User guide for Laboratorio di Ateneo

PoliFAB

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

Electricity and high voltage

General description

In PoliFAB several electrical machines and few high voltage systems are installed. The purpose of this document is to inform the users about the danger involved with the usage of electrical systems and to teach them about the operational procedures of these machines.

Potential danger regarding electricity in the laboratory are: electrical wiring (switchgear, socket, etc...), electrical machines (power supply, instrumentation, PC, etc...) and extension cables. All of these elements have to be conformal to the law and compliant to the CE regulation (legge 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; thermal-magnetic circuit breaker. 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 system to the cleanroom, always ask the Staff before installation. In case of devices which are not compliant to the CE regulation, ask the Staff about the installation and always provide a suitable grounding.

Th most relevant danger 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.

Operative instructions

Users have to carefully operate electrical systems 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 for high voltage systems.** Any modification, even if temporary, has to be performed by qualified workers and cannot be done by any user freely. Before turning electrical systems on, especially in the case of high voltage, please confirm the cable connection and always follow the specifications that are found in the user manual of every machine. For this purpose users have to carefully consult the user manuals and know the general safety of the systems. In the following, a non-complete list of typical laboratory situation to take care about is reported:

- Parts of the electrical wiring or of the instrument are (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 wrong way).

- Conductive parts (e. g. cables) unprotected (special care must be taken in the case of high voltage or high current).

- Instrument parts (instrument itself) being hot during the usage (this can be due to an electrical problem, or lack of ventilation or problems to the cooling system).

- Instruments components which create sparkles, smoke.

- 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 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 socket.

- Dirt or dust is present close to the electrical parts.

- Electrical parts are damaged even if not seriously.

In addition, care must be taken to the use of extension cables. In general, their use should be as limited as possible. **For any need, please 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 warranty the grounding). In case of adapter 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 or liquid leakage. 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 case of presence of water close to electrical parts, the first thing to do is to switch the power supply of the instrument off. 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 systems utilizes high voltages. The danger connected with high voltage instruments is very severe and all the precautions described in this document has to be considered even more seriously for these machines. In the following we report the list of high voltage systems and their placement in the cleanroom, together with some technical details.

Machine	Location	Max Voltage	Current
SEM	Yellow room	30 KV	10^2 μA
e-beam evaporator	Thin films and grey corridor	11 KV	1.25 A
RHEED	Magnetic thin films	50 KV	10^0 μA
LEED	Magnetic thin films	5 KV	10^0 μA
XPS	Magnetic thin films	15 KV	10^0 μA

It is absolutely forbidden to modify or manipulate directly or indirectly any part under high voltage for any non-expert user and without a careful study of the user manual. For users who will not follow this prescription the access to PoliFAB will be suspended for a period of time decided by the Staff. Always turn the high voltage on 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).

Emergency

In case of accident during the operations the users have to behave maintaining the highest safety for themselves and the others. **Even in case of accidents without consequences to people or**

instruments users have to report about it to the cleanroom Staff. User also have to keep the Staff informed about situations that can be potentially harmful for users safety or that are in disagreement with the instructions present in the present and in the other instruction and safety documents.

In case of health emergency, defined as any situation where one or more users show (even small) health problems, it is necessary to evaluate the danger. Only after a careful evaluation it is possible to proceed, helping the injured person(s). At the same time users have to inform the Staff. In the case of potential danger for other users, activate the fire alarm. If no Staff personal is available it is possible to call Portineria Centrale of Politecnico (9300) and, only if also there nobody replies, call 118.

In case of electrocution, the damage to the human body depends on the intensity of the current, on its path in the body and on the body mass. An AC current of 500mA can cause death in an adult person. Depending on the damage, effects are: burn, faint, carbonization, deep burn, 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 the current as well. If the injured person is still connected to the current, immediately cut the power or remove the person using a conductive part. At the same time, no connection to the ground should be present for the reliever. Always call the cleanroom Staff in case of accident.

In case of fire, activate the fire alarm by the dedicated button and inform the Staff. If the fire alarm is heard, immediately leave the working place, evacuate through the closest emergency exit and reach the collection point (courtyard, gate to via Pascoli). In case the emergency exit of the cleanroom is blocked or the access through it not possible, it is recommended to leave the cleanroom via the first air-lock, leaving its two doors open for the other users.