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Guide to Health and Safety when Working with Low Voltage Electricity

 **FREMAP**

*Mutua Colaboradora con la
Seguridad Social nº 61*



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1. Introduction

This guide to work and manoeuvres carried out in electrical facilities under low voltage aims to describe the minimum safety and health provisions for workers with regard to electrical risks while carrying out work in electrical facilities. This guide deals with both material resources (labour and protection) and human resources (qualification or professional training) necessary for carrying out the different jobs.

This guide is also intended to comply with the specifications of article 18 of the OCCUPATIONAL RISK PREVENTION ACT with respect to the employer's obligation to provide its workers with information on the risks involved in their jobs that could affect their health and the preventive measures that must be applied to avoid them.

The present guide affects all workers in the company performing work in electrical facilities of up to 1,000 volts.

The technical criteria applied in this guide is based on the contents of the following legal provisions:

- Act 31/95 of November 8 1995 on Occupational Risk Prevention.
- R.D. 614/2001, of June 8 on the minimum provisions for protecting the health and safety of workers from electrical risks. (Technical Guide).



2. Definitions

Electrical Risk: Risk caused by electricity. It specifically includes the following risks:

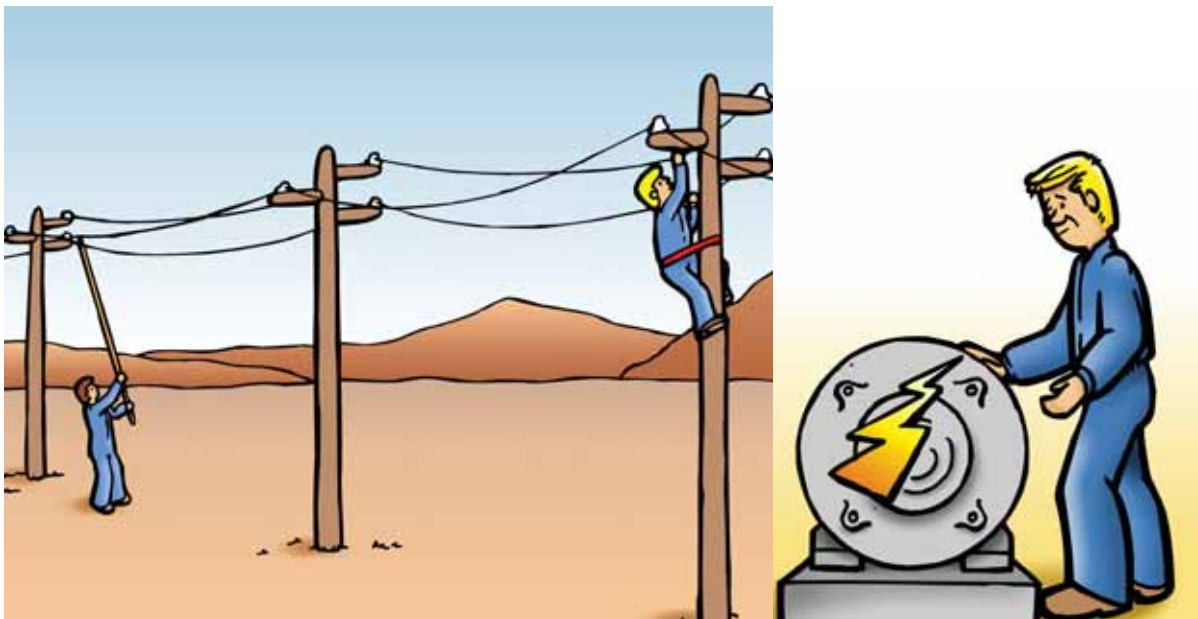
- Electric shock: due to contact with live elements (D.E.C.: direct electrical contact), or masses (metal parts) accidentally under voltage (I.E.C.: indirect electrical contact).
- Burns: due to electric shock or electric arc (union of two points at different potentials by an element with low electrical resistance).
- Falls or knocks caused by electrical shock or electric arc.
- Fire or explosions caused by electricity.

AUTHORISED Worker: Worker who has been authorised by his employer to carry out certain work with electrical risks, based on his capacity to deal with them correctly, in accordance with the procedures established in R.D 614/2001.

QUALIFIED Worker: An authorised worker with specialised knowledge on electrical facilities, due to his accredited professional or university training or his certified experience of two or more years.

Danger zone or WORKING UNDER VOLTAGE ZONE: Space around live elements in which the presence of unprotected workers entails a serious and imminent risk of creating an electric arc or direct contact with a live element, taking into account the normal gestures or movements made by the worker without moving around. In areas where there is no physical barrier to guarantee protection against this risk, the distance between live elements and the outer limit of this zone must be 50 cm. (for voltages up to 1000 V.).

PROXIMITY Zone: Space marked off around a danger area from which the worker may accidentally invade the latter. In areas where there is no physical barrier to guarantee protection against electrical risk, the distance between the live element and the outer limit of this zone must be 70 cm. or 300 cm., depending on whether it is possible or not to accurately delimit the work zone and control that workers do not exceed it while working.



2. Definitions

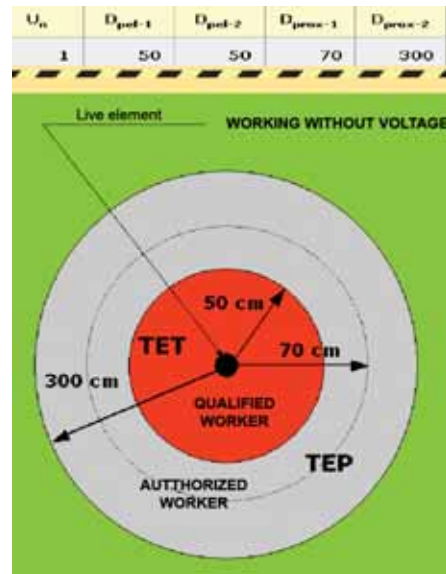
Working WITHOUT VOLTAGE: Work on electrical facilities carried out after taking the necessary precautions to maintain the facility without voltage.

Working UNDER VOLTAGE: Work during which a worker enters into contact with live elements or enters the danger zone, either with part of the body or with any tool, instrument or material been handled. Manoeuvres measurements, tests and verifications are not considered as working under voltage.

Work IN PROXIMITY: Work in which the worker enters or may enter the danger zone either with a part of the body or with any tool, instrument or material been handled.

Manoeuvre: Intervention intended to change the electrical status of an electrical facility that does not entail assembling or disassembling elements of any kind.

Measurements, tests and verifications: Activities intended to check compliance with the specifications or technical conditions and safety conditions necessary for the proper operation of an electrical facility, including those directed to check its electrical, mechanical or thermal state, the efficacy of the protections and the safety or manoeuvring circuits, etc.



3. R. D. 614/2001 on minimum provisions for protecting the safety and health of workers from Electrical Risks

This R. D. has the objective of protecting workers from electrical risks and applies to all areas where this risk exists, either due to the electrical facilities themselves or the work performed on them or near them.

In the case of facilities, the Royal Decree has limited to establish general obligations and refers to the applicable specific rules for particular recommendations (basically the electrotechnical regulation).

On the contrary, in the case of the «work», the Royal Decree is much more extensive and specific. It regulates in a certain amount of detail the techniques and procedures when:

- Switching off the current before starting a job and switching the current back on after finishing it.
- Working in facilities under voltage.
- Performing manoeuvres, measurements, tests and electrical verifications.
- Working in proximity to live elements (including overhead or underground cables).
- Working in sites with a risk of fire or explosion or where there could be a dangerous electrostatic charge accumulation.



3.1. ELECTRICAL FACILITIES

3.1.1. Electrotechnical regulations establish general conditions and guarantees to be fulfilled by electrical facilities in relation with safety of persons and goods. Electrotechnical regulations determine what follows:

- Protection systems used to prevent the effects of excess current and excess voltage which, due to different reasons, could be generated in the facilities.
- Conditions that must be fulfilled by the facilities in order to prevent direct contact and cancel indirect contact effects, for general safety purposes.

**PROTECTION SYSTEMS CONSIDERED
IN THE ITC-BT 24 (R.E.B.T. 2002)**

Protection from direct contact
<ul style="list-style-type: none"> • By coating the live parts • By barriers or casings • By distancing • By using residual current devices (RCD)
Protection from indirect contact
<ul style="list-style-type: none"> • By automatically shutting down the facility • By the use of Class II equipments • By electrical separation of circuits • By local equipotential connection

3.1.2. Low Voltage Electrotechnical Regulation also establishes the requirements that must be fulfilled by receivers, classifying them based on their degree of insulation, power voltage and the system for protection against electrical contacts. Consequently, in relation to the protection offered by receivers against electrical contact, the following classification is established:

**CLASSIFICATION OF RECEIVERS BASED ON THEIR PROTECTION
AGAINST ELECTRICAL CONTACT**

	Principal characteristics of the appliances	Safety Precautions
Class 0	No means of protection by earthing (protection is based only on functional insulation)	An insulated earth environment is necessary.
Class I	With earthing connection means (by a protective conductor)	Connect to the protective ground clamp.
Class II	Supplementary protective insulation but with no means of protection due to earthing.	No other protection necessary.
Class III	They are intended to be supplied with very low safety voltage (VLSV)	Connection at a very low safety voltage.
This classification does not mean that any of these types of receivers can be used. The safety conditions may impose restrictions on the use of any of these types		

The **Low Voltage Electrotechnical Regulation** specifies the conditions for using receivers, based on their «classification» and the characteristics of the premises where they are installed. By way of an example:

- Manual portable electrical tools used in construction work or highly conductive sites, must belong to Class II or Class III. (ITC-BT-47 of the REBT).



- In sites where potentially explosive atmosphere may form, the facility and electrical equipments used must comply with the requirements of ITC-BT-29 of the REBT, and RD 400/1996, of March 1, on protective appliances and systems for use in potentially explosive atmospheres.

3.1.3. In relation to maintenance of facilities (and regular control of protection systems) electrotechnical regulations establish the obligation to perform regular inspections: of the ground clamps and in some cases, inspections by Authorised Control Bodies and the arranging of maintenance contracts, etc.

With regard to the use, control and maintenance of low voltage facilities by the owner, as the responsible party, must be done in accordance with the instructions guides provided by the installer.

The necessary transformations must be done by *authorised installers*.

3.2. TRAINING AND INFORMATION FOR WORKERS

The different Annexes forming part of this Royal Decree indicate the minimum training/instruction to be given to workers, depending on their job (see Chart 1).

Work under voltage must be carried out by qualified workers only.



CHART 1
SUMMARY CHART OF MINIMUM TRAINING/INFORMATION FOR WORKERS

	Working without voltage		Working under voltage		Manoeuvres, measurements, tests and verifications		Working in Proximity	
	Suppression and replacement of voltage	Execution of work without voltage	Execution	Replacing of fuses	Measurements, tests and verifications	Local manoeuvres	Preparation	Execution
LOW VOLTAGE	A	W	Q	A	A	A	A	W
HIGH VOLTAGE	Q	W	Q+AW (supervised by a Manager)	Q (at a distance)	Q or Q assisted by A	A	Q	A or W supervised by A
W= ANY WORKER A= AUTHORISED Q= QUALIFIED Q + AW =QUALIFIED AND AUTHORISED IN WRITING					1. Work with electrical risks in HV must not be carried out by workers from a company of temporary work (R.D. 216/1999). 2. The execution of the different activities considered must be done as set forth in the provisions of the present Royal Decree.			

3.3. OPERATING PROCEDURES

«Operating procedure» refers to the effective implantation of a series of coordinated activities and tasks that clearly define the sequence of operations to be carried out in normal situations, in planned changes and in foreseeable emergencies, and includes:

- Material operating resources.
- Collective and personal protective equipment.
- The necessary human resources, indicating their qualifications, training and assigning the tasks.

It is recommended that the procedures relating to working in electrical facilities or in proximity to them, which are referred to in the different annexes of this Regulation, are drawn up in writing. The provisions of those annexes constitute the minimum basis that must guide any operating procedure for working in or in proximity to electrical facilities.

All work carried out on electrical facilities or in proximity to them which involves an electrical risk must be carried out **without voltage**.

The general principle (with the exceptions indicated below) leads to the obligation of all work performed on or near a facility has to be done **without voltage**. Breach of this guideline could cause serious accidents.

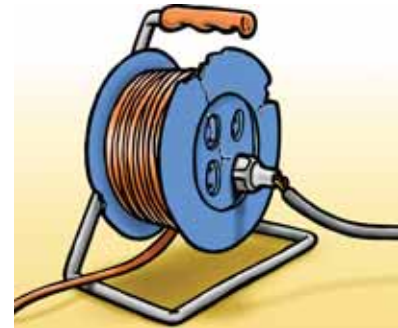
The following may be carried out with the facility **under voltage**:

a) Elementary operations such as connecting-disconnecting in low voltage facilities with legally marketed electrical material that is in good condition and used in a correct manner and for the correct purpose.

b) Work carried out on facilities with safety voltages (24 V. for damp sites and 50 V. for dry sites), whenever there is no possibility of confusion in terms of identifying them and if the intensities of a potential short-circuit do not entail the risk of being burnt.

c) Manoeuvres, measurements, tests and verifications, the nature of which requires this, such as opening and closing of switches or isolating switches, measuring electric current intensity, performing electrical insulation testing or checking phase concordance.

d) Work in which this is required due to the operating conditions or continuity of supply. Whether or not to perform work under voltage should not be a decision to be taken lightly, but based on the option that entails the least risk for the workers and for the users that depends on the supply.



This work must be performed by *qualified wokers* following a *written operating procedure*.



3.3.1. WORKING WITHOUT VOLTAGE (RD 614/01. ANNEXE II)

All operations and manoeuvres aimed at removing the voltage from an electrical facility before starting "work without voltage" and the restoring of the voltage, upon completing the work must be done by **authorised workers**.

3.3.1.1. VOLTAGE SUPPRESSION

Prior to applying the procedure for eliminating the voltage, a first step must be taken: identification of the zone and the elements of the facility in which the work is going to be carried out. This identification forms part of the work planning.

In complex facilities, to prevent confusion due to the great many types of equipment and networks, it is advisable to design procedures in writing, in order to carry out the operations for eliminating the voltage.

The process is described below in five steps, where by the voltage is suppressed from the facility in which the «work without voltage» has to be carried out. These are usually known as the «five golden rules».

THE FIVE GOLDEN RULES

- 1 Disconnect completely (isolate the installation from all possible sources of electrical power).
- 2 Secure against reconnection.
- 3 Verify there is no electrical power.
- 4 Ground and connect in a short circuit.
- 5 Protect against nearby power sources and delimit the working zone.

1^a



2^a



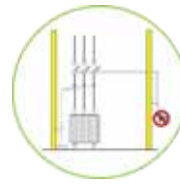
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4^a



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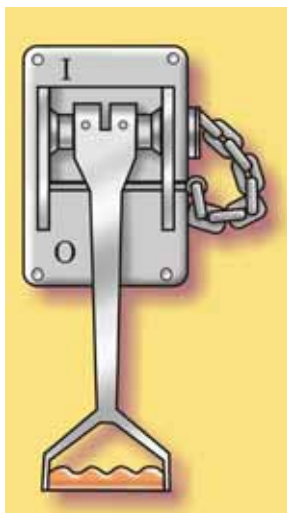


1 Disconnect completely.

- All the switches or contactors must be open. Remove fuses or bridges through which the facility can be connected to a power source.
- Disconnection must include the neutral conductor if there is one. In this case, the neutral must always be disconnected last and connected first.

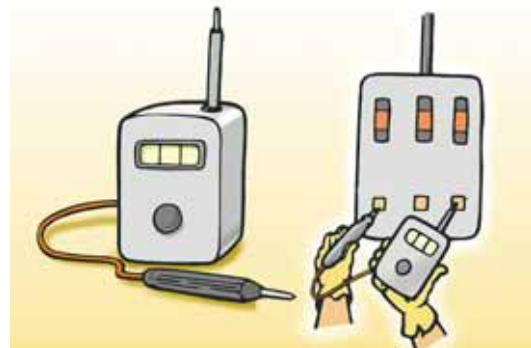
2 Secure against reconnection.

- Manoeuvring devices used to disconnect the facility ensure that it cannot be reconnected, preferably by locking out the manoeuvring mechanism and, placing a danger tag at the disconnect device which indicates that the electrical supply may not be operated until the danger tag is removed.



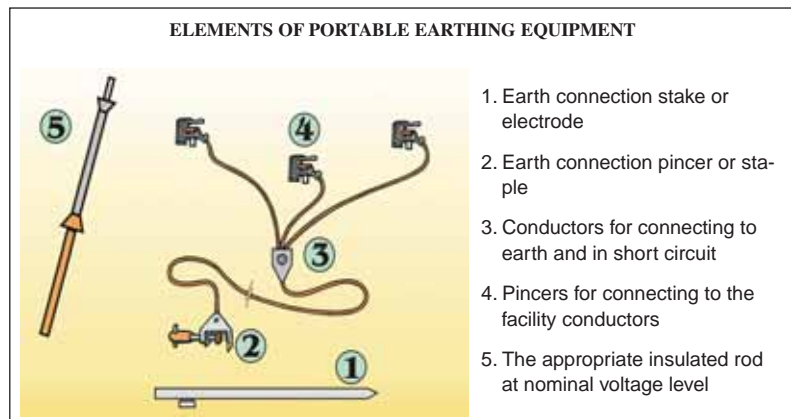
3 Verify there is no electrical power.

- This verification must be done immediately before connecting to earth and in short circuit on the facility, in the place where these operations are going to be carried out.
- It is compulsory to check the correct operation of the equipment used to verify the absence of voltage immediately before and after making that verification.
- Checking for the absence of voltage must be done during each phase and in the neutral conductor, if there is one. It is also advisable to check for the absence of voltage in all accessible masses that could eventually become under voltage.



4 Ground and connect in a short circuit.

- Electrical systems must be connected to earth and in short circuit before starting the work, if the risk of accidental reconnection can occur while the work is being carried out. For example: In work carried out on low voltage overhead cables, especially those constructed on bare conductors.
- In low voltage electrical systems where the risk of accidental reconnection can not occur is not necessary to connect to earth and in short circuit.
- Earth wired and short circuit operations must be done with safety guarantees: using specially manufactured equipment that are in keeping with the applicable technical guidelines.
- Clamps always must be placed in position using rods or insulated gloves and not with the hands.
- In each case the appropriately-sized equipment will be selected for supporting the foreseeable short circuit currents in the electrical system.



Operations sequence for connecting to earth and in short circuit under low voltage.

**Personal protective equipment required in LV
(for connecting and disconnecting to earth)**

- Insulated gloves for work under low voltage.
- Goggles and face shield for electric arcs.
- Harness or safety belt, if applicable.
- Insulated safety helmet with a chin strap.
- Protective gloves to protect against mechanical risks and electric arc.

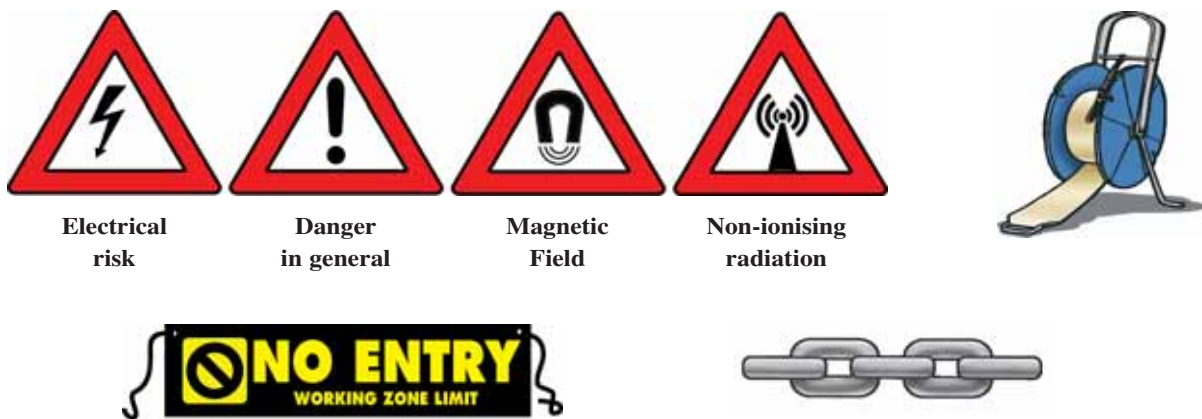
Additionally, workers will use:

- The appropriate clothing.
- Work boots.

- Connect the earth clamp to the protective conductor or to the earth connection of the low voltage panel.
- Connect the clamps of the equipment to the neutral and to each of the three phases using the right operating rods for low voltage, if working with overhead lines, or the suitable terminals if working on low voltage panels, beginning with the nearest conductor.

5 Protect against nearby power sources and delimit the working zone.

- If any part of a facility near the working zone needs to remain under voltage, protective elements must be used such as shields, insulation or obstacles that allow to consider that the working area is outside the danger or proximity zone.
- Work area boundaries must be marked, when a separation is necessary between the area where the work without voltage is being carried out and the proximity zone, in which no-one should enter unless the pertinent measures are taken for works in proximity.
- Area where only authorised staff can carry out the work must also be marked off.
- Marking and signposting must be done using fencing, tape or insulated chains designed for that purpose and danger, prohibition or compulsory signs in accordance with the provisions of Royal Decree 485/1997, of April 14 1997 on signals used in occupational safety and health.



3.3.1.2. RESTORING VOLTAGE

In general the reverse process used to eliminate the voltage should be used for restoring voltage:

- 1 Remove additional protections and signs indicating the work zone limits, if any.
- 2 Remove the earth connection and short circuit connection, if made, starting with the clamps of the nearest elements and lastly the earth end clamp.
- 3 Unblock and/or remove the signs from the cut-off devices.
- 4 Close the circuits and restore the voltage.

Great care must be taken before starting those stages. When carrying out those operations, special attention must be paid to the following aspects:

- Previous notify any affected workers that the power is about to be restored.
- Check that all the workers have left the zone, except those working on restoring the power.
- Check that all the earth and short circuit connections have been removed.
- If necessary, inform the person in charge of the facility that it is about to be reconnected.
- Activate the respective manoeuvring appliances.

3.3.1.3. PARTICULAR PROVISIONS

• **Replacing of fuses.**

a. It is not necessary to connect to earth and short circuit if:

- disconnection devices on both sides of the fuse are within worker sight,
- cut is visible or the device provides equivalent safety guarantees,
- there is no possibility of accidental shut down.

b. If it is necessary to access a fuse after disconnecting the devices at both sides of it, check for the absence of voltage using the appropriate equipment.

• **Works carried out on facilities with electrical condensers that cause a dangerous accumulation of power.**

To leave a facility without power:

- 1 Disconnect them previously from any power source.
- 2 Discharge them.
- 3 Connect to earth and in short circuit.

During these operations, workers must use the personal protective equipment described above for making the earth and short circuit connections in the facility.

3.3.2. WORKING UNDER VOLTAGE (RD 614/01. ANNEXE III)

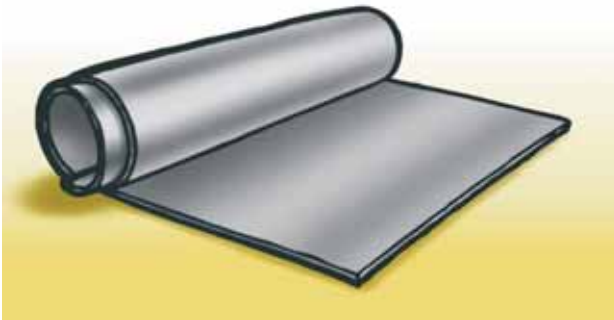
1. Work under voltage must be carried out by qualified workers, following a previously-studied procedure and if its complexity or nature requires it, testing without voltage, and adopting the requirements indicated below. Work carried out in places where communication is difficult, due to the orography, confinement or other circumstances, must be executed with at least two workers with training in first aid.

2. Main precautions to be adopted:

- Keep your hands protected using the appropriate insulated gloves.
- Perform the work on an insulated carpet or stool that is also firmly supported and stable.

Personal Protective Equipment Required
<ul style="list-style-type: none"> • Insulated gloves and if necessary, insulated muffs. • Face shield for protection from projections from electric arcs. • Goggles with safety lenses. • Insulated helmet with a chin strap. • Gloves for protection from mechanical risks.





- Wear clothes without zippers or other conductive elements.
- Do not wear bracelets, chains or other conductive elements.
- Use insulated tools specially designed for this type of work.
- If possible insulate live parts and metal elements in the work zone using the appropriate protectors (sheaths, caps, insulated plastic film, etc.).

The equipment and materials referred include:

- a) Insulated accessories (screens, a prons, sheaths, etc.) for covering live parts or masses.
- b) Insulating or insulated tools (tools, clamps, test probes, etc.).
- c) Insulated rods.
- d) Insulating or insulated devices (stools, insulating blankets, work platforms, etc.).
- e) Personal protective equipment for electrical risks (gloves, goggles, helmets, etc.).



3. Equipment and materials for carrying out work under voltage must be chosen considering:

- Job and workers characteristics.
- Running voltage.
- Equipment and materials must be used, maintained and inspected following the manufacturer's instructions.

4. Workers must have a solid, stable base that enables them to have their hands free and they must have a suitable lighting that enables them to perform the job with the appropriate visibility. Workers must not wear conductive elements such as bracelets, watches, chains or metal zippers that could accidentally come into contact with live elements.

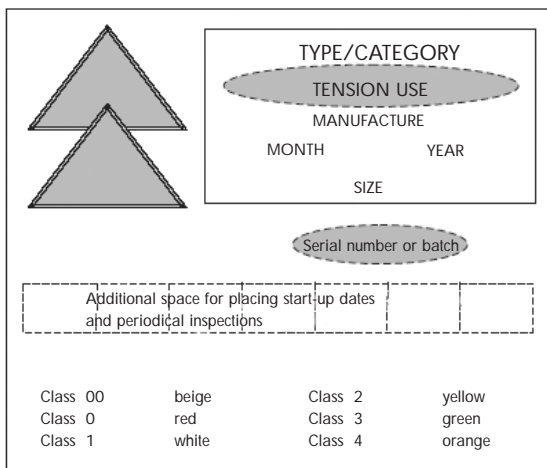
5. Work area must be marked and/or signposted properly, if there is the possibility of other workers or persons entering that area and come into contact with live elements or interfere with the work, distract the workers or startle them.

6. When working outdoors, the possibility of unfavourable weather conditions must be considered to achive workers protection at any time. Work must be suspended or prohibited in the event of storms, rain, or strong winds, snow or any other unfavourable weather condition that reduce visibility or makee tool handling more difficult. Work on indoor facilities connected directly to overhead electric lines must be interrupted in the event of a storm.

7. Replacing of fuses in low voltage facilities:

- This does not need to be carried out by a qualified worker, any authorised worker may do this job, if handling the fuse holder means disconnecting the fuse and the fuse material offers full protection from direct contact and the effects of a potential electric arc.
- It must be done using the standard tool used for each type of fuse, and it is expressly prohibited to use pliers for this purpose.
- Every effort must be made to do the task “without load” or with the minimum load, to prevent the generation of electric arcs.

8. While working with voltage, it is advisable not to talk on the phone or carry mobile phones that could “startle” the worker if the phone starts ringing while working.



9. With respect to the necessary PPE for working under voltage, the most important items are **dielectric gloves**, which must comply with the following requisites:

- a) Compulsory marks:
- Symbol (double triangle)
 - Name, registered trademark or manufacturer’s name
 - Category, if applicable
 - Size
 - Class
 - Month and year of manufacture
 - EC Mark

b) Each glove must have one of the following systems:

- A rectangular band or
- Band on which holes can be perforated, or other mark that makes possible to know the date of start-up, of verifications and regular controls.

c) Recommendations for using the gloves:

Manufacturer’s instructions must be followed to ensure gloves are used correctly.

For informative purposes, the following are indicated:

Storage

Gloves must be stored in their packaging.

Care must be taken to ensure they are not squashed, folded or placed near radiators or other sources of artificial heat, and that they are not exposed directly to the sun, artificial light or ozone sources.



Check before using

Before each use, the gloves must be inflated and a visual check must be made to see whether there are any air leaks.

If it is suspected that one of the gloves is not in good condition, the pair must be discarded and returned for testing.

Precautions in use

Gloves must not be unnecessarily exposed to heat or light, or placed in contact with oil, grease, turpentine, alcohol or strong acids.

If other protective gloves are used simultaneously to insulated gloves for electrical use, those gloves must be placed on top of the rubber gloves. If the insulating gloves are wetted or stained with oil or grease, they must be taken off.

If gloves become soiled, they must be washed with soap and water temperature should not exceed the one recommended by the manufacturer. Dry and sprinkle them with talcum powder.

Regular inspections and electrical testing

Inspections consist of inflating each glove with air to check for leaks, followed by a visual check while inflated, and then an individual electrical test.

For Class 00 and 0 gloves, a check for air leaks and a visual check will be sufficient.

PROCEDURE WHEN WORKING UNDER LOW VOLTAGE

Prior considerations:

- A **supervisor** will be available to decide whether to work under voltage or not. That decision must be based on the needs imposed by the facility operating conditions or continuity of supply.
 - Work must be carried out by **qualified workers**.
 - Workers must remove all metal elements they might be wearing: rings, bracelets, watches, chains, etc. and non-metallic objects such as: mobile telephones, music appliances, etc. that are not necessary for performing the job and could cause a distraction.
 - Work area must be marked and/or signposted, if necessary.
- 1 Ensure that **the work zone is sufficiently illuminated**, and that it will remain so while the work is being executed, even though there is a failure in the electricity supply.
 - 2 Check the proper condition of the **insulating tools**.
 - 3 Check the proper watertightness of the **gloves**.
 - 4 Wear the necessary **personal protective equipment and accessories** depending on the task to be executed.
 - 5 Check you have a **solid, firm support** to keep your hands free:
 - a) Stand on the insulating carpet or stool (if the task is done on the floor or a conductive platform).
 - b) Put the ladder in place, and stabilise it (insulated ladder: made of wood or fibre), holding it by its upper end or getting another worker to hold it at all times while you are on it, after checking its condition.



- c) Climb onto the support, using a safety belt, climbing elements carrying the service rope and respecting the safety distance.
- 6 Open the panel, box or simply **observe the state of the facility** on which the job is to be done looking for possible deterioration of the materials of which it is made, its fastening elements and connections as well as the presence of foreign objects in the facility that could affect the safety of workers. In case of detecting failures that could entail a serious and imminent risk this must be report to the person in charge so that the appropriate measures can be taken, such as discharging the facility.
- 7 Execute the necessary actions required by the job, following the **right** and/or stipulated **sequences**. In the presence of other live circuits, barrier shields and insulating elements must be put in place to prevent accidental contact while performing the job.
- 8 If replacing fuses, do it using pliers and leather sleeves for removing the fuse. Beforehand, **eliminate any important charges** from the circuit if any, and if this is possible.
- 9 Before ending the job, carry out a visual check or **verify that the facility is operating within safety parameters and is safe** for users, using measuring equipment, if necessary.
- 10 Clear up the tools, work equipment and protective elements used. Replace the functional insulation in the facility (putting barrier shields and covers back in place and closing doors, etc.). Take off the gloves and store them properly (following the manufacturer's instructions), leaving them ready for the next use. Remove the signs and/or elements used to mark off the work area.



3.3.3. MANOEUVRES, MEASUREMENTS, TESTS AND VERIFICATIONS (R. D. 614/01. ANNEXE IV)

Local manoeuvres measurements, tests and verifications under low voltage must be carried out by **authorised workers only**.

In high voltage electrical facilities, manoeuvres shall be performed by authorised workers, but not measurements, tests and verifications, in which they may only act as an assistant of the qualified worker who must perform them.

Before executing the job, it is necessary to have specific systematic procedure:

- 1. Analysis of the facility or parts of the facility affected by the work (identification). For this purpose, the greatest possible amount of information must be obtained: drawings, electrical diagrams, facility users who know how to use them.
- 2. Visual inspection (without touching) of the equipment or facilities on which the work is to be done, in order to verify the real state of such equipment or facilities: potential faults in the equipment, errors in documentation, possibility of making mistakes while manoeuvring, etc., for the purpose of analyze potential risks arising from the work to be carried out.

3. Based on what has been observed, determine whether: the staff, procedure, equipment and materials used and personal protective equipment are appropriate for executing the work, so that the worker is protected from electrical contact, electric arc, explosions or projected materials.



Manoeuvres

1. A systematic safety procedure must be prepared for each type of manoeuvre, which will include the following:
 - a) The sequence of operations to be carried out.
 - b) Auxiliary and personal protective equipment required (**face shield, goggles with safety lenses, helmet, belt, etc.**)
 - c) Previous checks to be performed on the equipment.
 - d) Cases in which the manoeuvre should be suspended.
2. Although manoeuvres under low voltage are usually executed with equipment that offers the appropriate safety guarantees, do not lower your guard, by that the safety procedure must foresee the following:
 - any potential defects that could reasonably be found in the appliances
 - the possibility of making incorrect manoeuvres (opening of charged power breakers, or closing of power breakers in short circuit).
3. The work area will be signposted and/or marked off, if there is a possibility that other workers or persons could enter the area, having access to live elements.



4. Manoeuvres that have been started outdoors or indoors and directly on outside lines must be suspended or prohibited in the event of adverse weather conditions, such as: storm, rain, intense snow, lack of visibility due to fog, or other conditions that could hinder or make it impossible to carry out the work safely.

5. In local manoeuvres with switches or power breakers for protecting against electric arcs, explosion or the project of materials, it is not compulsory to use protective equipment if the place where the manoeuvre is being executed is completely protected from those risks by distance or by placing obstacles in between the power source and the worker.

Measurements, tests and verifications

1. For each type of test that entails a great deal of complexity (measuring current leaks, tests and verifications on insulation, on the operation of automatic protective devices, etc.) a procedure must be planned to guarantee safety execution.

In general, this procedure must include at minimum the following:

- a) The **marking off and signposting of the work area**, if necessary, using fences or barriers to prevent access to the work area or by using tapes or strips with distinctive colours.
- b) **Aspects related to connecting to earth**, that lead to the establishing of safety practices for connecting the equipment used in the tests to earth:
- previous insulation of the facility being tested,
 - connection to earth of all the conductive parts that could be touched by the worker, including the chassis of vehicles,
 - treatment of terminals or terminal connections connected to earth as live elements unless otherwise checked,
 - previous discharge of condensers before executing the work,
 - elimination of possible voltage on concluding the work, etc.
- c) **Manner in which test equipment has to be used:**
- terminals or accessible parts of measuring equipment and other insulated instruments used,
 - avoid running cables of the equipment used along the area, unless those cables have a shield or metal armouring,
 - maintain cables in an orderly manner: keep control, power and earth cables separate from each other.
 - if workers must remain in the test area while the equipment is being tested under voltage, a person must be designated to supervise all operations, and must have a device that permits the immediate disconnection of test circuits, in the event of an emergency.
2. The person **responsible** for the tests must assure the fulfillment of the sequence of the operations, in accordance with the established procedure. Among other things, he/she must check:
- That disconnection device for cutting off the power used for the tests is clearly identified and easy to activate in an emergency.
 - That earth connections are clearly identified and in good conditions.
 - That personal protective equipment and auxiliary protective equipment are in good conditions and used properly.
 - That signposting and marking systems are properly installed.

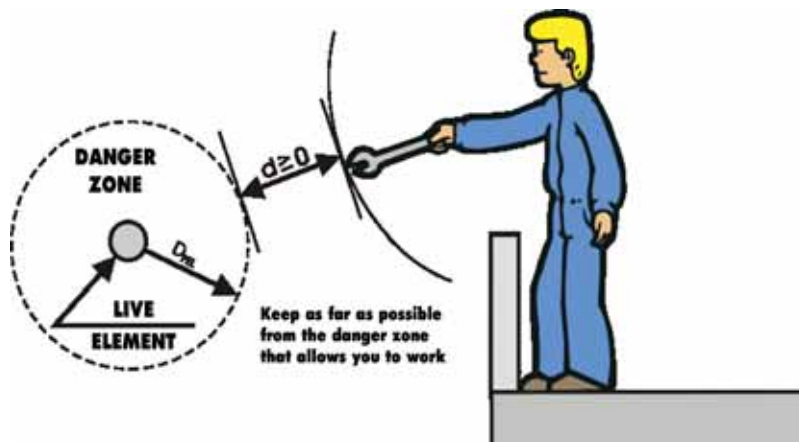


3. If it were necessary to remove any earth connection devices installed during the operations for switching off the voltage in the facility, all necessary precautions must be taken to prevent the risk of accidental reconnection.
4. If using an external power source, all precautions must be taken to ensure that:
 - a) The facility cannot be restarted by another power source other than the one foreseen.
 - b) Cut-off points have sufficient insulation to resist the simultaneous application of test voltage on one hand and service voltage on the other.
 - c) Preventive measures taken against electrical, short circuit or electric arc risks must be adapted to the level of voltage used in the electrical/system.



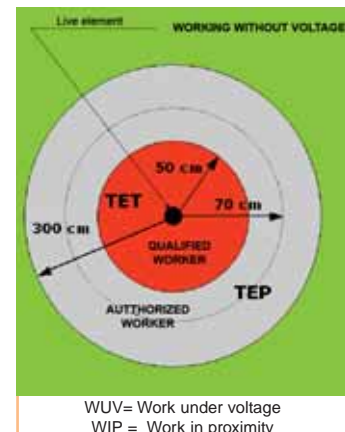
3.3.4. WORK CARRIED OUT IN PROXIMITY (RD 614/01. ANNEXE V)

In all work performed in proximity to live elements, workers must remain outside the danger zone and as far away as possible.



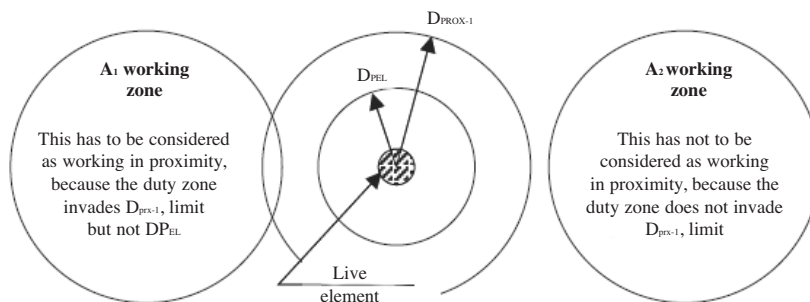
Prior to starting work

1. The viability of executing the job must be determined by an authorized worker, taking into account the provisions of the above paragraph and the following provisions.
2. If the job is viable, the appropriate safety measures must be adopted to reduce to the minimum the following items:
 - a) The number of elements under voltage.
 - b) The danger zone of the elements under voltage, by putting up shield barriers, barriers, casings or insulated protectors whose characteristics (mechanical and electrical) and method of installation guarantee effective protection, taking into account:
 - Nominal voltage of the facility
 - Operations that must be carried out in proximity.



- In which of those operations the work zone can be accurately delimited and in which of those no precise delimitation can be established.
- The maximum proximity foreseen in work with respect to the existing elements under voltage.

A) WORKS THAT ITS DUTY ZONE CAN BE EXACTLY DELIMITED.
(The precision involved in delimitation is related to the live element or elements)



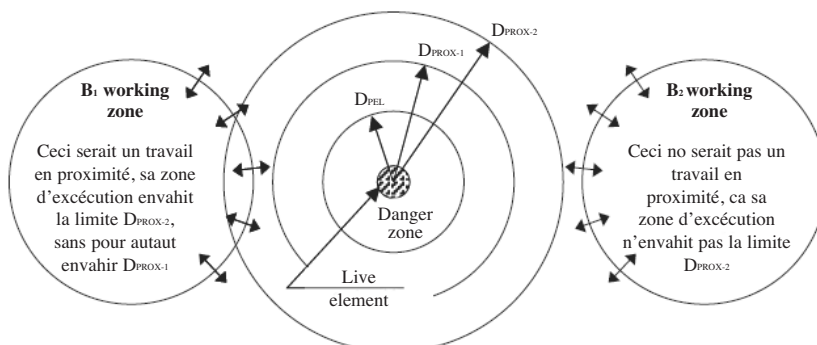
3. Inform workers who are directly or indirectly involved about:

- Existing risks,
- Situation of the elements under voltage,
- Limits of the work area and
- all the safety precautions and measures they must take to avoid entering the danger zone, in addition to informing them that they have to report any circumstance that reveal the insufficiency of the measures taken.

Executing the job

4. With delimiting the work area and training and information for workers, work in proximity must be carried out by «authorised workers», or by workers who have permission to work in the area (even though they are not «authorised workers» in the strict sense of the definition given on page 4 of this guide).
5. Access to independent areas designated to providing electrical service must be restricted to authorised workers, or staff, under constant supervision by workers, who have previously been informed of the risks and precautions to be taken.

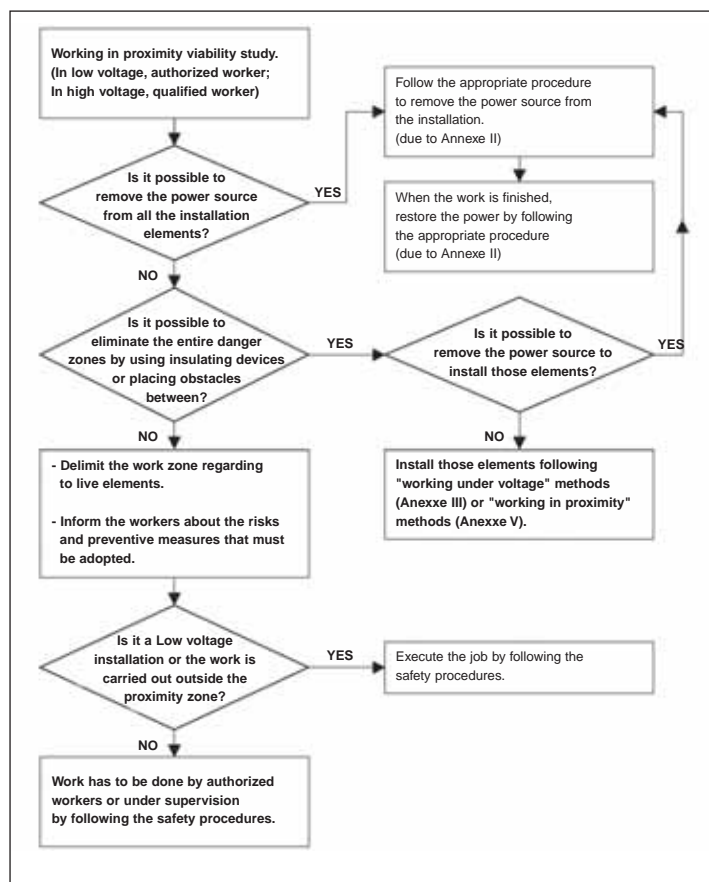
B) WORKS THAT ITS DUTY ZONE CANNOT BE EXACTLY DELIMITED.
(The precision involved in delimitation is related to the live element or elements)



6. The doors of these areas must be marked, indicating that entry by non-authorized staff is prohibited and they must remain closed to prevent entry to all non-authorized persons.
7. The opening of cells, cabinets and other places housing electrical material must be restricted to authorized workers.
8. Access to restricted areas and opening of casing elements by authorized workers may only be done if the employer for which they work and the owner of the facility is not the same person, and it has to be done with the knowledge and permission of the latter.

Planning work in proximity

Based on the values of the distances that define *work in proximity* in low voltage electrical facilities (between 50 cm. and 70 cm. from the element under voltage), and the dimensions of the electrical panels and cabinets used in them, we can conclude that practically no work in proximity must be carried out under LV and any potential situations must be treated as *work under voltage* or after delimited the work area by placing screens, barriers, casings or insulated protectors (work under voltage), treated *work without voltage*.



**3.3.5. WORKING IN LOCATIONS WITH RISK OF FIRE OR EXPLOSION
(R. D. 614/01. ANNEXE VI)**

1. All work carried out in electrical facilities in places with **fire risk** must be done by **authorized workers**. In case of **explosive risks**, prior to starting work a **procedure must be set up** to guarantee the safety of the workers involved. That procedure will be drawn up in writing. Furthermore the work must be done by **qualified workers** following that procedure.
2. Equipment and facilities used in places with risk of fire or explosion must comply with the applicable requirements set forth in the pertinent standards (UNE-EN-50281-1-2. ITCBT-29)

3. Before entering a confined space where there is risk of fire or explosion due to the presence of gases and vapours a check must be made of the atmosphere using the appropriate equipment, for instance, an explodimeter. In the event of a risk being detected, the following must be done:

- Identify and locate the source of contamination.
- Eliminate the source of contamination, or if this is not possible, control it by ventilating (natural or artificial if necessary) until contamination is reduced to an acceptable level under explosion limits.

PROTECTION WAYS WITH DECLARATION OF CONFORMITY			
EXPLOSIVE ATMOSPHERE			
PRINCIPLE	SKETCH	DESIGNATION	RULE
IT PREVENT THE CAUSES OF ELECTRIC IGNITION		INTRINSIC SECURITY « I »	IEC 79.11 UNE 20319 EN 50.020
		INCREASED SECURITY « E »	IEC 79.7 UNE 20328-79 EN 50.019
IT PREVENT CONTACT BETWEEN EXPLOSIVE ATMOSPHERE AND ELECTRICAL EQUIPMENT		INTERNAL OVERPRESSURE « P »	IEC 79.2 UNE 20.319-78 1 ^a Rev EN 50.010
		POWDER ISOLATING MATERIAL « Q »	IEC 79.5 EN 50.017 UNE 20.321-71
		OIL IMMERSION « O »	IEC 79.6 EN 50.015 UNE 20.326-70
		ENCAPSULATION « M »	EN 50.028
IT PREVENT EXPLOSION TRANSMISSION		ANTIDEFLAGRANT CASING « D »	IEC 79.1 UNE 20.320-80 EN 50.018



waves (e.g.: radio transmitter, radiofrequency generators for medical or industrial use for heating, drying, welding, etc. located nearby).

- In sparks generated by electrostatic charges.

- Perform continuous measurements to verify that contaminant are at all times within acceptable levels.

4. Prevent the forming of electric arcs or sparks that could be converted into ignition sources, generated:

- By opening and closing electrical contacts in uninsulated appliances.
- In portable electrical tools (push button and collector(motor brushes)).
- When connecting a pin to the socket base.
- When establishing contact with live elements using probes of measuring appliances.
- In loose connections.
- At points in the facility that could reach high temperatures.
- In the incandescent filament of a broken lamp.
- In unprotected fuses.
- In sparks generated between the lamp and lamp-holder while being replaced.
- During the induction of voltage in conductive elements, caused by radiofrequency electromagnetic

5. Disconnection of a facility or part of a facility, when it could be affected by a fire, is influenced by its operating needs in fighting the fire.
6. Voltage must not be switched off in the event of the alarm and evacuation system depending on that circuit or if it supplies critical processes, unless the operativity of other supplementary power sources can be guaranteed.
7. In the case of facilities protected against fire with automatic systems for dousing with CO₂, when executing electrical work, the automatic system must be disconnected and portable extinguishing systems taken near to the work zone, after checking that they are in good working order.

3.3.6. WORKING IN LOCATIONS WITH RISK OF ELECTROSTATIC CHARGES ACCUMULATIONS (R. D. 614/01. ANNEXE VI)

Although energy from static electricity that is produced spontaneously it is insufficient to cause direct harm to humans, it could indirectly cause knocks or cause the operator to fall from a high place, and lead to contact with live elements.

In addition, the sparks generated in the discharges could be a source of ignition, giving rise to fire or explosion.

The following are some of the main procedures for preventing the accumulation of static electricity:

- Maintain relative humidity of the air above 50%.
- Connect metal parts that could accumulate static electricity to earth.
- Apply antistatic products to surfaces that could be charged with electricity.
- Use air ionisers nearby or next to the zone where there is static electricity.
- Floors or paving must be made of dissipating materials (concrete, ceramic, wood without insulating cover, etc).
- **Wear antistatic footwear and clothing made of cotton or an antistatic fabric.**



Actions to be taken in the Event of an Accident

1 PROTECT

2 REPORT THE ACCIDENT

3 GIVE HELP

CHECK FOR SIGNS OF LIFE

A CONSCIOUSNESS
B BREATHING
C PULSE

**REMEMBER THAT THE VICTIM NEEDS
TO BE TREATED URGENT
NOT MOVED URGENTLY**





Cardiopulmonary Resuscitation

MOUTH-TO-MOUTH BREATHING CARDIAC MASSAGE

The rate of mouth-to-mouth respiration to cardiac massage is:

30 CHEST COMPRESSIONS AND 2 INSUFFLATIONS (100 COMPRESSIONS PER MINUTE)



- Check that the airway is not blocked.



- Pull the victim's head back.



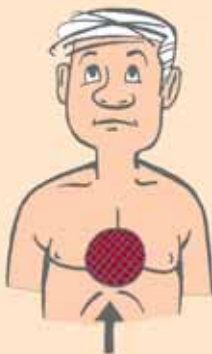
- Keep the victim's jaw upwards.



- Put your lips over the victim's mouth and blow air in, pinching the victim's nose.



- If the victim's mouth is closed and his/her teeth clenched, cover his lips with your thumb to prevent the air from escaping when air blows in through the nose.



- Cardiac massage point.



- Position of the heels when applying cardiac massage.



Bleedings



- Apply clean gauze or clean cloths at the source of the bleeding point.
- If the bleeding does not stop, put more gauze on top and press down harder.
- Press down on the bleeding artery with your fingers.
- The victim is then taken to a medical centre.



Wounds



- Do not touch the wound.
- Wash it with soap and water.



- Do not apply ointments to the wound.
- Cover the wound with sterile gauze.



Burns



- Rinse out the burned area for at least 15 minutes
- Remove clothing, rings, bracelets, etc. impregnated with hot liquids.



- Do not apply ointments.
- Cover the burn with sterile gauze.
- Take the victim to a medical centre.



Fainting



- Lie the victim down with his/her head at a lower level than the rest of his/her body.



Convulsions



- Do not try to stop his or her movements.
- Place the person lying down where he or she can not get hurt.
- Roll the person carefully onto their side to help him or her breathe.



Projected Materials

Chemical splash into eyes

- Flush it gently with water at room temperature >15 degrees.
- Do not rub the eye.
- Take the victim to a Hospital.



Foreign object in the eyes

- Do not touch it.
- Do not rub the eye.
- Cover the eye with clean gauze and take the victim to a Hospital.





Poisoning

In All Cases:

- Obtain information about the substance (safety data sheet and label). If this information is not available or more information is required, call the National Toxicological Service to the telephone number **91 562 04 20**.
- If there are signs of choking, apply artificial mouth to mouth breathing.
- Place the victim in the safety position (see figure) and cover with a blanket to keep him/her warm.
- Take the victim to a medical centre.

In the Event of Ingestion:

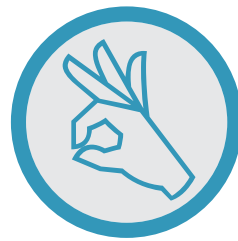
- If the victim is conscious, induce vomiting, unless the product information makes this inadvisable (corrosives, hydrocarbons).



Safety position







**WORKERS' OBLIGATIONS
REGARDING OCCUPATIONAL
RISK PREVENTION**



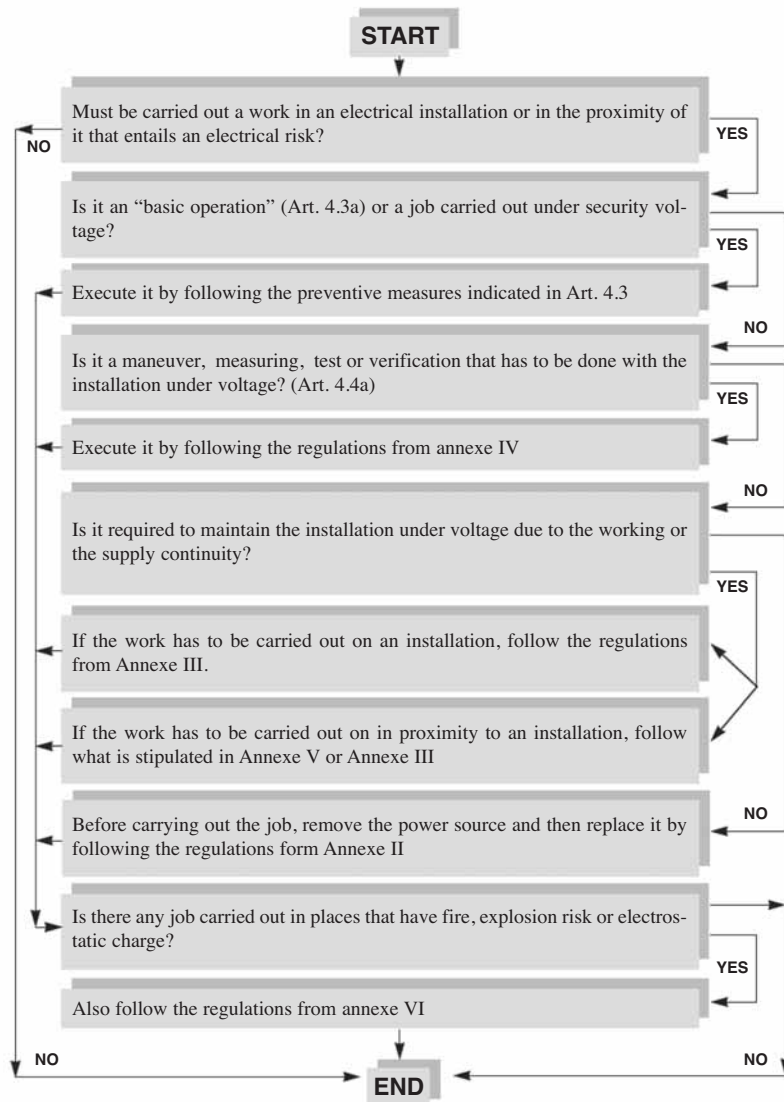
Workers' Obligations Regarding Occupational Risk Prevention



Article 29 of the Occupational Risk Prevention Act (Ley de Prevención de Riesgos Laborales) makes it incumbent on workers to take reasonable care for his or her own health and safety and for the health and safety of anyone else who may be affected by his or her acts or omissions at the workplace.

In due accordance with the training and the employer's instructions, workers are in particular bound to:

- Make proper use of machines, appliances, tools, hazardous substances, transportation equipment and, in general, any other method used to carry out their activity.
- Use the protection resources and equipment provided by their employers and maintain them correctly, and if damage, request them to be replaced.
- Use existing safety devices properly and never put them out of order.
- Immediately inform their supervisor of any situation they deem may entail a risk to workers' the health and safety of workers.
- Cooperate with the employers so that they can guarantee safe working conditions that involve no risk to the health and safety of workers.
- Any breach of the risk-prevention obligations referred to above will be deemed to be an occupational infringement for the purposes of the provisions laid down in article 58.1 of the Statute of Workers' Rights (Estatuto de los Trabajadores).





GUIDE TO HEALTH
AND SAFETY WHEN
WORKING WITH LOW
VOLTAGE ELECTRICITY

I have received the Guide to Health and Safety which shows the risks and basic preventive measures when Working with Low Voltage Electricity and gives a summary of workers obligations as laid down in Article 29 of the Occupational Risk Prevention Act.

I.D. Number:

Date:

Worker's name and signature:





Published by:
FREMAP

*Mutua de Accidentes de Trabajo y Enfermedades
Profesionales de la Seguridad Social N° 61.*

Designed by:
Imagen Artes Gráficas, S. A.



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