁ = Resistance value at ambient temperature (Ω)

α = Temperature coefficient of resistance material

As per IEEE-32 for neutral earthing resistor made from stainless steel resistance material, the allowable temperature rise for 10,30 or 60 sec time rating is 760°K, 610°K for extended time rating and 385°K for continuous rating.

QUALITY IS OUR BUSINESS

DESIGNING, HANDLING, MANUFACTURING TOOLS and FACILITIES

To meet the various requirements and clients needs in resistors, the graduate engineers and engineers team of Métal Déployé has developed different software :

- mechanical and electrical calculation
- vibration and seismic simulation
- drawings made by CAD

MANUFACTURING AND TESTING FACILITIES

Manufacturing : the factory is located in Montbard close to DIJON and is equipped with CNC and automatic machines.

Testing : all routine and type tests (except lightning and switching impulse tests) are performed in the electrical laboratory equipped with all necessary instruments; power transformers and software.

QUALITY AND STANDARD

Routine tests performed on each Neutral Earthing Resistor:
Measurement of resistance

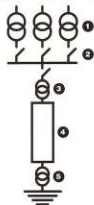
- High Voltage Power Frequency
- Insulation Measurement
- Aspect Verification
- Dimensional control

All resistors are designed in accordance with international standards IEC and if required the resistor can be designed in respect of other standards as BS, DIN, UTE, NFC, IEC, IEEE, ANSI, NEMA.

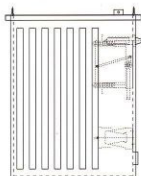
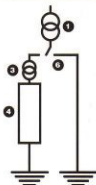
An internal quality system based on a quality manual has been developed and certified ISO 9001 by AFAQ in 1994.



SOME APPLICATIONS



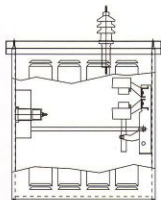
- 1 Power Transformer
- 2 ON or OFF Load Disconnecter 12 kV, 24 kV or 36 kV, from 200 A to 630 A
- 3 Current Transformer's for protection relay HV
- 4 Neutral Earthing Resistor
- 5 Current Transformer's for protection relay LV
- 6 Reversing Disconnecter Switch 12 kV, 24 kV or 36 kV, from 200 A to 630 A



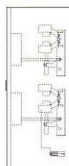
Neutral Earthing Resistor IP54 including CT and off Load Disconnecter 400 A, 24 kV



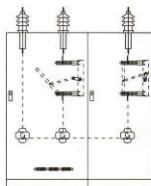
Neutral Earthing Resistor 40kV 2 Frames



Neutral Earthing Resistor including on Load Disconnecter 400 A, 12 kV and CT



Disconnect Switch Cabinet with on Load Disconnecters 400 A, 12 kV



Disconnecting Switch Cabinet with off Load Disconnecters 400 A, 17.5 kV

HOW TO CALCULATE YOUR RESISTOR

ELECTRICAL CHARACTERISTICS		ACCESSORIES	
Nominal voltage (kV)		LV Current Transformer*	Yes / No
Rated Fault current (A)		Ratio	
Rated Resistance at 20°C (Ω)		Accuracy Power (VA)	
Short time rating (sec)		Accuracy Class	
Permissible continuous current (A)		Insulation Class (kV)	
INSULATION			
Insulation level (kV)		HV Current Transformer*	Yes / No
Power frequency withstand voltage (kV)		Ratio	
Lightning impulse withstand voltage (kV)		Accuracy Power (VA)	
		Accuracy Class	
CONNECTION		Insulation Class (kV)	
Type*	Porcelain Bushing / On elements		
Insulation Class (kV)			
FRAME			
Use*	Indoor / Outdoor	Isolator*	Yes / No
Protection degree (IP)		type*	Off load / On load
Finishing*	Painted / Galvanized / Stainless Steel	Insulation Level (kV)	
		Maximum Continuous Current (A)	

* Delete wrong option



METAL DEPLOYE RESISTOR

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