

**User Training for the  
“Laboratorio di Ateneo”**

# **PoliFAB**

**Building 30, via G. Colombo 81, 20133 Milano**

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**Electric and high  
voltage appliances**

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# General description

At PoliFAB there are various types of electrical appliances and a limited number of instruments capable of generating high voltage. The aim of the present document is to inform users about the risks related to operation with electrical appliances and train on operational procedures for such instrumentation.

Potential dangers regarding electricity in the laboratory are: the main laboratory electrical system (electric panels, sockets, etc...), electrical appliances (power supplies, instrumentation, PCs, etc...), removable extension cables and power strips. All of these elements have to be conformal to the law and compliant to the EU regulation (italian law reference 46/90 art.9, D.M. 22/1/08 n.37 art. 7, D.L. 626/96, D.L. 17/2010). The electrical system has to be equipped with suitable protections: earth leakage circuit breaker (to protect from current dispersions) and thermal-magnetic circuit breaker (to protect from overloads and short-circuits). It is mandatory to use a safe and stable ground connection for all the systems. Always consult the Staff about this aspect and carefully verify the grounding connection. In case users bring electrical appliances to the cleanroom, always ask for Staff authorization before installing. In case of devices which are not compliant to the EU regulation, ask the Staff about the installation and always provide a suitable grounding.

The most relevant dangers are: fire in case of overheating (caused by overload or short circuit); electrocution caused by physical contact with parts of machines which carry electrical current.

## Operating instructions

Users have to carefully operate electrical appliances and minimize the danger connected to their use. **It is forbidden to manipulate or touch directly or indirectly the parts of the machines which are under voltage, especially in case of high voltage systems.** Any modification, even if temporary, has to be performed by qualified personnel and cannot be done by any user freely. Before turning electrical appliances on, especially in the case of high voltage devices, ensure that the cable connections are stable and always follow the specifications found in the user manual for every machine. For this purpose, users have to carefully consult the user manuals and know the general safety features of the instrumentation. In the following, a (not exhaustive) list of typical laboratory situations to take care about is reported:

- Parts of the electrical wiring or of the instrument are (even partially) defected or broken (including instrument protection and case. A typical case is the instrument which was opened for maintenance and then not closed, or rearranged in a wrong way).
- Conductive parts (e. g. cables, plugs) unprotected (special care must be taken in the case of high voltage or high current).
- Instrument parts (or the instrument itself) getting hot during operation (this can occur because of an electrical problem, or lack of ventilation or issues with the cooling system).
- Components which create sparkles, smoke or bad smell during operation.
- The user can feel current dispersion.
- Temporary or persistent electrical fault of the instrument are known.
- Frequent electrical faults (voltage drop, electrical noise, electrical breakdown) of the wiring or of the instrument are known.
- Flammable substances (like solvents or gases) are present close to the instrument. Never use these substances close to electrical machines or wiring.
- Water leakage is present close to the machine or sockets (take special care when using extensions and power strips).
- Dirt or dust is present close to the electrical parts and power strips.

- Cooling apertures are dirty or cooling fans are malfunctioning
- Electrical parts are damaged even if not seriously at first glance (appliances that have fallen and sound like broken parts are inside).

In addition, care must be taken when using extension cables, power strips and socket adaptors. As a general rule, their use should be limited as much as possible. **For any need, consult the Staff for a safe and more permanent solution.** Use the correct standard, given the type of socket and never mix different standards (e.g. a Schuko plug to an Italian 3-pin-socket which would not ensure the grounding). When plugging a connector to a socket you must ensure that insertion is complete in order to avoid incomplete contact and local overheating. In case of adaptors, power strips and extension cables, never connect a higher load than the maximum the component can handle. Every cable, extension, plug, etc... must be protected from mechanical damage (this includes risk of falling when cables cross walking paths) or liquid leakage. Extension cables and power strips should not be connected sequentially, to avoid overheating, and should not interfere with walking paths. To prevent any short circuit, electrical components must be fixed at a higher position compared to the floor, which would cause severe problems in case of flooding. In the event of water leakage close to electrical appliances, the first thing to do is to switch off the power supply of the instrument. In case of temporary unplugged connection, disconnect the cable both from the socket and from the instrument and leave it on the floor.

Only a limited number of instruments operate at high voltages. The danger related to high voltage instruments is very serious and all the precautions described in this document have to be considered even more strictly for these machines. In the following we report the list of high voltage systems and their location in the cleanroom, along with some technical details.

Instrument	Location	Max. voltage	Typ. current
SEM	Yellow room	30 KV	$10^2 \mu\text{A}$
e-beam evaporator	Thin films / Grey corridor	11 KV	1.25 A
RHEED	Magnetic thin films	50 KV	$10^0 \mu\text{A}$
LEED	Magnetic thin films	5 KV	$10^0 \mu\text{A}$
XPS	Magnetic thin films	15 KV	$10^0 \mu\text{A}$

It is absolutely forbidden to modify or manipulate directly or indirectly any part under high voltage or to use such instruments in improper ways or without careful study of the user manual. All users who will not follow this prescription will be suspended for a period of time decided by the Staff and will not have access to PoliFAB. Turn on the high voltage only after careful inspection of the status of the electrical parts and of the cooling parts of the system. It is also mandatory to use the discharge sticks before touching parts which may keep a residual charge after the process (e.g. e-beam evaporator).

## In case of emergency

In case of accidents during cleanroom work, the operator must act in total safety for him/her-self and for colleagues present in the laboratory. Even in case of accidents without damage to people or things, the operator must report as soon as possible and with as much detail as possible to the laboratory Staff personnel. The operator must also inform the Staff in case of situations or behaviors that could be dangerous for people and for the cleanroom itself, or that could be in

contrast to the prescriptions reported in this document and the other cleanroom safety training documents.

In the event of health emergency, defined as any situation where one or more operators show health problems, even of light intensity, it is necessary to evaluate how dangerous the event is. Only after checking that the accident scene is not dangerous for other users, you can help the involved operators. At the same time it is mandatory to inform the Staff about the events. In case Staff members are not available and the event can be dangerous for other users, you must activate the fire alarm. In case of health emergency, defined as risk to human life, any user can call the emergency number 112. After this, inform the Staff personnel.

In case of electrocution, the damage to the human body depends on the intensity of the current, its path in the body, the duration of contact and the body mass. An AC current of 500mA can cause death in an adult person. Electrocution effects include: skin burns, fainting, carbonization, deep burns, respiratory failure, cardiac fibrillation. In the latter case the heart beating is no longer regular and the correct blood circulation is not present. The reliever must take care not to be exposed to the current as well. If the injured person is still connected to the current, immediately cut the power or remove the person using a non-conductive part. At the same time, no connection to the ground should be present for the reliever. Always inform the cleanroom Staff in case of accident, and if sanitary assistance is needed, call the emergency number 112.

In case of fire, activate the fire alarm using the dedicated alarm buttons and inform the Staff. In case you hear a fire alarm, immediately leave the workplace, evacuate through the closest emergency exit and reach the emergency assembly point (in the backyard at the gate to via Pascoli). In case the emergency exit of the cleanroom is blocked or the access through is not possible, it is recommended to leave the cleanroom via the first air-lock, leaving its two doors open for the other users. An emergency exit is also present on the stairs between the basement and the office floor.