



Electrical laboratory equipment generally runs on monophasic alternating current of 230 V, and very occasionally on three-phase current of 400 V (used by heavy electrical power users, such as ovens, old-model autoclaves, sterilizers, motors).

In France, electrical equipment is classified into five categories of power.

Domain	Alternating	Direct
Very Low Voltage	< 50	< 120
Low Voltage A	50 < U < 500	120 < U < 750
Low Voltage B	500 < U < 1,000	750 < U < 1,500
High Voltage A	1kV < U < 50 kV	1.5 kV < U < 75 kV
High Voltage B	> 50 kV	> 75 kV

Electrical equipment, run in the confines of a structure, is classed in the category of Low Voltage A (50 V < U < 500 V) and Very Low Voltage (U < 50 V).

NFC 20-030 standards define 4 classes of electrical equipment:

Class 0	With functional insulation; without ground connection. Use is prohibited at the workplace.
Class I	With functional insulation, with ground connection. Use is permitted at the workplace to run fixed electrical equipment.
Class II	With double insulation or reinforced insulation, without ground connection. Use is permitted at the workplace to run non-fixed electrical equipment.
Class III	Operation only at very low voltage, or with a low degree of protection (without ground connection, power safety ensured by a safety transformer). Mandatory on portable devices, and on non-fixed electrical equipment run in humid or wet conditions. Maximum power indicated.

NF EN 60529 and NF EN 50102 standards classify the degree of protection upon direct contact provided by electrical insulation. It is expressed with the code "IP" (International Protection) that designates maximum protection with the highest rating.

Effects

In living organisms, an electrical current will always follow the path of least resistance, which may or may not, depending on the situation, traverse vital organs (heart, lungs, kidneys). A short path (e.g. between two fingers) causes deep localized electrical burns.



Electrization refers to the entire physiological and pathological manifestations caused by an electrical current in an organism. Such accidents occur rarely, but are serious.

The main effects of electrization on humans are :

- the stimulation or inhibition of cellular electric phenomena ;
- electrical burns on the skin, eyes (arc flash), or internal organs.

Electrization may occur :

- upon direct contact with electrically charged conductive matter ;
- indirectly upon contact with matter, inadvertently charged electrically due to faulty insulation (e.g. contact with the metallic cover of an electrically-driven laboratory device, or accidental insertion of a metallic tool).

The severity of lesions caused by electrization depend on :

- the type of current, voltage, intensity, duration ;
- multiple factors that affect the resistance to the current (the amount of surface area in contact with the conductor, humidity and thickness of the skin, the wearing of insulated clothing, contact with the ground).

Electrocution is a result of fatal electrization.

Electricity must not be a cause for **fire**.

Prevention

Electrical hazards can be prevented with the proper installation and design of electrical equipment, adequate safety protection for workers, and compliance with the specific requirements set out by management.

Installation and design of electrical equipment :

- electrical security standards are mandatory : refer to installation standards NF C 15-100, NF C 13-200 ;
- emergency power cut-off devices must be readily identifiable and within easy reach :
 - **circuit breakers** must be of the “**differential**” type (500 to 600 mA) ;
 - a shedding branch circuit breaker can be installed, separate from the general circuit breaker, at the source of each electrical supply network ;
 - high sensitivity differential devices (30 mA) are recommended, especially for areas subject to specific hazards.

- specific protective safety precautions must be enforced, where there is any risk of direct or indirect contact ;
- preventive safety precautions must be taken against electrically-caused burns, fires, and explosions ;
- established work practices, surveillance, maintenance, and inspections are mandatory :
 - The work code states : “Safety inspections of electrical equipment are required”. All workers must be kept informed of the scheduling of these inspections.
 - “Such inspections are required to be carried out as often as deemed necessary, and must be aimed at repairing damages and malfunctions affecting electrical installations in the shortest lapse of time possible”.

Inspections are to be carried out annually by a certified outside contractor. The scope and the purpose of electrical inspections, as well as the content of the inspection reports, are fixed by decree ;

- Outside contractors must be informed of the repairs and other work needed on equipment not connected to power, as distinguished from equipment in close proximity to power.
- use of certified NF equipment (extension cords, outlets, cables...).

Safety precautions for personnel

All work on electrical installations must be carried out by professionally trained and qualified personnel accredited by management.

- avoid having electric cords crushed or pinched by a machine or a door ;
- never place a multiple socket adaptor at the level of or in close proximity to a container of water or an electrolyte (buffer solution) ;
- avoid connecting several multiple socket adaptors together in the same wall socket or workbench (heat and fire hazards) ;
- do not leave an electrically connected “bare” extension cord lying on a workbench or on the ground.

Compliance with the specific requirements

- First-aid instructions must be posted and made available to all personnel, so that emergency procedures can be applied to victims before medical treatment arrives ;
- Safety instructions in areas with specific hazards must be posted ;

- Buildings classed as “Open to the Public” and/or “High Rise” are subject to additional requirements regarding security lighting (autonomous systems), alarms and smoke-extraction systems, storage of flammable materials, etc.