

**How to Act After Accidents Caused by Electrical Current – Course:  
Basic Skills and Knowledge of Electrical Engineering. Methodical  
Guide for Instructors**



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# **How to Act After Accidents Caused by Electrical Current – Course: Basic Skills and Knowledge of Electrical Engineering. Methodical Guide for Instructors**

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## **1. Aims and Contents of Practical Vocational Training in the Field of "How to Act After Accidents Caused by Electric Current"**

At the end of the training, the trainees should have achieved the following aims:

- The trainees have acquired the necessary knowledge and skills for acting correctly after accidents caused by electric current.
- The trainees know how to use instructions on first aid.
- The trainees are able to render first aid quickly, safely and carefully after accidents caused by electric current.
- The trainees observe the labour safety regulations.

In order to achieve the above mentioned aims, the following contents have to be imparted by the instructor:

### *Knowledge*

- Effects of electric currents on the human organism.
- Rules of conduct and hints on labour safety concerning the safety of the rescuer.
- First aid measures after accidents caused by electric current.

### *Skills*

- Finding and rescuing of the injured person.
- Rendering first aid.
- Artificial respiration of the injured person.
- Carrying out of the cardiac massage.
- Preparing the injured person for transportation.

## 2. Organizational Preparation

In order to guarantee a smooth course of instructions and exercises, it is necessary to organize and prepare the lessons well.

This includes the following steps:

### 2.1. Preparation of the Labour Safety Instructions

Before beginning the exercises, a brief instruction has to be given as to the expert use of the working means and to working free of accidents.

It is recommendable to start a book on labour safety instructions, in which all instructions on safe working and proper use of the working means are entered in brief outlines. The trainees confirm by their signatures that they have participated in the respective instruction.

The following instructions should be included:

- Protection of the rescuer while rescuing the injured person out of the fault–current circuit.
- Name and workshop place of an educated first–aid attendant.
- Working hours and telephone number of the next first–aid post.
- Name, address and telephone number of the department or office of the enterprise disposing of a car for the transportation of injured people.
- Address and telephone number of the office in charge of ambulance service.
- Address and telephone number of the next clinic or outpatient's department.
- Practical exercise at a person must not be detrimental to the health of that person. (Artificial respiration and cardiac massage are only indicated!)

Possible further hints on labour safety are given to the respective local conditions.

### 2.2. Preparation of the Teaching Aids

For theoretical instructions the trainees need a place where they can take notes. Recommendable is a room with blackboard, desks and electric connection.

If the instructions are given in the workshop or at the working place, clean pads should be on the working tables, so that the trainees can make notes.

For practical demonstration during the instructions, an exercising place with the following equipment should be available:

- Equipment required for rescuing an injured person out of the fault–current circuit or auxiliary means that may be used for this purpose.
- Fire–fighting equipment suited for extinguishing fire in electric plants.
- Materials required for the preparation of an alkalization solution.
- Dummy or anatomical model.
- Materials required for first–aid measures with injured people.

- Mouth opener.
- Mouth respiration apparatus, mouth masks.
- Stretcher.
- Blankets, safety belts.

The "Trainees' Handbook of Lessons – How to Act After Accidents Caused by Electric Current" is distributed among the trainees. Diagrams are prepared before the lesson in the form of blackboard drawings.

### **2.3. Preparation of the Working Means**

As a theoretical basis for the practical exercises, distribute the "Instruction Examples for Practical Vocational Training–How to Act After Accidents Caused by Electric Current" among the trainees according to their number.

The materials required for the exercises are to be prepared on the basis of the "Instruction Examples..." in sufficient quantity. Each trainee must have a place for exercise.

### **2.4. Time Planning**

Starting from the total number of teaching hours, the time for each respective section of this lesson should be planned individually. Time planning is recommended for the following sections:

- Introduction into the respective working technique in the form of an instruction.
- Required demonstration.
- Task–related instructions in preparation of the exercises.
- Carrying out of the exercises.
- Recapitulations and tests.

For time planning take into consideration the following factors:

- The level of education of the trainees.
- The training conditions.
- The future field of working of the trainees.
- The degree of difficulty of the respective section.

The main stress of each section is on the acquisition of abilities and skills by exercises.

If, despite a good planning, it should come to waiting times for the trainees, these should be filled by small corresponding tasks such as the preparation of materials for the exercises.

## **3. Recommendations for Practical Vocational Training in the Working Techniques Required for "Acting After Accidents Caused by Electric Current"**

The following sections contain suggestions as to how the instructions, demonstrations as well as exercises and tests can be arranged.

### **3.1. Introductory Instructions, Demonstrations and Exercises**

The introductory instructions on each respective working technique can be held with the trainees in a classroom. During the instructions, make sure that the trainees write down necessary supplements and

answers into the "Trainees' Handbook of Lessons".

The "Trainees' Handbook of Lessons", in its structure, is adapted to the introductory instruction. The main points have to be imparted. A precondition for learning the techniques of "Acting After Accidents

Caused by Electric Current" is that the trainees master the techniques for first aid.

Therefore, refer to these techniques in the form of repetition. The main points of "Rescue of Injured

People out of Electric Plants under 1 kV and Immediate Measures After an Accident Caused by Electric

Current" should be imparted making intensive use of all teaching aids that are available.

### **Effects of electric current on the human organism**

In order to make the trainees aware of the danger of electric current, especially point to the irritating and heat effects of electric current.

#### *Irritating effect*

- Explain to the trainees that the intensity of current and the time of the current flow through the body are decisive for the degree of its detrimental effects.
- Starting from Ohm's law, the current intensity is determined by voltage and resistance.
- In this context, repeat the importance of protecting oneself against hazardous contact voltage.
- Especially point to the most dangerous effect of electric current, that of ventricular fibrillation as well as to the incurable cerebral defects due to missing blood circulation.

#### *Heat effects*

- Explain to the trainees that the heat effect of electric current can cause burns of the skin as well as fire by an electric arc.
- Put special emphasis on the fact that fire caused by electric current must never be extinguished by water.

After this section the trainees must have realized that first aid must be rendered promptly and carefully.

### **Rescue of injured people out of electric plants under 1 kV**

- Give detailed practical demonstration of the possibilities to break an electric circuit. However, do only explain how to create a short circuit.
- Especially deal with the possibilities of the rescuer to protect himself, if it should be impossible to break the fault-current circuit.

Here, the trainees must learn that the rescuer has to protect himself against the dangers of electric current when trying to rescue injured people.

### **Immediate measures after an accident caused by electric current**

Explain to the trainees that the degree of health defects and the life of the injured person to a far extent depend on the correct measures of help.

Explanations and demonstration in this field should be concentrated on the following techniques:

- Rescuing and bedding of the injured person.
- Emergency respiration in the case of respiratory arrest.
- Measures with cardiac arrest – cardiac massage.



- Alkalinization.
- First treatment of wounds.
- Calling medical help.

Here, the survey of "Measure in the Case of Unconsciousness" from the "Trainees' Handbook of Lessons" may be used as a blackboard diagram or projected illustration.

*Measures to be taken when the injured person is conscious*

- Bedding.
- Protection against hypothermia.
- Examination of respiration and pulse.
- Calling another person for help.
- Calling medical help.
- Transportation and further medical treatment – preparation.

The demonstration of the activities to be carried out must be carefully prepared. Groups of 6 to 8 trainees should be formed to enable each trainee to watch the demonstration well. Only then start the demonstration of the required measures.

In doing so, pay attention

- that during the demonstration the aim and purpose of the demonstrated actions are explained;
- that the correct sequence of operations is emphasized;
- that it is pointed out that it is important to taste the alkalinization solution.

It is also important to point to the fact that every person who had an accident caused by electric current has to be considered as a seriously injured person and must not be left alone!

After demonstration, one or two trainees should repeat the required operations. Here, the correct order of actions has to be observed and faults have to be corrected immediately.

In order to develop the practical skills of the trainees, they should practise the measures repeatedly.

*Measures taken if the injured person is unconscious but respiration is regular*

With demonstration and relevant explanations it is assumed that the injured person has just been rescued.

In the order: explanation – demonstration – exercise all required measures are carried out in logical order at a person for practice. The examination of the injured person should be demonstrated in such a way that statements of the extent of injuries can be made. Make sure that such examination takes only little time!

The examination should be concentrated on

- heart action
- respiration
- further signs of life
- further injuries.

Then, the correct coma position has to be demonstrated and the importance of this measure be explained. This measure, too, should be demonstrated at a person for practice by single steps each of which has to be repeated by the trainees after demonstration. Only then, the entire coma position should be practised by the trainees. In doing so, all actions from understanding the accident situation to coma position have to be carried out. Mistakes have to be corrected immediately and assessed together with the trainees.

This should be followed by further measures such as

- Treatment of arterial bleedings
- Calling of medical help
- Preparation of the transportation of the injured person for further medical help.

### *Measures taken when the injured person is unconscious and has stopped to breathe*

Make clear that respiratory arrest means acute danger of life! Together with the trainees repeat the consequences of an interruption of oxygen supply to the brain. In doing so, show the correlation between blood circulation, respiration and blood supply to the brain. Since 5 minutes at the latest after respiration has stopped it comes to incurable cerebral damages, make clear that the rescuer must start artificial respiration as quickly as possible.

Artificial respiration must be started immediately after the rescue of the injured person.

Explain to the trainees how and why artificial respiration has to be prepared.

Preparatory measures are:

- opening of the mouth of the injured person
- cleaning the oral cavity
- bending the head backwards.

Cleaning of the oral cavity is only explained theoretically. Point out that with unconscious people there is the danger of suffocation.

In order to prevent this, the upper respiratory tract must be made free by overstretching the head backwards. After demonstration and explanation, the trainees must practise the preparatory measures for artificial respiration.

Wrong movements have to be corrected permanently.

Always bear in mind, that the trainees acquire safe skills only, if they practise the measures again and again. Therefore, the main points of the immediate measures should now be repeated in their entirety.

This includes:

- rescue of injured people
- examination of the injured person
- alkalization
- bedding
- preparation for artificial respiration
- calling of medical help
- preparation for transportation.

### **Artificial respiration of injured people**

For showing the different methods of artificial respiration, the survey of "Measures in the case of unconsciousness" may be used.

Again it is important to emphasize that every second is precious and that prompt and effective help decides about life or death of the injured person.

Giving artificial respiration takes priority over any other measure.

Explain the principle of giving artificial respiration.

- By blowing the breath of the rescuer into the lungs of the injured person the required oxygen is supplied. Process of breathing in!
- The injured person breathes out by the natural elasticity of his chest. Process of breathing out!

Artificial respiration is always begun with breathing in. Respiration is continued until the injured person starts to breathe independently or till a physician orders to stop artificial respiration.

In your explanations on artificial respiration also deal with the oxygen content of the breathing-out air of the rescuer and with the advantages of giving artificial respiration compared with other methods.

Especially point to possible mistakes with artificial respiration. These should be mentioned, explained and together with the trainees it should be found out how such mistakes can be avoided.

All the methods of giving artificial respiration must not be practised at people for exercise. For this purpose, dummies have to be used.

It results from the importance of the various techniques of artificial respiration that the instructor must prepare himself thoroughly for the demonstration of artificial respiration.

#### *Mouth-to-nose respiration*

With the preparation for and giving of the demonstration the following should be taken into consideration:

- The trainees must be told to follow each demonstration very attentively.
- The working place has to be carefully prepared for the demonstration and exercises that follow.
- All required auxiliary means have to be kept ready before the demonstration starts.
- The dummy and breathing apparatus have to be cleaned before and after every exercise. This prevents aesthetical and hygienical objections on the part of the trainees.
- Make sure that each trainee is in a position to exactly follow each demonstrated movement and operation.
- During the demonstration, each individual phase has to be explained and the correct sequence of operation be pointed out.
- Mention the possible mistakes with artificial respiration as well as the way to avoid them.
- Make sure that the trainees recognize the signs of returning life.

When the trainees exercise the giving of artificial respiration, especially see to the following:

- The breaths must be regular.
- The position of the head of the injured person (dummy) must remain unchanged.
- The trainees must watch how the chest of the dummy goes down with breathing out.
- The trainees must keep the mouth of the injured person (dummy) closed.

#### *Mouth-to-mouth respiration*

Point out that this technique should be used only if the respiratory tract of the nose is blocked.

This method is very similar to the mouth-to-nose respiration. Explanations and demonstration are given in the same way as those of mouth-to-nose respiration at the dummy.

With the exercises of the trainees that follow the explanations make absolutely sure that the correct order is observed.

It is important to point out that with this technique of artificial respiration the nose of the injured person must be kept closed.

*Artificial respiration with the help of apparatus* Explain to the trainees, that there are different auxiliary means for artificial respiration such as:

- mouth respirators and
- mouth masks.

These are shown to the trainees and their application is demonstrated.

Point out that also here the success of respiration should be watched after each breath.

At this point, repeat the sign of returning life together with the trainees.

Make clear that, in case of emergency, one must not search for auxiliary equipment but start with artificial respiration immediately!

Mouth respirators or other apparatus are universally applicable and can also be used while the injured person is moved.

Explain to the trainees that the oral tube is allowed to be used only by a physician, because a layman could easily injure a person's respiratory tracts by intubating.

#### *Manual methods of artificial respiration*

Explain to the trainees that the manual techniques – especially with respect to the breathing volume – are inferior to the methods of giving artificial respiration.

The manual methods should only be used, if extensive wounds in the face of the injured person make the respiration from mouth to mouth impossible.

Also here, make the principle of the manual methods clear:

#### – Breathing out

By pressing the chest down and thus the lungs, the air is forced out of the lungs and a low pressure is created.

#### – Breathing in

With relieving the external pressure, the chest – due to its flexibility – returns to its original position, the lungs expand and air is taken in. It must be made clear that the manual methods of respiration must be started by breathing out.

In preparing and giving the demonstration, consider the following:

- Start from the fact that the injured person has just been rescued.
- It is recommendable to repeat or let the trainees repeat why the immediate measures must be taken without delay, to have some chance of succeeding at all.
- The trainees should repeat the required examination of the injured person as well as the measures for preparing the artificial respiration of the injured person.
- It would be best if the demonstration was given on the floor. For this purpose, a blanket or tarpaulin should be kept ready.
- Demonstration can be given at a person for exercise.
- Make sure that all trainees can follow the sequence of operations.
- During the demonstration make the trainees constantly aware that it is a moral duty of each of them to put his personal interest after the rescue of human life.
- The movements are accompanied by explanations during the demonstration.
- The demonstration should be repeated by one or two trainees in order to check whether the actions shown have been understood.
- With the then following exercise pay attention that the trainees observe the measures which were demonstrated and repeated as well as the explanations.

- During the exercises, the trainee should be given assistance. Mistakes are corrected immediately.

In order to avoid fractures of the ribs and the breast bone, only moderate pressure has to be exercised on the chest of the injured person.

The first manual method of artificial respiration that is taught should be the one in prone position. Only if the trainees master the above method, the technique in dorsal position can be dealt with. Before starting the demonstration of the technique of artificial respiration in dorsal position, emphasize that this method should only be used if the rescuer masters no other technique. The method in dorsal position is the most inconvenient and least effective one.

In the course of the exercise pay attention that

- the trainees apply the methods correctly;
- the respiration phases are deep enough;
- the respiration rhythm is observed;
- the movements of the arms are made in the anatomically correct way;
- the respiratory movements are carried out evenly.

### **Measures taken with circulatory arrest**

At the beginning of explanations and demonstration, again make the trainees aware that by all means human life must be saved unselfishly.

The trainees must realize that circulatory arrest is a sign of utmost danger to life.

Here, let the trainees repeat what is understood by ventricular fibrillation and how dangerous it is.

Demonstration and exercises of first aid in the case of circulatory arrest must not be carried out at people. The respective measures are only taken in the case of emergency.

It is recommended just to indicate the required measures at a person for exercise, to demonstrate them with the help of a dummy or to explain them by illustrations. Again it is important that the trainees can see all details well and concentrate upon the demonstration. Explain to the trainees why the feet of an injured person should be elevated if the pulse beat of the person is weak.

If the injured person is unconscious, has no pulse and does not breathe and if his pupils are wide and show no reaction, cardiac massage has to be given in addition to respiration – if possible simultaneously by a second person.

Before giving demonstration, explain to the trainees the principle of cardiac massage.

Point out that before beginning the cardiac massage, 10 breaths must be given in breathing rhythm.

After that, cardiac massage is combined with artificial respiration in the ratio of 4:1. That is to say that 12 strokes of cardiac massage have to be followed by 3 breaths.

It is recommendable at this point to repeat the methods of artificial respiration together with the trainees.

With the then following exercise special attention has to be paid that the trainees carry out the individual operations accurately.

Special value has to be attached to the control and correction of the following actions:

- correct application of the hands to the breast bone;
- correct order of giving respiration and cardiac massage;
- correct ratio of giving respiration and cardiac massage;
- correct pressure on the breast bone.

Too much pressure on the breast bone involves the risk of fractures of the ribs and the breast bone.

Emphasize that the cardiac massage must be continued until the heart of the injured person starts to beat or till a physician orders to stop the massage.

Other measures for stimulating the heart action are allowed to be taken only by a physician.

As soon as the trainees master the cardiac massage, it should be combined with giving respiration. The trainees should realize that cardiac massage is hard work and that, therefore, the rescuer should call for help, so that another person can come to his assistance. During the exercises, mistakes should be corrected immediately and analyzed with the trainees.

### **Hints for the transportation of injured people**

In this context, it is important to point out to the trainees that

- injured people have to be transported very carefully;
- the condition of health of the person concerned can be decisively influenced by a perfect transportation;
- the most important rules of the transportation of injured people must be known.

The demonstration must show the trainees what they must pay special attention to in moving injured people and how exactly transportation has to be carried out.

After the demonstration, the trainees should practise how to move injured people.

During these exercises, special value is attached to

- the bedding of the injured person on the stretcher;
- the even lifting up and putting down of the stretcher;
- the cautious transportation and
- the surmounting of obstacles with the stretcher.

Show the trainees where near their working place stretchers and auxiliary means for moving injured people are to be found.

## **3.2. Recommendations for Working with the Instruction Examples for Practical Vocational Training**

In the instruction examples, the sequence of actions is described including a sketch of rendering first aid to people who had an accident caused by electric current. Moreover, a list of materials and the required basic knowledge is attached to each instruction example. To the sequence of actions, corresponding remarks are given, so that the trainees get all necessary information to render first aid systematically.

When working with the instruction examples, consider the following:

- The trainees shall put the instruction examples into practice on their own. This enables the instructor to assess the performances of each trainee individually and to correct them.

## **3.3. Examples for Recapitulation and Tests**

For consolidating and testing the knowledge and skills acquired, questions are raised in this section.

To each question the corresponding answer is given.

Questions which are contained in the "Trainees' Handbook of Lessons" are marked with the letter "A".

### **1. What voltages have to be considered as hazardous contact voltages?**

(a.c. voltages of more than 50 V; d.c. voltages of more than 120 V)

**2. What are the effects of electric current on the human organism?**

(Irritating effect; heat effect)

**3. What is the intensity of a current flowing through a person, if the current path goes from hand to feet and the applied voltage is 220 V?**

"A" (220 mA)

**4. What conclusion is to be drawn from this current intensity?**

"A" (The current intensity is lethal.)

**5. Why is every single minute of first aid measures decisive in the case of an accident caused by electric current?**

"A" The most dangerous irritating effect – ventricular fibrillation – may occur. Due to failure of blood circulation, no oxygenic blood reaches the brain of injured person, so that it comes to incurable damage to the brain.)

**6. What measures have to be taken for rescuing an injured person?**

(Breaking of the fault–current circuit; rescuing the injured person; rendering first aid.)

**7. Why must the rescuer never touch the injured person with bare hands?**

"A" (He exposes himself to utmost danger of death.)

**8. What information should an information board of first aid give?**

"A" (Name and working place of a trained first–aid attendant; service hours and telephone number of the station of an ambulance address and telephone number of the department/office of the enterprise disposing of a car for the transportation of injured persons; address and telephone number of the ambulance service concerned; address and telephone number of the next clinic or outpatient's department.)

**9. Why must unconscious people not be given anything to drink?**

(Danger of suffocation.)

**10. What must be kept in mind when treating wounds and secondary injuries?**

"A" (Immediate measures take priority. Open wounds must not be touched with hand. Do not try to remove foreign bodies that have penetrated the injured person's body. Measures are restricted to first aid.)

**11. Why is an alkalization necessary with people who had an accident caused by electric current?**

(In order to achieve a neutralization of the acids created in the body by the electric current.)

**12. Why are unconscious people exposed to the danger of suffocation?**

"A" (Whit unconscious people, the lower jaw falls back and the tongue blocks the upper respiratory tracts. There is the danger of suffocation.)

**13. Why are injured people placed in coma position?**

(The coma position prevents the squeezing of the respiratory tracts and guarantees that blood, mucus and vomit can flow out of the mouth.)

**14. What methods are used for giving artificial respiration?**

(Mouth–to–nose respiration with the help of auxiliary equipment such as mouth breathing apparatus and masks.)

**15. Why must aesthetic and hygienic objections be suppressed with giving artificial respiration?**

(Because otherwise the injured person cannot be saved.)

**16. Why must the head of the injured person be overstretched backwards?**

"A" (Because this makes the upper respiratory tracts accessible for artificial respiration.)

**17. When must the manual methods of artificial respiration be used?**

(When extensive injuries of the face make the giving of respiration from mouth to nose or mouth to mouth impossible.)

**18. Why should manual methods of artificial respiration be applied only in exceptional cases?**

"A" (Because the manual methods are clearly inferior to the giving of respiration from mouth to nose or mouth to mouth, respectively.)

**19. Why must measures of resuscitation not be broken up by the rescuer on his own?**

"A" (Because only a physician is able to determine whether or not an injured person is dead.)

**20. Why must an injured person be carried by at least two people?**

"A" (Because a person who had an accident caused by electric current must be moved in lying position and must be constantly observed during transportation.)

**21. Why must the medical staff be informed about the first aid measures taken?**

"A" (To enable them to assess the condition of the injured person and to take further measures.)