

SCHOTT AG Electrotechnical Engineering Division	<b>Electrotechnical Rules of SCHOTT AG</b>	<b>SCHOTT</b> glass made of ideas
Version 06.12.2013	<b>Electrotechnical Safety Guidelines for the Prevention of Electrical Accidents</b>	Version 1.3

# Electrotechnical Rules of SCHOTT AG

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## Note on "Electrotechnical Rules"

Electrotechnical rules are the "generally recognised good engineering practice" as formulated in the *VDE Regulations* and which have been designated as such by the announcement of the Federal Ministry of Economics and Labour (BMWA) in the Bundesanzeiger (German Federal Gazette) and Bundesarbeitsblatt (Federal Labour Gazette) "Reference 2 in Annex 3 to the Performance Directives on BGV (accident prevention regulation) A3 (Section 2 BGV A3). This regulation makes electrotechnical rules and accident prevention provisions binding for insured parties and member companies of the institution for statutory accident insurance. The application of generally recognised good engineering practice, in particular the VDE standards, ensures the presumption of conformity on compliance with generally recognised good engineering practice under Section 49 of the German Energy Act (Energiewirtschaftsgesetz). By applying VDE standards therefore, this means that from a legal perspective, a negligent and therefore culpable act must first be proven. Other solutions for maintaining safety may of course be applied. However, users would not be able to invoke the presumption of conformity and would then have to provide written evidence of the equivalent or better solution in relation to VDE standards in the event of a loss. This is what is known as the reversal of the burden of proof.

## 1. Scope of application and general information

The following Electrotechnical Safety Guidelines apply for all persons working for SCHOTT AG and its subsidiaries who are assigned with planning, installing and operating electrical installations.

These Electrotechnical Safety Guidelines also apply for all external service providers carrying out electrotechnical work on behalf of Schott AG.

Electrical installations are used for the generation, transmission, conversion, distribution and use of electric energy. These installations also include the electrical installations of the production plants, machinery, buildings, supply and disposal installations, all electrically operated ancillary structures and power supply of the furnaces at all SCHOTT sites in Germany.

The Electrotechnical Safety Guidelines constitute preventive measures for the prevention of electrical accidents and should be used as a practical guide for all employees working with electrical energy.

The DIN/VDE regulations and the application accident prevention regulations, all as amended, apply for the installation, alteration, maintenance and operation of electrical installations within SCHOTT AG work areas. The Product Safety Act (ProdSG) with its applicable ordinances, the Low Voltage Directive, the Explosion Protection Ordinance to the Product Safety Act (ProdSV) and the Machinery Directive also apply. An overview of the main underlying standards is provided in paragraph 15. The safety guidelines laid down herein do not replace applicable regulations, but constitute a supplement for the specific requirements of SCHOTT AG.

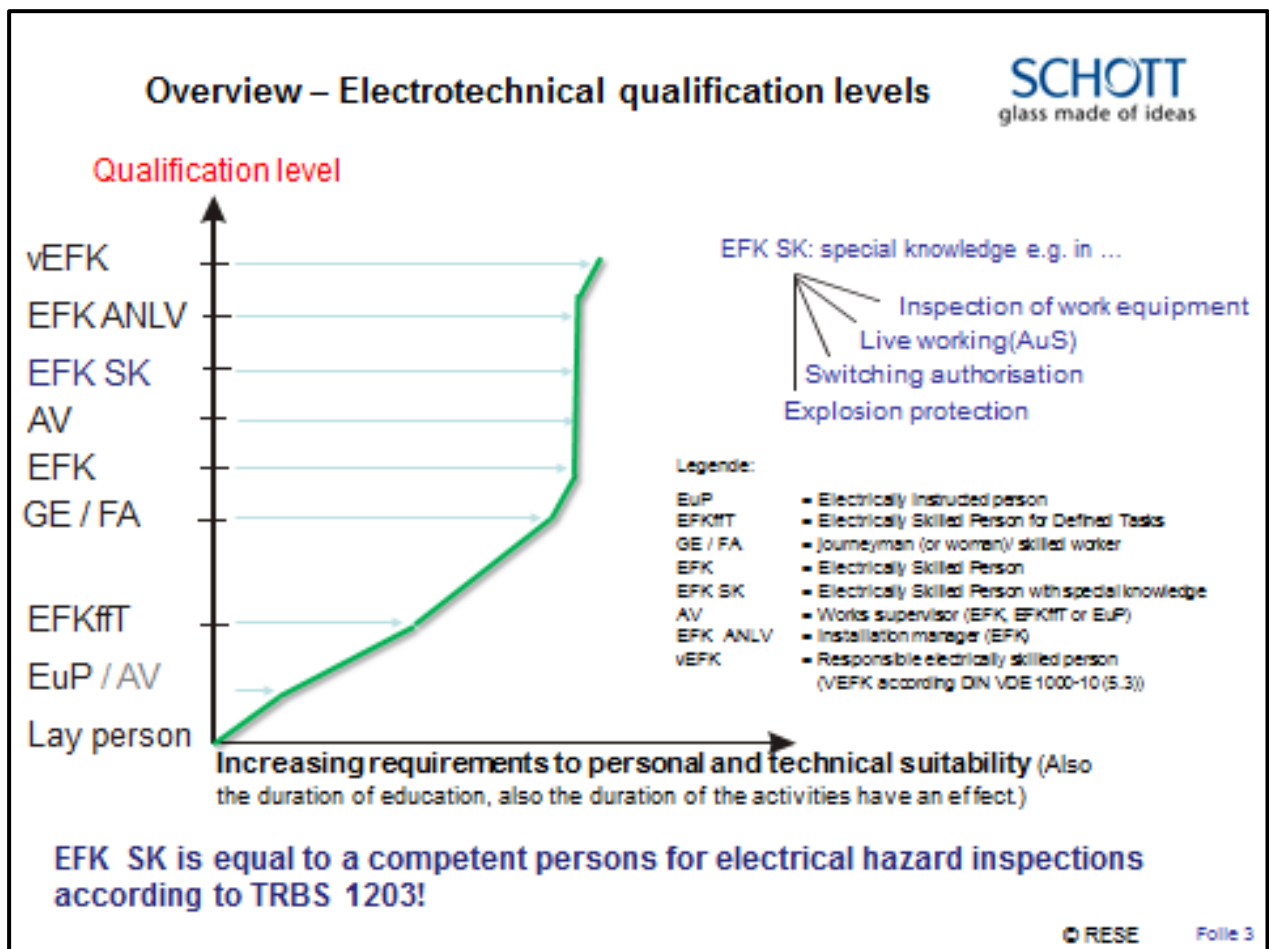
The above provisions and regulations take into account the applicable state of the art. Principles applicable in the absence of electrical rules are laid down in "Electrical installations and equipment accident prevention regulation (BGV) A3". If the rules must be deviated from in serious exceptional circumstances, such as to be able to carry out tests, then equivalent substitute measures from a safety perspective must be taken, which must be displayed in the electrical engineering department. Evidence of the effectiveness of the substitute measures must be provided to the "BG" upon request.

All employees, irrespective of their status, must follow the instructions of the control centre staff and the responsible electrician (as stated under paragraph 2) when in proximity to electrical switchgear and distribution systems.

## 2. Legal framework, statutory provisions, terminology

- Occupational Health and Safety Act ("Arbeitsschutzgesetz", ArbSchG)
- VDE 1000-10 "Requirements for persons working in the field of electrical engineering"
- VDE 0105-100 "Operation of electrical installations"
- BGV A1 "Principles of Prevention"
- BGV A3 - "Electrical Installations and Equipment"
- Ordinance on Industrial Safety and Health ("Betriebssicherheitsverordnung", BetrSichV)
- Technical Regulations for Safety in the Workplace TRBS 1203 "Competent Persons"

There are various qualification levels in electrical engineering:



(1) Figure:1 (Overview of electrical engineering qualification levels Source: Mebedo GMBH):

### 2.1 Terms



In accordance with the above occupational health and safety regulations, the following concepts are defined for SCHOTT AG.

### **2.1.1 Electrically Instructed Person (EuP)**

A person instructed and trained by an electrically skilled person on the tasks assigned and the possible hazards, who has received training on the use of the necessary protection equipment and protection measures and who can perceive hazards of working with electricity.

The EuP is appointed by the VEFK or the G-VEFK in accordance with the management system and may only perform the tasks in accordance with their appointment. This person always works under the direction and supervision of their assigned EFK (mentor).

Under the direction and supervision does not mean that this person is always present; they need only ensure at appropriate intervals that the instructions given are being followed and that work is being carried out safely. The EFK is as such responsible for the tasks assigned.

### **2.1.2 Electrically Skilled Person for Defined Tasks (EFKffT)**

A person who, on the basis of their unrestricted specialist training in theory and practice, knowledge and experience and knowledge of the rules to be followed for these tasks, can evaluate the work assigned to them and perceive possible hazards.

The EFKffT is appointed by the VEFK or the G-VEFK in accordance with the management system and may only perform the tasks in accordance with their appointment.

### **2.1.3 Electrically Skilled Person (EFK)**

In accordance with VDE 0105-100 "Operation of electrical installations" and the accident prevention regulation BGV A3 Section 2(3) and the associated performance directive, an electrically skilled person is

- a person who, on the basis of their specialist training, knowledge and experience and
- knowledge of the applicable standards, can evaluate the work assigned to them
- and perceive possible hazards.

A skilled person with training in an electrotechnical profession for the relevant field of activity assigned, who with their knowledge and experience and knowledge on the relevant provisions for the relevant field of activity can evaluate the work assigned and perceive possible hazards. In exceptional cases, technical training can be appraised on the basis of years of professional experience in the field of activity concerned (with the corresponding theoretical and practical evidence).

Full knowledge of the site and of the system is indispensable for safe work. The electrically skilled person is appointed by the responsible electrically skilled person. A checklist is used for evidence of the required qualification level of the EFK.

The EFK is appointed by the VEFK or the G-VEFK in accordance with the management system and may only perform the tasks in accordance with their appointment.

#### **2.1.4 Responsible electrically skilled person (VEFK)**

A highly qualified electrically skilled person, who is assigned by the employer to assume company responsibility in the electrical engineering area and who must therefore make fundamental decisions concerning live working in the company (see VDE 1000-10 in chapter 5.2). The fundamental responsibility for live working at SCHOTT AG is borne by the G-VEFK.

Performance responsibility for live working is borne by the respective responsible electrically skilled persons, who are subordinate to the G-VEFK (VEFK or N-VEFK) or their representative and the relevant persons responsible for instructing and operating.

#### **2.1.5 Installation Operator (ANLB)**

As defined by VDE 0105-100 Section 3.2.2.101, the installation operator is responsible for the safe operation and good conditions of electrical installations. The ANLB is usually the employer himself or a natural or legal person assigned by him.

For extensive or complex installations, the responsibility of the installation operator can also be transferred to sub-installations.

The required qualification of the installation operator is not mentioned. If the installation operator is not an electrically skilled person, he must transfer the obligations and rights under his responsibility by appointing an EFK, i.e. either using an external electrically skilled person or appointing a responsible electrically skilled person within the company as the installation operator.

At SCHOTT AG, the N-VEFK have also been assigned with the obligations and rights of the ANLB for their area of responsibility in writing.

#### **2.1.6 Installation Manager (ANLV)**

An EFK assigned and authorised to issue instructions, who holds direct responsibility for the safe operation of an assigned electrical installation or sub-installations while work is being carried out on this installation.

The technical knowledge and experience including certain relevant provisions for the allocated electrical appliance, and the relevant operating conditions or work processes qualify this EFK to appraise the greatest possible working and installation safety for the intended works at all times.

ANLV must be informed about live working before and after such works. He must provide information on the specific conditions of his installation and guarantee the agreed installation condition for the duration of live working.

ANLV must be familiar with the principles of live working, especially the characteristics of relevant hazards of the live work to be carried out. The ANLV gives the work supervisors the approval for live working following careful inspection of all safety-relevant aspects. Such approval does not constitute the start of live work. This decision remains with the relevant works supervisor for the tasks to be carried out.

### **2.1.7 Works Supervisor (AV)**

A named electrically skilled person or in exceptional cases a named electrically instructed person, who bears direct responsibility for carrying out a certain task. In particular, this also concerns all required safety-relevant specifications and tasks for live working.

The live working works supervisor must have proven special training and skills on the principles and for the performance of live work and receive regular safety training.

When appointing other persons authorised for live working, he must be familiar with their competence. The named live working AV retains sole responsibility for the work. Prior to starting live work, AV must take into account the site and environmental conditions at the work site. If safe live working cannot be guaranteed or is not foreseeable, the work may not be commenced. If the conditions change during the work, then this must be suspended immediately and the work site or live parts secured.

The AV is the person responsible for the performance of the work.

The second person specified in some work instructions (EFK or EuP) is responsible for occupational safety. They may assist in a supervisory capacity, but not be affected in their supervisory function. They are only present in a supervisory capacity to monitor occupational health and safety at the place of work itself.

### **2.1.8 Authorising EFK for live working (ANWB)**

Specified authority of a named EFK to authorise live working or to work live himself. This authorised EFK must be familiar with the principles of live working and the competence of the EFK authorised to carry out the works. For SCHOTT AG, certain employees with the relevant electrical engineering qualifications in the various company divisions have been named in writing.

### **2.1.9 Authorised person for live working (AUSFB)**

Authorised persons are specially qualified EFK who are qualified and designated to undertake live working. The responsible electrically skilled persons can view a list of authorised EFK at SCHOTT AG in the file "List of authorised skilled persons for live working". The authorisation for live working is provided in the written appointment as electrically skilled person.

### **2.1.10 First aiders for electrotechnical works and specifically for live working**

EFK or EuP with first aid certification and regular first aid training including heart-lung re-animation HLR (twice a year, see also BGV A1 Part III).

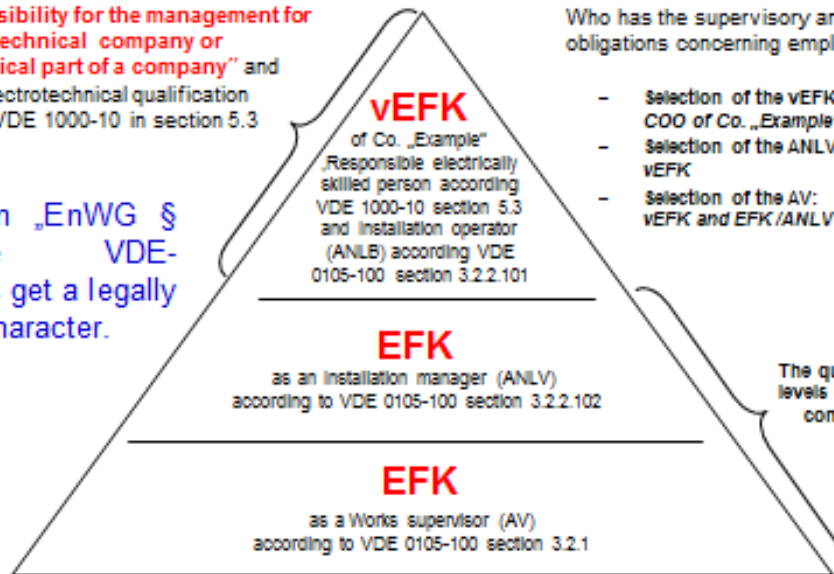
### **2.1.11 Other required organisational structures according to VDE 0105**

# Legally secure organisation of an electrotechnical company

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With responsibility for the management for the „electrotechnical company or electrotechnical part of a company“ and necessary electrotechnical qualification according to VDE 1000-10 in section 5.3

Based on „EnWG § 49“ the VDE-standards get a legally binding character.



Who has the supervisory and controlling obligations concerning employees?

- Selection of the vEFK: COO of Co. „Example“
- Selection of the ANLV: vEFK
- Selection of the AV: vEFK and EFK/ANLV

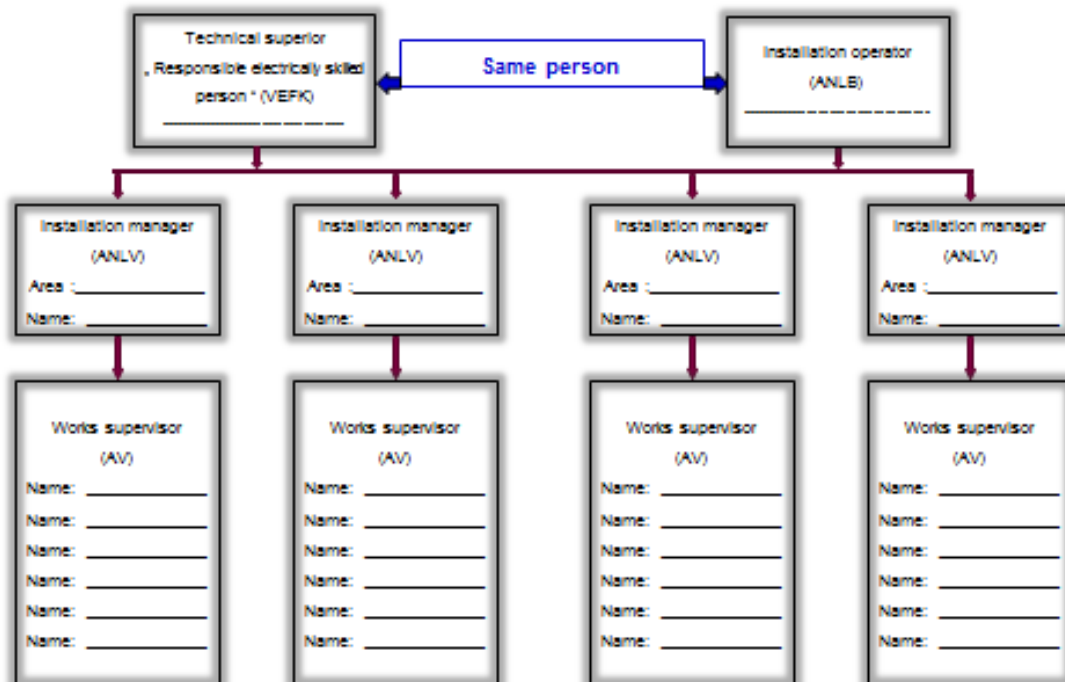
The qualification levels have to be considered!

Legende:  
COO = Managing director; vEFK = Responsible electrically skilled person; EFK = Electrically skilled person;  
ANLB = Installation operator; ANLV = Installation manager; AV = Works supervisor

(2) Figure:2 (Source: Rechtssichere Organisation eines Betriebsbereiches-Elektrotechnik Mebedo GmbH)

## Legally secure electrotechnical organisation

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(3) Figure:3 (Source: Rechtssichere Organisation im Elektro-Bereich Mebedo GmbH)

## **2.2 Competent persons for electrical hazard inspections**

### **2.2.1 Requirements for the competent person**

On the basis of technical knowledge from vocational training, professional experience and current professional activity, there must be a reliable understanding of safety concerns so that inspections can be properly carried out. Depending on the complexity of the inspection (scope, type, use of certain measurement instruments), the required technical knowledge may vary.

### **2.2.2 Vocational training**

Professional experience assumes that the competent person has spent a proven part of their career working with work equipment equivalent to that to be inspected and is sufficiently familiar with its function and operation. As such, they have known many occasions that trigger inspections, such as following the risk assessment or from day-to-day monitoring. By participating in the inspection of work equipment, this person has gained experience in carrying out the inspection in question or similar inspections and has acquired the required knowledge in dealing with inspection equipment and with regard to analysing inspection results.

Professional experience includes being able to assess whether a suggested inspection procedure is suitable for the equipment inspection to be carried out. This also means that the risks from the inspection and the work equipment to be inspected can be recognised.

In addition, the competent person must have completed electrotechnical vocational training (electronics technicians in the energy and building technology field, automation technology or information and communications technology, electronic systems technicians, information technology technicians, specialising in office systems or equipment and systems engineering, electronics technicians for machinery and drive technology and similar industrial training) for the inspection for the protection from electrical hazards, or have a degree in electrical engineering or another equivalent electrotechnical qualification for the inspection task intended.

### **2.2.3 Current professional activity**

Current professional activity comprises activity within the environment of the intended inspection of the object of the inspection as well as appropriate further training.

Current professional activity also includes carrying out several inspections per year (practical inspection experience).

In the event of a long break in the inspection activity, inspection experience must be reacquired by participating in inspections by third parties and the required technical knowledge must be updated.

The competent person must have knowledge of the state of the art with regard to the work equipment to be inspected and the risks to be considered, and must keep this up to date.

### **Special requirements for "electrical hazards"**

They must be sufficiently familiar with the following provisions, requirements and regulations so that they can assess the safe condition of the work equipment:

- Statutory occupational health and safety provisions (e.g. ArbSchG, BetrSichV),
- Product requirements (e.g. ProdSG, applicable ProdSV),
- Regulations of the accident insurance institution and other regulations (Technical Rules, BG rules, DIN standards etc.)

The competent person for inspecting for protection from electrical hazards must update their knowledge in the electrical engineering field, such as by participating in training courses or in relevant exchange of experience. At the Schott sites, the competent persons for electrical hazards are selected by the VEFK with the assistance of the G-VEFK using a checklist and appointed in writing with the latest appointment form. If external competent persons to inspect work equipment or electrical hazards are used, the client shall request certification of the required competence pursuant to Section 2.7 of the Ordinance on Industrial Safety and Health, as substantiated by the Technical Regulations for Safety in the Workplace - TRBS 1203, of the person being employed, including proof of further training issued no earlier than 3 years before, from the contractor.

A person without certification may not be employed.

The responsible electrically skilled persons of the individual legal entities as well as the G-VEFK are required to monitor compliance with these specifications by way of random checks.

## **2.2.4 Professional experience**

In relation to their professional experience, the competent person to inspect for protection from electrical hazards must have at least one year of experience in the erection, assembly or maintenance of electrical work equipment and/or installations. Persons with the above electrotechnical training have the required professional experience for competent persons to inspect for protection from electrical hazards in the relevant field of activity.

### 3. Organisation and responsibilities

The following stipulations are made for SCHOTT AG on the basis of the regulations listed under paragraph 2.

#### 3.1 Chief responsible electrically skilled person

In order to establish an efficient organisation in the area of electrical safety at SCHOTT AG, each site in Germany and all legal entities will have at least one chief responsible electrically skilled person (G-VEFK) appointed by the STOM and the Managing Director of the legal entities. The scope of appointment basically comprises all the electrotechnical installations present at the relevant SCHOTT site. For external tenants, the responsibility shall end at the transfer point agreed under contract.

For each legal entity, a responsible electrically skilled person (VEFK) will also be appointed, who is selected and appointed in coordination with the G-VEFK and who shall be subject to their instructions in the area of electrical safety.

The chief responsible electrically skilled person and the responsible electrically skilled persons appointed at the relevant Schott sites by him and the Managing Directors of the legal entities shall be appointed according to the checklist and with the appointment form.

**The organisational responsibility, including staff responsibility of the Managing Directors of the legal entities, remains unaffected.**

The tasks of the chief responsible electrically skilled person include

- Ensuring a legally secure organisation and clear responsibilities at each site in consideration of and in compliance with the applicable standards, ordinances and legislation
- The organisation of briefings, training courses for electrically skilled persons and electrically instructed persons,
- Briefing all VEFK on the current modifications and addenda to applicable standards
- Organising the inspection of electrical devices and installations according to VDE 0701-0702, VDE 0100-600 / VDE 0105-100 and VDE 0113-1 including its analysis
- Establishing and maintaining a full inspection concept in the electrical engineering area
- Close collaboration with the occupational health and safety department
- Maintaining the current status with regard to the provisions of the institution for statutory accident insurance and generally recognised good engineering practice (VDE), as well as the Ordinance on Industrial Safety and Health including the substantiating Technical Regulations for Safety in the Workplace (TRBS).

### **3.2 Responsible electrically skilled person**

The site managers and Managing Directors of the legal entities, together with the chief responsible electrically skilled person (G-vEFK), are required to appoint a responsible electrically skilled person for the relevant company in writing. These responsible electrically skilled persons are subject to the technical instructions of the chief responsible electrically skilled person.

The tasks of the responsible electrically skilled persons include:

- Appointing other subordinated responsible electrically skilled persons for individual installations or areas of responsibility
- Implementing the principle of "safe working" according to the provisions of the institution for statutory accident insurance and generally recognised good engineering practice (VDE)
- Ensuring electrical safety in the relevant areas of responsibility (defined in the appointment form)
- Guaranteeing the safe condition of all electrical installations and the electrical equipment
- Organising the briefing and monitoring of all external enterprises working on electrical installations
- Assisting in the planning, construction supervision and commissioning of electro-technical machines, installations and equipment
- Theoretical and practical briefing on the specific work tasks and authorities for electrically instructed persons including the required guidance and supervision.
- Guidance and supervision of electrically skilled persons in the assigned scope of appointment
- Maintaining the current status with regard to the provisions of the institution for statutory accident insurance and generally recognised good engineering practice (VDE), as well as the Ordinance on Industrial Safety and Health including the substantiating Technical Regulations for Safety in the Workplace (TRBS).

### **3.3 Other rights of the responsible electrically skilled persons**

The responsible electrically skilled persons are guaranteed the possibility and the budget for further technical training and external consultancy if required. They are also provided with access to the current VDE guidelines and regulations.

## **4. Important provisions for personal safety**



## 4.1 Protection against contact

For the purposes of safety in the construction and operation of electrical installations, standards are based on the principle of double safety. It is therefore not sufficient to protect the live parts of electrical installations by insulating them **against direct contact**, but additional measures such as protective earthing or insulating housing, must be taken to ensure that no dangerous electric shocks can occur even in the event of a fault, e.g. insulation fault. This is known as protection from **indirect contact**.

## 4.2 Closed electrical operating areas

At SCHOTT AG, there are substantial electrical energy installations with different voltage levels.

These installations are primarily administered as "**closed electrical operating areas**". They are identified accordingly and are in principle kept locked. Access, including to open installations, is only permitted to unauthorised persons accompanied by electrically skilled persons or following instruction.

This point takes into account the requirement of DIN VDE 0105-100.

### 4.2.1 Entering and working in electrical operating areas

#### 1. Basis

- a. Definition of electrical operating area and access according to DIN VDE 0105-100

##### **Closed electrical operating area**

A room or a place which is only intended for the operation of electrical installations and which is kept locked. Electrically skilled persons and electrically instructed persons have access, but laypeople may only have access when accompanied by electrically skilled persons or electrically instructed persons.

**NOTE:** This includes, for example, closed switchgear and distribution installations, transformer cells, switch panels, distribution installations in sheet metal casings or in other closed installations, tower stations".

- b. BGV A1 on Hazardous Tasks

##### **Section 8**

##### **Hazardous Tasks**

(1) If a hazardous task is performed by several persons jointly and requires communication between said persons in order to prevent any hazard, the employer shall ensure that a reliable person who is familiar with the task supervises the work.

(2) If a hazardous task is performed by one person on their own, the employer shall ensure suitable technical or organisational personal protection measures are in place, in addition to the general protection measures.

### **Specification:**

Tasks which are not classed as hazardous tasks (e.g. control processes) may be carried alone out under the following condition:

- During normal working hours:
  1. Internal log out in the department
  2. Log in on site in the measuring station
- Outside normal working hours:
  1. Log in at the security centre
  2. Wear a personal emergency calling device"

Tasks which are classed as hazardous tasks (e.g. tasks in the vicinity of live parts according to DIN VDE 0105) may only be carried out in the presence of a second person.

## **4.2.2 Locking system for closed electrical operating areas**

Access authorisation to closed electrical operating areas is controlled with the locking system and the issue of a key.

In this way, the following requirement from the above legislation is fulfilled.

- Access to the hazardous area of the electrical installation is only permitted for electrically skilled persons and electrically instructed persons who, on the basis of their vocational training, knowledge and experience, can recognise the occurrence of electrical hazards and take the required occupational health and safety measures. Other persons may only enter the hazardous area when accompanied by the above persons.

Unauthorised access to the key to the electrical locking must be prevented.

## **4.2.3 Electrical locking hierarchies**

At SCHOTT AG, a relevant electrical locking hierarchy structure guarantees that only persons with the suitable instructions and training have access to areas with increased electrical hazards.

## **4.2.4 Authority to receive and issue the keys for closed electrical operating areas**

Electrically skilled persons, electrically skilled Person for defined tasks and electrically instructed persons who need to frequently enter closed electrical operating areas will receive a personal key. Keys are in the form of a sequential number and are assigned as such to a single person. The key issue is documented in an "electrical locking key list".

Electric keys are issued as follows

1. according to the qualification of the employee and
2. their work task.

Keys for closed electrical operating areas are issued to competent persons under the following conditions:

- The named responsible electrically skilled person at the site decides on the issue of the electric key. This person will define the group of people allowed to handle electric keys.
- A briefing then takes place, which must be confirmed by signing the form provided.

#### **4.2.5 Issuing keys to closed electrical operating areas to laypeople**

The following regulation does not correspond to the recommendations of DIN VDE 105-100.

Laypeople may receive a personal key to electrical operating areas on the basis of their capacity (e.g. board member, BU manager, tank manager, managing director, officer of the company). These persons are only allowed entrance to electrical operating areas when accompanied by electrically skilled persons or electrically instructed persons assigned to that area. The key may not be transferred to third parties. The reason behind this regulation is for safety of persons who cannot sufficiently recognise electrical hazards and cannot take the required occupational health and safety measures.

Before issuing the electric key, the key recipient will confirm they have been briefed by signing the form.

#### **4.2.6 Returning keys to closed electrical operating areas**

If the electric key is not longer needed due to a change in work task or for another reason, this must be returned immediately. Electric keys are returned according to the plant safety specifications (key issue).

#### **4.2.7 Storing electrical locking keys in the guard office**

Keys are kept in the guard office for short-term works in electrical operating areas.

Unauthorised access to the key to the electrical locking must be prevented.

In permanently manned guard offices, this is ensured by way of an uninterrupted supervisory and control requirement.

If an uninterrupted supervisory and control requirement is not provided, the electrical locking keys must be stored in an inaccessible manner.

#### **4.2.8 Issuing keys to closed electrical operating areas in the guard office**

- Keys for closed electrical operating areas are only issued from the guard office to competent persons who are designated by the relevant electrical engineering department by name in the electrical locking key list.
- Before being issued, a briefing then takes place, which must be confirmed by signing the form provided.
- The key must be returned to the guard office once works are completed or at the end of the working day on the same day.

#### **4.2.9 Access to closed electrical operating areas in the event of fire**

In the event of an accident or a fire in a closed electrical operating area, the competent electrically skilled person or his representative must be called in.

If none of the competent electrically skilled persons or their representatives can be reached, the chief electrician from the guard office can be received by the fire office in charge following a briefing, which must be confirmed by signing the form provided.

Access shall only be allowed in the presence of an electrically skilled person.

#### **4.2.10 Terms**

**Closed electrical operating areas** are areas which are used exclusively for the operation of electrical installations.

#### **4.2.11 Contact persons**

Contact persons are named by the relevant VEFK of the site.

#### **4.2.12 Other applicable documentation**

The applicable DIN VDE and TRBS provisions also apply.

### **4.3 Tanks and experiment areas**

When in operation, tanks and parts of the experiment areas are considered closed electrical operating areas. Only electrically skilled persons or electrically instructed persons may then have access for the purposes of measurement and monitoring. For other persons, the circuits must be switched off and secured. The locations of the interfaces vary and are assigned in the tank control room or for crucibles near the melting stations. The operators (melting staff) must be trained accordingly. The functions and safety instructions must be covered in detail the instruction manuals. The trained service staff is familiar with the site and as such will handle the instructions of the five safety rules.

For voltages higher than  $1000V_{AC}$ , the appropriate earthing and short-circuit devices must be used. Work on high current heating circuits  $U_b < 50V$  and  $I \leq 6000 A_{AC}$  shall only be carried out if these are secured and switched off.

For occasional maintenance works on closed electrical operating areas (perforated plate elements, perforated plate doors), so-called traffic light signals (red/green) will be used.

This system will signal in the control room when the area can be safely entered. Green means measured voltages < 50V.

Before commissioning work begins, the tanks are cleared and a search for persons is undertaken in order to ensure that there are no persons located in the hazardous area during switch on without specific instructions.

As such, only temporary access is allowed for expert and trained staff when the tanks are running.

## 4.4 Protection against electric shock

As a measure for protection against electric shock, the following are used at SCHOTT AG:

### Protection against direct contact:

- Insulation and/or integration in metallic, fully enclosed and earthed casing.

or

- Encapsulation with gridded or perforated sheets

They must be designed in such a way that "*test fingers*" cannot come into contact with the bare parts through the grid or perforations in low-voltage installations (IEC test finger pursuant to VDE 0470 part 1).

or

- For voltages pursuant to

TRBS 2131 up to 25 V<sub>AC</sub> and 60 V<sub>DC</sub> (withdrawn in 2010)

or according to VDE 0105-100 up to 50V<sub>AC</sub> and 120V<sub>DC</sub> (currently still valid)

no protection against direct contact is required if there is no additional risk, such as electric arcs when disconnecting high current heating circuits.

### Protection against indirect contact:

- Shutdown by overload or residual current protection device.

The protective earthing must make the overload protection device respond in the event of a fault. The residual current protection device has (e.g. in the laboratories) a rated differential current of 30 mA and is used where there is a risk of contact.

Note: The only purpose of a residual current protection device with 300 mA is for preventive fire protection and is not for any personal protection!

or

- Protective insulation.

Additional insulation, e.g. full plastic housing, prevents the occurrence of contact voltage.

or

- Protective separation.

An isolating transformer provides for a secure electrical separation between the primary and the secondary circuit. Hazardous contact voltage cannot occur.

or

- Use of extra low voltage. Protection is achieved by means of extra low voltage ( $<50 V_{AC}$  and  $<120 V_{DC}$ ) and a secure electrical separation from the primary circuit.

or

- Limitation of the discharge energy to 350 mJ.

## 4.5 Contact protection of transformers and conductor rails

Transformers and conductor rails must be equipped with contact protection. Access restrictions to the tanks and experiment areas are described in section 4.2.

The heating transformers are operated without a door interlock and emergency stop system. The power connections are secured against contact.

The amount of electrical current in the transformers and conductor rails may lead to secondary hazards. The magnetic forces could attract metals (tool) and cause crushing. A short circuit in an electrical circuit could also cause the shorting point to be overloaded. This may result in electric arcs or fires.

## 5. Classification of voltage areas and responsibilities

According to VDE provisions, the voltage areas are classified as follows:

Extra low voltage:	$\leq 50 V_{AC}$	or	$\leq 120 V_{DC}$	DIN VDE 0100 Part 410
Low voltage	$\leq 1000 V_{AC}$	or	$\leq 1500 V_{DC}$	DIN VDE 0100
High voltage:	$> 1000 V_{AC}$	or	$> 1500 V_{DC}$	DIN VDE 0101

High voltage includes both medium voltage up to 60 kV and maximum voltage from 100 kV.

### 5.1 (ELV = Extra Low Voltage)

Protection is achieved by using lower voltages (up to  $50 V_{AC}$  or up to  $120 V_{DC}$ ). The following can be distinguished

- SELV = Safety Extra Low Voltage  
referred to as protective extra low voltage until now.  
SELV current sources must have a secure separation.
- PELV= Protective Extra Low Voltage  
referred to as functional extra low voltage with secure separation until now.  
PELV current sources must have a secure separation.
- FELV= Functional Extra Low Voltage  
referred to as functional extra low voltage without secure separation until now.  
FELV current sources only need to have one basic separation.

Devices with extra low voltage may be manufactured in compliance with the safety requirements for the construction and operation of all groups. It is recommended for the devices to be inspected by the technical department of the relevant site.

## 5.2 Low-voltage installations

At SCHOTT AG, the permanently installed low-voltage installations for buildings and converter supply through to individual plugs for rated voltages single-phase 230 V<sub>AC</sub>, three-phase 400 V<sub>AC</sub> and 690 V<sub>AC</sub> are operated by the technical department. The specialists operate their low-voltage installations independently from a defined interface, usually up to the control cabinet input terminal of the machine or installation. When erecting and making significant modifications to these installations, the relevant technical department must be called in. For safety reasons, modifications may only be undertaken by the relevant technical department by appropriately trained technical staff or authorised specialist enterprises appointed by the relevant technical department. When work is carried out by external electrically skilled persons, a written confirmation certifying that the work and inspection was carried out on the modified part of the installation professionally must be given to the relevant technical department along with inspection protocols, installation plans, circuit diagrams etc. without being requested to do so.

For all new installations and distributions, a clear definition of responsibilities and interfaces and transfer points as well as the corresponding labelling on installations with the associated documentation must be provided.

Main and sub-distribution boards are clearly labelled with the name.

## 5.3 High voltage installations

High voltage installations with rated voltages over 1000 V<sub>AC</sub> are generally the 10/20 kV electric energy installations. They are only planned, procured and operated by the relevant electric energy supply department.

## 5.4 Guidelines for the planning of low voltage installations

Low voltage installations with rated voltages up to 1000 V (effective value) with alternating current up to 500Hz and up to 1500V for direct current must be erected according to DIN VDE 0100. SCHOTT AG operates low voltage systems with rated parameters 230/400 V, 50 Hz. The voltage tolerances for this are 207 V to 253 V for alternating voltage, and 360 to 440 V for three-phase alternating current.

SCHOTT AG operates a TN-S system (see figure 2) or TN-C-S system (see figure 3) as a protection measure against electric shocks. For new projects, the TN-S must be used in principle.

**In the TN-S system, neutral conductors (N) and the protective conductor (PE) are separate. The protective conductor does not carry operating currents. For this reason, single-phase systems require 3 lines and three-phase systems 5 lines. After separating PE and N, these may no longer be connected to each other.**

Older electrical systems are designed as TN-C-S systems. Here, neutral conductors and the protective conductors are partially led together as PEN from the transformer to the main distributor.

The insulated protective conductor (PE) or the insulated neutral conductor (N) with a protective conductor function (PEN) must be marked in green-yellow over its entire length. For other conductors, the green-yellow colour marking is not permitted.

**In the TN-C-S system, the neutral conductors (N) and the protective conductors (PE) are kept separate from the PEN bridge. The protective conductor does not carry operating currents. For this reason, single-phase systems require 3 lines and three-phase systems 5 lines. After separating PE and N, these may no longer be connected to each other.**

Components in electrical installations must be designed according to their rated parameters, including if lower values can be set using regulating and protective devices.

It must also be ensured that supply lines for electrical devices are selected according to the local mechanical stresses and with a conductor cross section assigned to the nominal current of the protective element (fuse, circuit breaker).

A distance of one meter along the entire width must be kept free and marked as an operating platform before (power) distribution units in consideration of the safety of operating staff and emergency access. Access to machines, switchgear and distributors must also be kept free. This must be taken into account in the building design and when setting up installations and machines.

New (power) distribution units may no longer be erected in escape and rescue routes (floors).



## **5.5 Guidelines for the planning of high voltage installations**

All power installations with alternating voltages above 1 kV or direct voltages over 1.5 kW must in principle be erected according to VDE 0101. They must be entirely protected against direct contact or be housed in "closed electrical operating areas". Cables and lines outside closed and monitored installations must have an earthed shield if they are operated with alternating voltage  $> 1.2$  kV or with direct voltages  $> 1.8$  kW.

## 6. Switching authorisation

The term switching authorisation is defined in the VDE publications, volume 79 "Switch authorisation for electrically skilled persons". As defined therein, a switching authorisation is "the authority to undertake switching operations in a defined area under one's own responsibility or on instruction [...]." It is always required if a safe state is to be achieved by switching on or off in more complex or interlinked installations, as required when working on installations for example. This may be a power supply installation or a high frequency installation.

Persons with switching authorisation must have the personal and technical qualification to safely carry out these works. They must evaluate the works and be able to recognise possible hazards. The technical qualification of a person with switching authorisation therefore includes the qualification as an electrically skilled person in combination with additional knowledge specific to the installation, location or system and fire fighting and first aid skills. For their own safety and for the purposes of smooth operation, the persons with switching authorisation at SCHOTT AG are trained every year. The operating procedures are defined in an instruction. Every person with switching authorisation must know their area of competence and responsibility. Switching authorisation is granted in writing.

The relevant technical department has set out the switching authorisation in detail in the work instruction *"Switching operations in medium voltage systems up to 20 kV"* and in the work instruction *"Switching operations in low voltage systems up to 1 kV"*.

## 7. Fire protection for cables and lines

All cables and lines used for open laying must in principle be halogen-free and flame-retardant, for all subterranean and tunnel areas, this is mandatory. They must comply with the applicable provisions and specifications of SCHOTT AG. The requirements of "MLAR 2005" must also be considered.

## 8. Operation of low voltage installations and devices

Electrical risks must be assessed before each operation process and before any work on an electrical installation is undertaken. This assessment will define how the operation process or the work must be carried out and which safety measures and precautions must be applied in order to guarantee safety (see DIN VDE 0105-100).

### 8.1 Switching operations

There are two basic types of switching operation:

1. Switching operations to modify the electrical state of an installation, to use equipment, switch on or off, start and shutdown equipment with facilities, the proper use of which is safe and may be undertaken by any user ("operate"). These tasks will not be examined in more detail in this chapter of the SCHOTT AG electrotechnical rules;
2. Switching installations off or switching installations back on in conjunction with carrying out works on the installations. For these works, prior consideration must be made as to the effects of the switching operation and the safety measures to be taken. Switching authorisation is required

Switching operations may be undertaken on site or by remote control.

Switching operations pursuant to paragraph 2 on low voltage distribution units used for buildings or general power supply, may in principle only be undertaken by employees of the relevant technical department. The 24 hour service employees must be informed outside normal working hours.

Electrical (power) distribution units which are exclusively assigned to certain users may be switched by the subordinate group responsible for the installation. A switching authorisation is also required for these works in accordance with paragraph 2.

Only the proper fuses may be used.

### 8.2 Emergency stop switches

Marked EMERGENCY STOP switches may be pressed by anyone *in an emergency*.

In principle, it must be assumed at SCHOTT AG that when pressing an emergency stop switch in the operating areas, production installations and tanks, the lighting and electrical plugs will remain in operation.

After pressing an emergency stop switch, the relevant person responsible for the installation must be informed. For the tanks and experiment areas, the control room or the relevant person responsible must be informed.

### **8.3 Safety requirements for electrical devices**

The electrical devices used at SCHOTT AG must comply with VDE provisions, the Equipment and Product Safety Act and the Machinery Directive or the international provisions with at least the same safety requirements. They must be suitable for 50Hz operation and for the voltage ranges mentioned under paragraph 5. Electrical devices manufactured internally must also comply with these provisions.

### **8.4 Plug connections**

Electrical devices are connected to the power supply grid either via fixed connection or plug and socket devices.

The standard plug and socket device at SCHOTT AG is:

- for single-phase alternating current 230 V; 16 A:
  - a) Schuko plug and socket device according to DIN 49440 and 49441
  - b) Shrouded plug and socket device according to CEE standard, DIN 49465
- for three-phase alternating current 400 V; 16 A, 32 A and 63 A:  
Three-phase AC shrouded plug and socket devices according to CEE standard, DIN 49462 and DIN 49463.

### **8.5 Examination of electrical devices and equipment**

According to BetrSichV, BGV A3 Section 5 (tests) and VDE 0105-100 paragraph 5.3.101, electrical installations and equipment must regularly be checked for proper condition. The intervals must be selected on the basis of a risk analysis such that defects which are to be anticipated are detected in good time. A differentiation is generally made between stationary and mobile electrical equipment.

#### **8.5.1 Mobile electrical equipment**

Mobile electrical equipment is equipment which is moved during operation or which can be moved easily from one location to another whilst connected to the supply circuit. According to DIN VDE 0100-200, the limit for such equipment is set at 18 kg.

### **8.5.2 Stationary electrical equipment**

Stationary electrical equipment is electrical equipment of fixed installation, or equipment without facility for carrying and of mass so great that it cannot easily be moved. This includes electrical equipment that is installed temporarily in a fixed arrangement and powered over flexible cables. Electronics cabinets (Switchgear assemblies) with integrated and connected devices are stationary equipment. If a device is removed or, for example, used or repaired elsewhere, it must be treated as a mobile device.

### **8.5.3 Inspection intervals**

Stationary electrical installations and electrical equipment operating under normal operating and ambient conditions and which are continually monitored and maintained by electrically skilled persons must be inspected by an electrically skilled person for proper condition (e.g. by means of visual checks or thermography) (BGVA3 Section 5(1)(2)) every 4 years. Continuous supervision by an electrically skilled person must be verified by the superior persons responsible.

The scope of the inspection comprises (extract from VDE 0105-100 paragraph 5.3.101):

- Inspection, including the protection against direct contact and fire protection
- Measurement of insulation resistance
- Measurement of conductivity of protective conductor
- Inspection of protection in the case of indirect contact
- Functional test of residual current protection devices and insulation monitoring devices
- Functional test of emergency stop systems
- Functional test of safety light curtains
- Functional test of locking mechanisms

Mobile electrical devices and equipment must be inspected at certain intervals for the effectiveness of the protection measures against electrical hazards. The inspections may only be carried out by electrically skilled persons with a certificate of competence to carry out inspections in accordance with Section 10 BetrSichV or specialist enterprises with the same competence. The coordination of all electrotechnical inspections shall only be done by the electrical engineering department of the relevant site.

All electrotechnical inspections at SCHOTT AG shall in principle be documented in an inspection log. The software package "ELECTROmanager" is used as an inspection log.

**The following references apply for the inspection intervals:**

	Device / installation	Inspection interval	Person responsible
Mobile	Devices in offices, control rooms, electronics rooms:	24 months	Cost centre manager of the operator group
	Devices in workshops, experiment halls:	12 months	
	Devices in rooms and workshops, in which they are exposed to special mechanical, chemical or corrosive influences.	6 months	

The risk assessment will decide which inspection intervals are considered sufficient. The values stated for the inspection interval of mobile equipment are indications. Irrespective of these fixed intervals, visibly defective devices must immediately be repaired or withdrawn.

#### **Users must check:**

Installation	Inspection interval	Person responsible
Permanently installed RCDs (FI) for perfect function by pressing the test device (button)	every 6 months	Installation manager or cost centre manager of the operator group
Mobile residual current circuit breakers for perfect function by pressing the test device (button)	Daily	User

## 8.6 Operation of low voltage installations and devices

High voltage installations and devices must be able to be activated with appropriate insulated sections, earthed and shorted. Low-power high-voltage supplies are an exception to this if the following conditions are fulfilled:

- Short-circuit current less than 3 mA<sub>AC</sub> or 12 mA<sub>DC</sub>
- Discharging energy, which is not more than 350 mJ.

High voltage installations and devices must also be protected against being unintentionally switched on. These must be marked using standardised warning signs (see also "Isolating and securing - the five safety rules").

## 8.7 Medium-voltage systems

Three-phase medium voltage installations are erected by the relevant electrical engineering department via specialist enterprises and are operated by the relevant electrical engineering department. Switching operations on these installations may only be undertaken by persons with switching authorisation.

The relevant electrical engineering department has set out the switching authorisation in the work instruction *"Switching operations in the medium voltage grid up to 20 kV"* in detail (see also paragraph 6 switching authorisation).

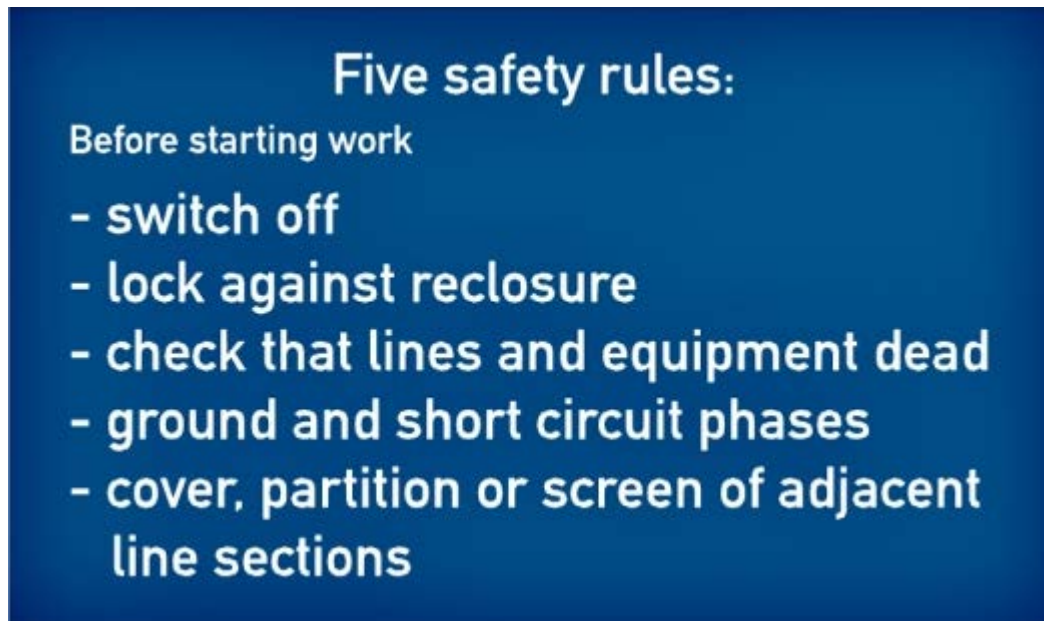
## 8.8 Working on electrical installations

Works on electrical installations include repairs, modifications and inspections. Works must be carried out professionally. They must be carried out by an electrically skilled person or under the guidance and supervision of an electrically skilled person. The electrically skilled person must know the possible risks inherent to the works assigned to him.

**WORKS ON ELECTRICAL  
INSTALLATIONS MUST IN PRINCIPLE  
ALWAYS BE CARRIED OUT WHEN THE  
INSTALLATION IS DE-ENERGIZED.**

**Isolating and securing - the five safety rules**

Before commencing works on live parts of electrical installations and equipment, these must be de-energized and secured for the duration of the works. The five safety rules must **ALWAYS** be followed.



Until the protection measures are fully executed and after their reversal, electrical installations shall be considered switched on.

Shutdowns must be arranged by the installation manager with the work supervisor according to VDE 0105-100 and the persons affected by the shutdown in good time beforehand. Before reconnecting, the work supervisor must declare the works complete and the worksite cleared. The work supervisor according to VDE 0105-100 must make sure that no more works are to be carried out on the installations. Only then may he begin with reversing protection measures and reconnect.

Switching agreements which only concern the agreement of a certain point in time are not permitted. In order to avoid misunderstandings, when notifying by telephone that the system is not live or that the system is ready to be switched on, the notifications must be repeated. In doing so, the name of the person notifying and the precise designation of the installation and location must be stated. The designations must be clear in order to avoid confusion.

Switching operations and clearance for work are usually processed verbally between the parties involved. SCHOTT AG uses clearance certificates for switching operations on high voltage installations and for the approval of works to third parties. External enterprises receive a work permit for works on high voltage installations.

Earthing and short circuiting may be omitted for installations with a rated voltage under 1000V. On the other hand, for large installations and unusual operating conditions, it is recommended that the worksite is secured by earthing and short circuiting in order to protect against the displacement of voltages. Voltages can be displaced if there are insulation fields or if voltages are inductively or capacitively coupled.



For example, the non-insulated conductor rails must be earthed together. In the commissioning phases of the transformer, measurements could be taken on part sections of an open rail system and the measurement voltage displaced. For this reason, additional earthing of free cable ends both at the place of measurement and the place of work is prescribed.

**For generally accessible distribution units, only shutting off and removing fuses to secure against reconnection is not sufficient.**

In addition, a prohibition sign

- must be applied in all cases



- It must be noted that only the persons entered under "name" may reverse these switching measures.

If possible, the operating handle must be locked with a padlock.



Many of the power supply units used at SCHOTT AG are supplied from different voltage sources, e.g.: Main circuit 3 x 690 V<sub>AC</sub>, 50 Hz, auxiliary circuit 3 x 400 V<sub>AC</sub>, 50 Hz, control system 60 V<sub>DC</sub>, feedback control system 24 V<sub>DC</sub>.

When working on such devices, the alternating voltages for the auxiliary plants mostly supplied via plugs must also be activated or covered and any remote control capacity must be deactivated.

## 8.9 Work in the vicinity of electrical installations

Work may be performed in the vicinity of live parts of electrical installations which are not protected against direct contact only if

- they have been disconnected from the power supply for the duration of the work
- or
- have been protected for the duration of the work by covering or fencing
- or
- the permissible approach distance is not violated.

<b>Voltage level</b>	<b>1. Minimum distance for</b> 1. electrically skilled persons 2. Electrically instructed persons (EUP) 3. Laypeople, under continuous supervision	<b>Minimum distance for other works without continuous supervision</b> Double distance
up to 1000 V	0.5 m	1 m
over 1 kV to 30 kV	1.5 m	3 m
over 30 kV to 110 kV	2 m	3 m

**The protection areas must be reliably marked for the duration of the works.**

## **8.10 Works on live low-power installations**

Works may only be carried out on live parts of electrical installations that have been protected against direct contact if the risk of electric shock or arcing is excluded by the type of installation. This is the case if the short circuit current at the worksite is

- no more than 3 mA<sub>eff</sub> for alternating current
- or 12 mA for direct current,
- the stored energy at the worksite remains under 350 mJ
- and potential bridging is prevented.

## 9. Live working

### 9.1 Other applicable documentation

The principal regulations in this area are:

Guidelines and regulations	Abbreviation
Occupational Health and Safety Act	ArbSchG
Accident prevention regulation "Principles of Prevention"	BGV A1
Accident prevention regulation "Electrical installations and equipment"	BGV A3
VDE regulation "Operation of electrical installations"	VDE 0105-100
VDE regulation "Requirements for persons working in the field of electrical engineering"	VDE 1000-10
Institution for statutory accident insur- ance regulation "Live working"	BGR A3
Institution for statutory accident insur- ance information "Safety by means of operating instruc- tions"	BGI 578
Ordinance on safety and health protec- tion when using personal protective equipment at work (PPE Ordinance)	PSA-BV
PPE selection against the thermal ef- fects of electric arcs	BGI/GUV-I 5188

The current versions as amended of the above documents apply. The special provisions on the individual protection equipment in the following chapters also apply.

### 9.2 Scope of application

The procedures described in the SCHOTT AG electrotechnical rules for live working apply for works in feed-in, switching and distribution installations, measurement, monitoring, regulating and signalling technologies and machining and processing machines and appliances. By applying these specifications and the use of protection and auxiliary equipment, these works can be safely carried out on live installations and equipment.

Live working means work of any kind in which a person may come into contact with live uninsulated parts of an installation or equipment, with parts of the body or with tools or objects or violate the danger zone.

Working near live parts also constitutes live working if there is a risk of direct contact by moving and handling of and with conductive non-insulated materials and tools and from bulky objects from uncontrolled movements. This also includes not respecting minimum distances. With live working, it must be noted that there is not only a risk of direct contact with live parts, but also a risk of an arc fault.

As a result, there are primarily two protection objectives for these hazardous works:

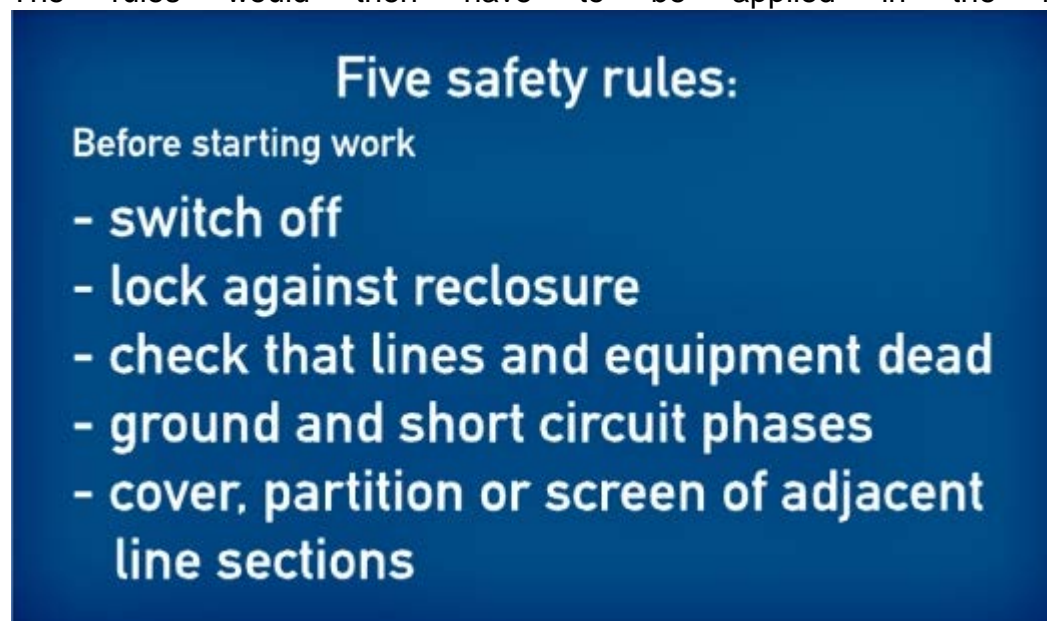
- **Protection of the person working against electric shock and**
- **Protection of the person working from electric arcs and persons involved, e.g. security person**

It is often more difficult to protect persons from arcing than against electric shock in low-voltage areas (rated voltage  $\leq 1,000$  V AC and  $\leq 1,500$  V DC). This is why the choice of personal protection equipment, insulated tools and aids must be made very carefully.

The overriding principle for all work on electrical installations and equipment in accordance with ArbSchG Section 4 and BGV A3 Section 6 must remain unchanged for all works. For this reason, the following question must always be asked:

Is live working possible with the implementation of the five safety rules?

The rules would then have to be applied in the following order:



**Five safety rules:**

**Before starting work**

- **switch off**
- **lock against reclosure**
- **check that lines and equipment dead**
- **ground and short circuit phases**
- **cover, partition or screen of adjacent line sections**

Live working with specially trained staff and the appropriate protection and tools is only permitted if an inspection of all technical and organisational measures has shown that working in a de-energised condition is not possible, if a shutdown would result in significant financial loss to the company or if there are grounds to fear a risk to the life and health of persons. In the Accident Prevention Regulation BGV A1 Section 8 and its specific

rules BGR A3, such occasional work on live parts is permitted in compliance with the following measures:

- **Equipment:** special tools and devices
- **Qualification:** staff with special technical qualifications
- **Organisation:** technical, organisational and staff measures

BGR A3 and VDE 0105-100 section 6.3 define live working, which is working on live parts, as a work method with the above mentioned measures.

## **9.3 Fundamentals of live working**

In accordance with BGR A3 and VDE 0105-100 section 6.3, live working is divided into two groups.

### **9.3.1 Group 1 live working:**

Work which may be carried out without any specific training for live working if the possibility of arcing can be excluded and

- both the voltage between the live parts and the voltage between live parts and earth does not exceed 50 V alternating voltage or 120 V direct voltage (SELV or PELV),
- the short circuit current at the worksite is no more than 3 mA alternating current (effective value) or 12 mA direct current,
- the energy is no more than 350 mJ or
- the electrical circuits have been constructed inherently safe according to DIN EN 60079-14 (VDE 0165-1) and DIN EN 61241-14 (VDE 0165-2).

Further live working tasks for which special training in live working is also required are

- Introduction of voltage testers, phase comparators and earthing and short circuiting devices
- Use of insulating rods to knock white frost clear
- Spraying live parts during fire fighting. VDE 0132 (VDE 0132) must be followed here
- Spraying insulators in outdoor installations. The standards from the DIN EN 50186 (VDE 0143) series must be followed here
- Introduction of tools to move easily accessible parts using insulating rods
- Applying insulating plates and enclosures
- Introduction of inspection, measurement and adjusting devices as well as testing works for fault isolation in auxiliary circuits with rated voltages up to 1000 V

- Removal or insertion of fuse inserts not protected against direct contact in consideration of 7.4.1
- Standardised works in electrical testing devices in accordance with DIN EN 50191 (VDE 0104)
- Functional tests on devices and switching operations, commissioning and trials
- Work on live overhead lines up to AC 1000 V / DC 1500 V, if the work is carried out according to VDE 0105-103 (VDE 0105-103) "Additional specifications for trains"

### **9.3.2 Group 2 live working**

All other live working not mentioned fall under group 2 and require specially qualified EFK in accordance with BGR A3 and VDE 0105-100 para. 6.3.

### **9.3.3 Additional remarks**

No works may in principle be carried out on live parts with voltages over 1000 V AC and 1500 V DC.

The institution for statutory accident insurance regulations BGR A3 apply in this area.

For SCHOTT AG, the following compelling reasons are laid down by the chief responsible electrically skilled person (G-VEFK) in accordance with the above rules and regulations:

- **Risk to life and health of persons or**
- **the company incurs significant financial loss.**

The special measures and specifications for these live works and tasks in accordance with the above rules and regulations are described in these electrotechnical rules with binding effect for SCHOTT AG. These do not apply for external enterprises commissioned, unless agreed with the external enterprise by contract.

## **9.4 Risk assessment for live working**

### **9.4.1 Live working risk assessment pursuant to Section 5 of the Occupational Health and Safety Act**

For general live working without specific training and explicitly for other special live working with special training according to VDE 0105-100 section 6.3.2 ff, the risk of electric shock and/or arcing can never be fully be excluded, i.e. free of residual risk.

However, the residual risk under normal circumstances is maintained at a permissible level if the requirements mentioned in the work instructions as concerns the personal protection and auxiliary equipment to be used, the terms and conditions (psychological and physiological and environmental conditions) and compliance with specially defined measures as concerns equipment, qualification and organisation are followed.



The corresponding work instructions will warn of the relevant hazards with this symbol.

In case of higher risk, the PPE and the specially required protection and auxiliary equipment constitute an important part of safe working. External local circumstances, personal circumstances and technical conditions may definitely increase the risk and may lead to the decision that the live working cannot be carried out.

## **9.5 Terms for live working**

Live working entails a higher risk of electric shock and injury from arcing for the authorised person. When carrying out works on electrical installations and also often in the vicinity of unprotected live parts, the boundaries between the risks of "perfusion" and "electric arcs" (burning) are blurred.

A high level of qualifications and responsibility is therefore required from the authorised person who may undertake live working.

The authorising persons must be aware of this responsibility for each relevant case ("compelling reasons pursuant to BGV A3"). In BGV A1, BGR A3 and VDE 0105-100 section 6.3, special organisational and technical measures are required prior to executing such hazardous tasks.

### **9.5.1 Organisational measures**

The division of live works with regard to electrical shock and arcing is made on the basis of a risk assessment pursuant to ArbSchG Section 5. The live working catalogue (see list of live work instructions) and the appended work instructions identify and describe the live work undertaken at SCHOTT AG.

### **9.5.2 Authorising skilled persons**



At SCHOTT AG, the authorising skilled persons (ANWB) for live working are the VEFK and G-VEFK. The VEFK or EFK define in the appointment as EFK to extent to which an EFK is able to undertake live work.

### **9.5.3 Skilled person authorisation**

The ability to carry out simple live work is fulfilled if the instructing and executing persons participating in the works, who can demonstrate basic knowledge of live working for the works carried out without special training in accordance with VDE 0105-100 section 6.3 and who have received sufficient instruction and, if necessary, training.

This group of persons must therefore be particularly sensitised or qualified. Further training for live working shall encompass theoretical and, if necessary, practical training.

The main contents are:

- **Knowledge of the applicable regulations, rules and provisions,**
- **The work procedures,**
- **Proper and professional execution,**
- **The use of insulated tools and aids,**
- **The authority (authorities) to issue instructions and to execute works,**
- **The work instructions,**
- **The hazards of live working and**
- **Measures to avert hazards.**

For all other works, these persons must have acquired the appropriate knowledge and skills in special training pursuant to BGR A3 and VDE 0105-100 section 6.3.2.

These employees shall receive theoretical and practical training especially for other special tasks. The EFK must have good command of this expertise (see training for content). Training on the operating tasks to be carried out subsequently, the application of regulations and all required protection and auxiliary equipment must be conveyed in practical exercises. This training shall be completed with a theoretical and practical final test. If this special training is successfully completed, this will be confirmed in a certificate subject to a prior check of results and comprehension. The employee shall also receive a live working pass, which he must always carry with him in accordance with BGR A3. The relevant N-VEFK is responsible for the sensitisation and special training of live working specialists in coordination with the superior VEFK or G-VEFK.

This knowledge and these skills, and therefore the live working competence, must be examined at regular intervals of one year. The technical skills can be demonstrated by way of practical tasks (e.g. by keeping the completed and returned live working work orders). Knowledge of the applicable provisions must be revised as part of briefings on the appropriate focal issues and documented specifically for each person. Briefings should also sensitise employees to the fact that they must always inform themselves on the conditions specific to the installations prior to commencing work. The ability to carry out live work according to VDE 0105-100 section 6.3 with special training must be updated by way of recurrent training after four years.

The VEFK is responsible for the examination and verification of knowledge and skills. Evidence of briefings and initial and recurrent training shall be documented by the VEFK.

Only specially authorised EFK, who are technically, physically and mentally fit may be designated and used for live working. If these conditions change, the employee shall be required to notify his limitations. With a relevant order or job execution, the authorised person declares that he is able to safely and professionally carry out the hazardous task for the intended work.

Personal and health certification shall be provided by way of an occupational health screening pursuant to the German Employers' Liability Insurance Association principle G25 "Driving, control and monitoring tasks" or G 41 "Working under the risk of falling" in an initial and in a biennial recurrent examination.

Pursuant to Section 22 of the German child labour act, employees under 18 may not be employed for live working; legal protection for expectant and nursing mothers must also be taken into account.

#### **9.5.4 Presence of a second person**

The work supervisor is responsible for executing the work order, and the second persons may have an advisory role, which must not distract from the live work. Simple live works are mostly prescribed for one work supervisor in most work instructions. In view of the knowledge and skills of a specially authorised EFK, no further supervision is required for very small worksites when working on low-voltage installations in accordance with VDE 0105-100 section 6.3.10.



The skilled person shall be warned to make a careful risk assessment with the "lightning symbol" in the work instruction. The warning statements in the work instructions and the visual warnings with the lightning symbol shown on the left must also be taken into account.

The work supervisor may also decide after visiting the the worksite and assessing the hazards whether a second person is required in order to safely carry out the work.



The second person as an additional skilled person must accompany the work supervisor at the worksite at all times and shall wear the same protection equipment as the work supervisor. As a first aider and alternative contributing skilled person, this person must be familiar with any shutdown devices and escape routes, as applicable. This person must be trained in first aid with

HLR.

### **9.6 Organisation of work processes in work instructions**

As of the work preparation, all safety aspects including the electrotechnical issues must be considered, for example

- **The use of work safety devices,**
- **Communication or information of all parties concerned,**
- **Arrangement concerning possible load reduction or**

- **Ensuring the agreed state of the installation.**

These safety aspects must be set down by the ANWB in the work instructions as implementation instructions. For “simple” live work, this must be discussed verbally in the job briefing as a “special note”. The residual risk (probability of occurrence and severity of injury) must be assessed by the live work skilled persons and reduced to a permissible level.

As operational documents, written work instructions describe the work methods and workflow for the relevant live work. Rules of conduct, responsibilities, task assignments and work areas must be mutually agreed by the skilled persons involved depending on the selected work procedure in accordance with the type and scope of the works.

Special duty of care and attention for the work supervisor and the second person when preparing and carrying out the work (live work and switching operations) is indispensable. If the planned execution is influenced or affected by personal and/or physical problems, it must be verified whether the works can be carried out. During the performance of live work, there must be no distractions from calls (e.g. radio, mobile), or conversations with superiors or colleagues.

## 9.7 Technical, organisational and staff measures

**Safe working procedures** are specified in accordance with VDE standards by identifying tools for the work supervisor and the insulation of the live working location.

Isolated working is **distance working**, i.e. where contact with live parts is prevented with insulating protection and auxiliary equipment and/or **working with insulating gloves**, i.e. the worker touches live uninsulated parts and is isolated, with site isolation, from earth potential.

Effective **safety measures with protection equipment and tools** in the event of insulation failures, i.e. two-fault security, must be guaranteed at the worksite with double insulation (live part to human body with insulating gloves and human body to other potential or to earth with insulating covering / site insulation).

**Adjacent live and other conductive parts** must be covered. Only the relevant potential to be worked on (phase, phase conductor, live part) must be accessible. Simultaneous contact (e.g. with tools) of different potentials must be avoided, there is a risk of short circuiting and arcing.

There must be no **unprotected metal objects** (rings, watches, chains, metal-frame glasses, piercings, etc.) directly in the hazard area on the body and there must be no loose (even secured on one side) metal objects in clothing. It is best to remove them and empty pockets for the duration of the works.

It must be ensured that the **location is secure** and that both hands remain free to perform works at all times.

Verification of **environmental conditions for exterior and interior works**: The weather conditions outdoors must be considered. Live working is prohibited in the event of precipitation, dense fog, thunderstorm, strong winds, low temperatures or must be safely interrupted if such weather conditions are imminent. The same applies for foreseeable weather conditions. Additional possible hazards (e.g. noise, humidity, hot steam) must be included in the risk assessment for interior works in workshops, production plants, facilities, and sufficient and good lighting / light conditions must also be ensured. The room and space conditions must permit safe working and unrestricted movement of the tool.

**Unrelated third parties** may not enter the hazard area. The safety distance for electrical shock from contact must be guaranteed by a clearance of  $> 1$  m for rated voltages  $\leq 1000$  V. During handling and work, arcing may still have hazardous effects for persons even at distances beyond these approach zones.

**No live working where there is a risk of fire and explosion** e.g. in gas stations, gas plants, dusty rooms. The relevant compulsory explosion protection documents must be followed in this regard.

## 9.8 Personal protection equipment and tools

In general, special electrician work clothing and the other protection equipment (PPE) for the live work supervisor must be selected by the G-vEFK (possibly in collaboration with the occupational safety officer) according to the risk assessment to be carried out (e.g. voltage levels, short circuit currents and short circuit energies, environmental conditions) on the basis of regulations, standards and manufacturer's certificates. The required PPE shall be provided to the employee.



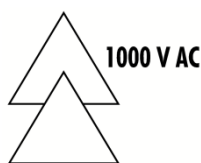
The mandatory use of suitable and permitted protection and auxiliary equipment is indispensable for live working. Comfort may in no event be considered for live working. The equipment, tools and protection and auxiliary equipment are described and the requirements for handling, dealing with and correctly using them are specified in VDE 0680, VDE 0681 and VDE 0682. As part of ongoing updating, the VDE regulations are replaced by "European Standards" (EN ...) or both are designated. For some protection and auxiliary equipment, the DIN shall continue to apply and separate reference must still be made to it.

The following marking currently applies and will continue to apply for class 0 (CL 0) and must be applied to all protection and work equipment for live working:

- Insulator mark (insulator symbol) used until 31.12.1998 and still valid.



- Double triangle (pine tree insulator) used from 01.01.1999.



In accordance with European standards, protection and auxiliary equipment is divided into classes which document the insulation resistance. CL 00 therefore means that the equipment is suitable up to 500 V AC. The CL 0 mark states that it is suitable up to 1000 V AC.

The insulating tools, insulating protective clothing, protection devices, operating equipment and other insulating auxiliary equipment shall be specified in detail by the G-vEFK and procured by the VEFK on their behalf. The relevant operator and user instructions also provided must be followed.

All tools, equipment, protection and auxiliary equipment provided for safe handling during live work or work in the vicinity of live (unprotected) parts must be received in proper condition and may only be used as intended.

In accordance with BGR A3 annex 4, these must be examined by the user (EFK / EuP) for visible defects and perceptible damage and soiling before use. This must preferably be done prior to each use. Damaged and highly soiled parts (cleaning with specified means possible and permitted) must be discarded.

Tools, protection and auxiliary equipment for live working must be kept separate from other tools. They must be stored in dry, well ventilated conditions away from sunlight.

Damage and defects to a general live working tool must be notified by the user to the relevant superior.

### **9.8.1 Electrician work clothing**



Electrician work clothing primarily protects the person working against possible arcing in the event of a short circuit. It must be dry and clean in order to have the highest possible resistance to prevent electric shock. The clothing, which consists of a jacket and trousers, or overalls with no metal parts (buttons, zips, etc.) must be worn closed and tight fitting and as such protects against arcing (e.g. in the event of a short circuit). At SCHOTT AG, electrician work clothing is given out as previously mentioned or can be acquired by the technical departments via the ordering system.

### **9.8.2 Protection against static charges**

In order to prevent electrostatic charges with work clothing, DIN 66 083 requires a cotton content of at least 35%. Work clothing with quality pursuant to EN 1149-1 with the "lightning" symbol identifies homogeneous material (antistatic). For works in electrical installations, homogeneous material must be used to prevent electrostatic charges.

### **9.8.3 Protection against arcing**

In order to protect against heat and flames (arcing), accident prevention regulations require "cotton electrician work clothing", and the explanations to VDE 0105-100 section 4.2 require "cotton material with a high grammage of at least 220 g/m<sup>2</sup> for low-voltage installations up to  $I_N < 63 \text{ A}$ ".

Nowadays, it must be assumed when working on energy supply systems and in large electrical installations that short circuit currents of at least 4 kA can be anticipated. Category 1

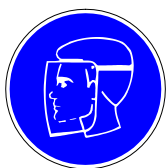
arc-rated protective work clothing pursuant to EN 61482-1-2 (formerly ENV 50354) must therefore be used. Appropriate underclothing must also be worn.

#### 9.8.4 Protective helmet



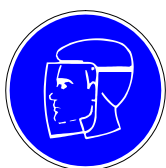
The "440 V AC" marking alone does not satisfy the insulation requirements for live working. The helmet must be manufactured according to EN 397 and/or according to DIN 4840 (which has not been withdrawn) in order to satisfy the requirements for live working.

#### 9.8.5 Visor



The visor (pursuant to EN 166) offers protection against possible arcing with resistance of 7 kA / 30 cm / 0.5 sec. The visor is affixed to the protective helmet. It has insulating properties up to 1000 V and protects against molten splash. The visor can only be used in combination with the protective helmet.

#### 9.8.6 Electricians' protective face shield



Protective electricians' face shields (pursuant to EN 166 in combination with code number CE 0340 of a notified registration office) are permitted for live working (e.g. in the cable distribution cabinet, in junction boxes or when removing and inserting NH fuses).



The shield must be made from 100% cotton material and, like the visor, offers arcing protection of 7 kA / 30 cm / 0.5 sec. It may only be used for works and switching operations in non-hazardous areas in accordance with the manufacturer's instructions. This means that it does not offer any protection against falling parts or collision or contact with live parts.

#### 9.8.7 Insulating gloves

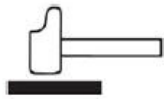


Insulating gloves (pursuant to BGR A3 - VDE 0682-311 / EN 60903 and EN 60984) are made from special natural latex or natural rubber. They are marked with CL 00 (500 V) or CL 0 (1000 V) and a double triangle. CL 00 and CL 0 insulating gloves only offer slight protection against arcing and mechanical damage (e.g. individual wire tips).

Appropriate cotton glove liners must be used to absorb any hand perspiration. These glove liners prevent plastic materials from burning into the skin in the event of a fault (arcing).

For very high mechanical stresses and foreseeable damage from pointy and sharp objects (e.g. wires, sheet metal edges etc.) and in high-energy main circuits, protective gloves made from leather must be worn on top of insulating gloves for additional mechanical protection and protection against any large arcs.

The insulating protective gloves must be stored in a protective cover or in a storage bag to protect them from damaging. These may be cleaned with standard cleaning materials. They must be checked for tightness before use: "inflation" by turning inside out and closing and squeezing.



Insulating protective gloves from special elastomer material (e.g. composite) and special inner lining have proven arcing resistance of 10 kA / 30 cm / 1 sec. These work gloves or switching gloves are symbolised to the user with additional marking with the "hammer symbol".

### **9.8.8 Site insulation with mats**

In accordance with BGR A3, a minimum surface of 1.5 m<sup>2</sup> and a minimum side length of 1 m must be secured as site insulation with mats according to VDE 0682-512 EN V 61111. These must bear the appropriate test marks (marking with 1000 V" and VDE mark "double triangle").

In switchgear and before main and sub distribution units, insulating mats are often already laid, whereby the live work assembler must verify the quality of the mats before commencing work. When laying insulating mats and where there are mats already present, this must not create any additional accident hazards, e.g. caused by raised edges from rolled storage.

### **9.8.9 Insulating covering**

There is a very large variety of pliable coverings for installations up to 1000 V AC. In addition to insulating blankets, mats, isolator and transmission line conductor covers, this also includes other fittings according to VDE V 0682-511. Blankets are affixed using insulating clips and with mounting eyelets if required.

## 9.8.10 Insulated tool

Available in the following versions according to VDE 0682-201 - EN 60 900:

- **Partly insulated tool with metal body (figure 1)**
- **Fully insulated tool with metal body (figure 2)**
- **Fully insulated tool with insulating body (figure 3)**

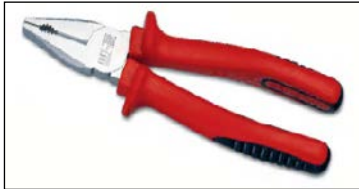


Figure 1



Figure 2



Figure 3

The use of the appropriate tool for the relevant usage must be verified. In so doing, the state of the art must<sup>1</sup> be considered. The insulation must be guaranteed by the manufacturer by way of age-proofing. Inspection by the user before use for mechanical damage or brittle material. Incorrectly stored or handled tools (UV irradiation, mechanical destruction) usually present visible changes and may not be used.

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<sup>1</sup>The state of the art is the state of the development of progressive processes, devices and methods of operation, which according to prevailing opinion of leading experts ensure the achievement of the objective laid down by law. Within the scope of the statutory target, economic perspectives must be considered as part of the proportionality considerations, but only on a secondary level in sub-areas depending on statutory targets. The procedure or a similar procedure must [missing text].



## 9.9 Voltage testers

At SCHOTT AG, only CAT IV 110 - 750 V DC / AC bipolar voltage testers are used to determine the absence of voltage.

Unipolar phase testers (voltage tester screwdriver) are **absolutely not permitted and forbidden!**



All voltage testers must be examined for their function on a reference voltage source prior to use. The user, i.e. the live work assembler, is responsible for the condition of the personal protection equipment (PPE). Damage / defects to a general live working tool must be notified by the user to the relevant superior. Only CAT IV measurement instruments pursuant to EN 61010 may in principle be used.

Category	Description	Examples
CAT I	Measurements on circuits not directly connected to the mains	e.g. batteries etc.
CAT II	Measurements on circuits with a direct electrical connection with the low-voltage system	Plugs e.g. in offices, workshops or laboratories
CAT III	Measurements in building installations	Stationary appliances, distribution units, fixed equipment
CAT IV	Measurements at the origin of the low-voltage installation	Low-voltage main distribution unit, meters, house junction boxes, overload protection devices

## 9.10 Basic live working equipment at SCHOTT AG

Basic live working equipment must be available in all divisions at SCHOTT AG in which live work may be undertaken, which contains at least the following components:

- **Electrician's visor with a hood and ear protection**
- **Insulation mat**
- **Insulating gloves**
- **NH plug-in grip with forearm cuff**
- **Eight small plastic clips**
- **Bipolar voltage tester (CAT IV)**
- **Two 500 x 500 x 0.6 mm cover blankets and**
- **All the insulated tools required to carry out the intended work (such as screwdrivers, pliers, insulating bushings, etc.)**

### 9.10.1 Inspecting the equipment

The equipment is subject to wear and tear from its use.

Weather influences and mere natural ageing also change the insulating properties. Periodic inspections are therefore indispensable.

Visual checks for visible external damage and defects before each use of insulating protection and auxiliary equipment is therefore an important aspect of occupational safety in live working. Damaged or soiled equipment entail a great risk and must be withdrawn from further use.

The intervals stated in the following table must be used for repeat tests.

Intervals are provided as a guide, from which there may be deviations on the basis of a risk assessment. The intervals must be calculated such that defects which are to be anticipated are detected in good time.

Inspection object	Inspection interval	Form of inspection	Inspector
Insulating protective clothing (where used)	Each time before use	For obvious defects	User

	12 months 6 months for insulating gloves	For observance of the limit values specified in the electrotechnical rules	Electrically skilled person
Insulated tools, cable cutters, insulating protective equipment, operating and earthing sticks	Each time before use	For externally visible damage and defects	User
Voltage testers, phase comparators		For proper operation	
Voltage testers, phase comparators and voltage test systems (capacitive systems with display) for rated voltages over 1 kV	6 years	For observance of the limit values specified in the electrotechnical rules	Electrically skilled person

The inspection intervals must be determined on the basis of a risk assessment pursuant to Section 3.3 BetrSichV, whereby particularly the type, scope and interval of the required inspections must be determined.

The scope of and the limit values to be observed in these inspections may in general be taken from the relevant standards.

### 9.10.2 Live working authority

Works falling within group 1 pursuant to VDE 0105-100 section 6.3 shall be decided and carried out safely following examination of all aspects by experienced and specially trained electrically skilled persons, the work supervisors without a further written individual order under their own responsibility according to the relevant progress of the work using the individual work instructions and all necessary organisational and technical measures (if applicable a second person at the worksite, use of PPE etc.). The authority to carry out live work is received by the authorised EFK via his appointment as EFK.

The authorised EFK for the relevant live work, who is usually always a work supervisor, shall decide, under his own responsibility, whether the live work can be carried out in each case. In case of any uncertainty, technical and / or organisational questions must be clarified with the NvEFK or their representative verbally (radio, telephone) and after clearance is given, the live work must be safely carried out. In the event of unclear circumstances, an authorising EFK must be on site (e.g. the installation manager) to make the decision. The authorised EFK (= work supervisor) may also decide after visiting the worksite and assessing the hazards whether a second competent person is required in order to safely carry out the work.

All other live work falling within group 2 pursuant to VDE 0105-100 section 6.3 may only be assigned with the relevant prior special written individual instruction from the specified and known authorising persons (ANWB) to the authorised persons (AuS-AV) and carried out in accordance with the electrotechnical rules and the individual work instructions. For group 2 works pursuant to VDE 0105-100 section 6.3 in the event of fault repairs and during on-call service, the organisational order shall be initiated by the NvEFK or their representative.

The form "Live work permit/work order" form is available for this type of work and must be used.

Note: The transfer of duties and designations at SCHOTT AG are understood as group 2 live working instructions pursuant to BGR A3 and VDE 105-100 section 6.3.

## **9.11 Live working work instructions**

The work instructions appended form a part of safe live working. The competent persons must carry out the specified works in compliance with the relevant work instructions. Knowledge of the work instructions in question shall be confirmed by the authorising person (responsible EFK) and the authorised live working skilled person (EFK) upon appointment.

The tools, protection and auxiliary equipment and the work (conditions) are listed in note form. Indications on the preparation and execution of the workflow rule the basic procedure. The safety instructions must take the form of rules of conduct. All details may be listed in detail, but do not always have to be. The qualified person (EFK, EuP) shall use their technical knowledge and experience to independently supplement all logically and technically required safety and implementation measures for the tasks described.

The work instruction must be modified if the conditions, work processes, protection and auxiliary equipment or safety-relevant aspects change. The state of the art and recognised good engineering practice<sup>2</sup> must be taken into considered in this regard. The G-VEFK is responsible for updating the work instruction.

The work instructions are summarised in paragraph 18 and constitute the live working catalogue at SCHOTT AG. The list and work instructions form a part of the electrotechnical rules as an annex and are appended thereto.

The relevant second person regulation must be filled using a risk assessment.

## **9.12 List of authorised skilled persons for live working**

The (EFK and EuP) persons for live working named in the list "Schott (relevant site) electrical engineering qualification matrix" shall certify their live working knowledge and skills for the purposes of practical scheduling and works in accordance with the position entered in the annex. The employee also declares this, along with additional specifications, in the authorisation to issue instructions / to execute instructions. This authorises him to issue / execute instructions for general and other live work.

For group 1 live work, a separate written live work order (or internal work order) is not issued for every single task. These tasks are generally assigned in accordance with these electrotechnical rules. The EFK (/EuP) shall decide, following careful expert verification, on the safe execution on his own initiative.

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<sup>2</sup>These are technical findings, remarks or construction methods which are recognised by a majority of representative technical specialists. The presumption of conformity on compliance with generally recognised good engineering practice in relation to electrical installations is secured under Section 49 of the German Energy Act (Energiewirtschaftsgesetz) when applying VDE standards. The use of other solutions is absolutely legitimate, but this presumption of conformity shall then cease to apply and the user will then be forced to demonstrate the correctness of his policy.

The special works within group 2 may only be carried out upon submission of a written individual order (or internal work order) and following careful verification that these can be carried out safely (see permit (work order) to carry out live work).

The skilled persons are listed in the "Schott (relevant site) electrical engineering qualification matrix". The list forms a part of the electrotechnical rules of SCHOTT AG and can be found at the administrative office of the relevant VEFK of the site. Evidence of training and further education.

According to VDE 0105-100 and BGR A3, the "live working qualification" must be assessed by the relevant vEFK as part of their responsibility to select and supervise in training taking place at least annually.

Evidence of training, such as for the initial training and further training as well as for the safety briefing, is administered and kept in the training plan.

The knowledge and skills for group 2 live work taking place in accordance with work instruction must be verified. The risks, the required protection measures, the PPE to be used and the protection and auxiliary equipment and live working work technologies (practical use and implementation of the work procedure) must be considered here. By mutual assessment between the superior and the employee, the instruction / further training can require practical exercises on rare works in addition to the theory.

The process of qualifying to undertake live work must be carried out after four years in a repeat training course with the same scope as the initial training. This further training measure can replace the safety briefing required for that particular year (recommendation pursuant to BGR A3).

## **10. Explosion protection**

### **10.1 Explosion protection legislation**

#### **10.1.1 EU Directives 94/9/EC and 1999/92/EC**

The European explosion protection system is based on two EC Directives, Directive 94/9/EC (ATEX 95) and 1999/82/EC (ATEX 137).

EU Directive 94/9/EC (ATEX 95) regulates the intended use of equipment and protection systems in potentially explosive atmospheres. It includes the following:

- The subdivision of equipment groups and categories and the decision criteria for the classification of equipment and protection systems,
- The conformity assessment procedures to be used for the relevant equipment groups and categories,
- The underlying health and safety requirements for the design and construction of potentially explosive apparatus.

1999/92/EU (ATEX 137) specifies the obligations of the employer for the protection of employees at work in potentially explosive atmospheres. The following issues are covered, amongst others:

- The basic technical and organisational measures for the prevention of explosions and their ranking,
- The assessment of explosion risks,
- The general obligations for the creation of a safe working environment and the required supervision,
- The coordination obligation in the presence of workers from several undertakings are present at the same workplace
- The classification of potentially explosive areas into zones,
- The obligation to draw up and maintain an explosion protection document and
- The transitional periods for installations that were already in operation before 30 June 2003 and for new installations.

### **10.2 Implementation of 94/9/EC and 1999/92/EC into national law**

The requirements under EC Directive 94/9/EC (ATEX 95) are implemented by the 11th Ordinance to the Product Safety Act (Explosion Protection Ordinance to the Product Safety Act). This ordinance lays down all the requirements relating to the product requirements and the marketing of apparatus and protection systems, components and protection, control and regulating devices for potentially explosive areas.

Directive 1999/82/EC (ATEX 137) is implemented by the Ordinance on Industrial Safety and Health (BetrSichV). This comprises the requirements for the provision and use of work equipment and installations, including the operation of installations subject to monitoring.

## **10.3 Technical regulations and standards**

Technical regulations are recommendations which may be modified by the employer under his own responsibility, if the level of protection specified therein can be otherwise achieved. The main technical regulations for the field of explosion protection are:

- the explosion protection regulations (EX-RL) for the prevention of hazards from potentially explosive atmospheres with examples (BGR 104),
- the Technical Regulations for Safety in the Workplace (TRBS) and
- the DIN VDE standards (especially DIN VDE 0165)

## **10.4 Duties of the operator**

### **10.4.1 Explosion protection document**

In carrying out his obligations, the employer must ensure that an explosion protection document is drawn up and kept up to date (BetrSichV Section 6(1)). The explosion protection document shall demonstrate in particular:

- Name of the enterprise / part of the enterprise / work area,
- Person responsible for the enterprise, part of the enterprise, work area, date of preparation and annexes,
- Description of explosion protection procedures,
- Substance information,
- Risk assessment,
- Explosion protection measures,
- Technical protection measures,
- Zoning and
- Organisational measures.

In preparing the explosion protection document, any available risk assessments, documents or other equivalent reports prepared on the basis of obligations under other legislation can be used. The assessment must be made in accordance with the following criteria:

- the type of tasks,

- the working conditions and
- the place of work.

The explosion protection document must be prepared before commencing work and must be revised if significant modifications or expansions are made.

### **10.4.2 Explosion protection measures**

The explosion protection document will lay down explosion protection measures. A distinction is made between:

*Primary explosion protection* (prevention of explosive atmospheres)

Measures which prevent or restrict the formation of hazardous explosive atmospheres. These include:

- Substitution of highly flammable liquids, flammable gases and dust,
- Inerting,
- Use of closed systems,
- Ventilation measures,
- Monitoring concentrations and
- Limiting concentrations

*Secondary explosion protection* (prevention of effective sources of ignition)

Measures which prevent the ignition of hazardous explosive atmospheres. This is done by using explosion-protected installations and equipment which do not contain any ignition sources.

*Tertiary explosion protection* (constructive explosion protection)

Measures which restrict the effects of an explosion to an acceptable level. The possible measures include:

- Independently operating closing valves in gas pipelines,
- Explosion suppression systems (e.g. foam extinguishing equipment) and
- Pressure relief devices which limit the explosive pressure to a manageable level

### **10.4.3 Instruction**

The employer must ensure that employees are instructed with regard to the potential explosion hazards and the selected protection measures and that the work instructions required for safety are laid down in writing. In the instruction, the employer must take reasonable steps to ensure that

- Employees using equipment receive the appropriate instruction, particularly on the explosion hazards associated to its use and
- The employees undertaking repair, maintenance, conversion, cleaning and other works receive the appropriate special instruction.



Instructions must be repeated at reasonable intervals and their content recorded. Participants shall confirm their participation in the instruction by signature.

#### 10.4.4 Labelling

Ignition sources, such as smoking, and the use of open fire in potentially explosive areas is forbidden. Unauthorised entry to these areas must also be forbidden. These prohibitions must be advised by way of signs.



*Prohibition signs pursuant to BGV A8*

Areas in which highly, easily or inflammable hazardous materials are stored in such quantities that they may lead to a destructive fire must be marked as such.



*Warning of combustible materials pursuant to BGV A8*

Potentially explosive areas must be clearly identifiable and permanently marked as such at their entrance.



*Warning of potentially explosive atmosphere pursuant to BGV A8*

#### 10.4.5 Written instructions and work clearances

The employer must issue written instructions for work in potentially explosive areas according to which the tasks are carried out. These work instructions may consist of a summary of the required measures in the explosion protection document. These must state at least the following:

- The expected hazards,
- The required protective measures and rules of conduct,

- The necessary control measures,
- The work procedure and the safety measures, as well as
- Measures after completion of the works.

A written clearance must be issued by the installation manager prior to commencing work for hazardous tasks in potentially explosive areas, and for tasks that could be hazardous in interaction with other works.

These must state the following:

- Works Supervisor,
- Duration of the works,
- Protection measures before, during and after completion of the works, as well as
- Emergency measures.

#### **10.4.6 Coordination**

For work involving different sections or establishments, a mutual risk including the occurrence of a potentially explosive atmosphere must be assumed. The works must be coordinated such that the risk can be excluded. A coordinator must be used for this purpose.

### **10.5 Carrying out works in potentially explosive areas**

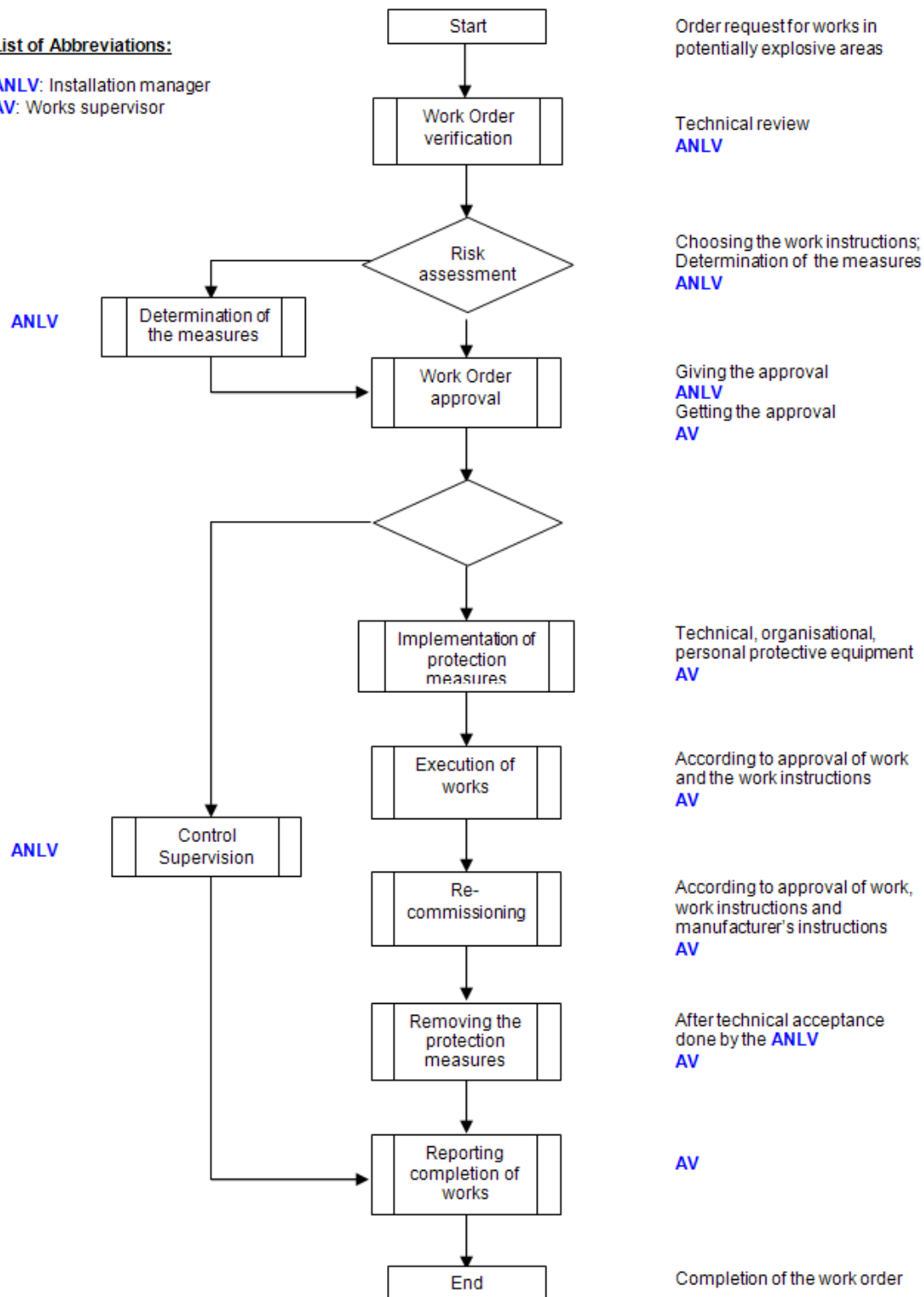
#### **10.5.1 Basic working procedure**

The following schedule provides an overview of the basic measures required for working in potentially explosive areas:

**List of Abbreviations:**

**ANLV:** Installation manager

**AV:** Works supervisor



(4) Figure:8 Basic working procedure (Source: Mebedo GMBH)

## 10.5.2 Repair works

According to TRBS 1201 part 3, repairs means the restoration of the target state of a device, a protective system or a safety device, controlling device and regulating device as defined by Directive 94/9/EC. This can either be done by exchanging individual parts or by repair measures on the parts themselves, whereby the measures for the ignition protection of devices and the function of protective systems, safety, control or regulating devices are maintained.

### 10.5.3 Inspections after repairs

Whether a device must be inspected by a competent person of the employer after repairs depends on whether the repair works are associated with the explosion protection of the device. The requirements for repairs relevant to explosion protection are defined in the Technical Regulation for Safety in the Workplace TRBS 1201 part 3. Some examples of this are found in annex 2 table 1, 2 or 3 to the TRBS 1201 part 3.

## 10.6 Inspection of the explosion safety of the workplace

### 10.6.1 Competent persons for the inspection of explosion safety

A competent persons for the inspection of explosion safety is a person who has the required technical knowledge to inspect the equipment on the basis of their professional training and recent professional experience. As part of their inspection task, they may not be subject to any technical instructions.

Technical Regulation TRBS 1203 specifies the requirements for competent persons for explosion hazards. With regard to the special requirements which must be placed upon the qualification, competence and experience of skilled persons in potentially explosive areas, the Ordinance on Industrial Safety and Health differentiates between three types of competent persons:

Competent person	Type A	Type B	Type C
Legal basis	Section 14 (1-3), Section 15 BetrSichV	Section 14 (6) BetrSichV	Annex 4 Part A no. 3.8 BetrSichV
Professional training	Technical professional training, sufficient qualification to inspect		Relevant studies or comparable technical qualifications or other technical qualifications with many years of experience in the field of safety technology
Professional experience	At least one year of experience in manufacturing, assembly or maintenance	At least one year of experience in manufacturing or maintenance	

<b>Current professional activity</b>	Work in the field of the intended inspection of the object, inspection experience (several inspections per year)		
	Updated knowledge of explosion protection, e.g. by participation in training or instructions		Continuing education by regular participation in relevant exchange of experience in the field of explosion protection
<b>Recognition by competent authorities</b>	No	yes	No
<b>Technical directive</b>	As par of their inspection activity, they are not subject to any technical directives and may not be discriminated against because of this activity		

(5) Figure:9 Competent person for the inspection of explosion safety (source: Mebedo GMBH)

## 10.6.2 Inspection before commissioning

According to Annex 4 Section A No. 3.8 of the Ordinance on Industrial Safety and Health, the explosion protection of the workplaces including the work equipment to be used and the working environment must be reviewed:

The purpose of this inspection is to demonstrate that the explosion protection concept and its implementation in the entire installation is correct. The focus thereof lies in a full system analysis for the protection of employees and third parties. All functional units and their interactions must be included.

This examination must be carried out by a **type C competent person**.

Installations in potentially explosive areas must only be put into service for the first time and after significant modifications if they have been inspected in consideration of the intended operating mode for their proper condition with regard to the assembly, installation, setup conditions and the safe function.

This examination must be carried out by a **type A competent person**.

## 10.6.3 Periodic inspections

Installations in potentially explosive areas must be periodically inspected at certain intervals for their proper condition with regard to operation. This inspection consists of a technical inspection undertaken on the installation itself using the inspection rules, and an inspection of good order.

The operator must determine the inspection intervals of the entire installation and the parts of the installation on the basis of a risk assessment. For installations in potentially explosive areas the maximum inspection interval is three years.

Inspections must be carried out by a **type A competent person**.

## 10.6.4 Inspection after repair

If repair works touch upon safety aspects of the device affecting explosion protection, the repaired equipment must be inspected by a **type B competent person** before recommissioned.

## 10.6.5 Inspection scope

The scope of the inspection is oriented to the specifications in the explosion protection document on the basis of the risk analysis and the provisions of TRBS 1201 part 1. This differentiates between the following inspections:

- *Inspection of good order*: The presence and completeness of all documents required for further inspections is verified. This includes the explosion protection document and the manufacturer's documentation.
- *Technical inspection*
  - *Visual check*: Comprises and external assessment of visible defects.
  - *Close inspection*: Finding defects using access equipment.
  - *Detailed inspection*: Finding defects that can only be recognised by intervening, e.g. opening housing and/or, if required, using tools and test instruments.

The inspection steps depend on the ignition protection category of the equipment used. Inspection plans can be taken from DIN EN 60079-17 (VDE 0165-10-1).

## 10.7 Selection of electrical equipment for potentially explosive areas

### 10.7.1 Definitions

#### **Zoning**

Potentially explosive areas are divided into zones in order to facilitate the selection of the appropriate devices and the design of sound electrical installations. The zones reflect the probability of occurrence of potentially explosive atmospheres. The following zones can be distinguished:

<b>Gas</b>	<b>Zone 0</b>	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.
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	<b>Zone 1</b>	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.
	<b>Zone 2</b>	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.
<b>Dust</b>	<b>Zone 20</b>	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.
	<b>Zone 21</b>	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.
	<b>Zone 22</b>	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

(6) Figure:10 Zoning (Source: Mebedo GMBH)

### ***Equipment group***

There are two equipment groups for equipment intended for use in potentially explosive areas:

- Equipment group I: Equipment for use in firedamp mines.
- Equipment group II: Equipment for potentially explosive atmospheres outside mines.

### ***Equipment category***

The following three categories are provided for:

- *Category 1*: Very high level of protection. Protection even in the event of rare incidents relating to equipment. Use of two independent explosion protection measures
- *Category 2*: High level of protection. Protection even in the event of frequently occurring equipment faults which normally have to be taken into account.
- *Category 3*: Normal level of protection. Protection during normal operation.

The additional letters "G" or "D" refer to the use of the equipment for potentially explosive atmospheres (G) or for explosive atmospheres caused by dust (D).

### ***Ignition protection types***

Sources of ignition caused during operation and due to faults must be avoided in potentially explosive atmospheres. This protection objective is achieved by the types of protection

for each equipment. These must be considered, particularly during inspection, in order to also achieve the protection objective during operation of the installation.

### ***Explosion group***

Potentially explosive atmospheres are divided into explosion groups on the basis of their ignitability and their ability to be propagated through gaps in the event of an explosion and to ignite an external atmosphere. These also characterise the ignition sensitivity for electrical and electrostatic discharges for mechanical ignition sources.

### ***Ignition temperature and temperature class***

The ignition temperature is the lowest temperature of a heated surface at which the ignition of the gas/air or vapour/air mixture occurs. It represents the lowest temperature at which a hot surface is capable of igniting the corresponding explosive atmosphere.

Flammable gases and vapours are divided into temperature classes according to their ignitability. The maximum surface temperature of an electrical apparatus must always be lower than the ignition temperature of the gas or vapour and air mixture in which it is used.

## **10.7.2 Working on electrical installations in potentially explosive atmospheres**

The following applies when working on electrical installations in potentially explosive atmospheres:

**Working on live installations or devices is prohibited in these areas.**

Earthing and short-circuiting is only allowed if:

- no sparks are produced
- the available energy corresponds to the condition for intrinsic safety
- there is no explosive gas present or
- the electrical apparatus has been placed in explosion-proof housing.

## **10.7.3 Overview of explosive operating areas at SCHOTT sites**

An overview of or information on the operating areas and specification of explosion protection documents of the relevant SCHOTT site can be provided by the relevant explosion protection officer of the relevant site.



## 11. Switching in case of imminent danger

If there is a danger to persons or property, each employee must act to avert or minimise danger on their own initiative and switch off the relevant installation:

- **as a priority** by pressing the emergency STOP or
- **if familiar with the installation** by using switching devices.

Emergency STOP buttons allow certain installations, such as machines and handling devices, to be shutdown quickly. They may not be used as a substitute for device activation or deactivation.

Anyone using the emergency STOP must be aware that

- not all power sources are switched off
- the normal building installation for light and plugs and therefore the devices in laboratories, operating buildings and operating areas connected to such systems are not included
- the presence of auxiliary power supplies must be anticipated for most current converters.

## 12. Other safety instructions

The required auxiliary equipment in order to safely operate electrical installations must be used (e.g. for measurements on busbars, measuring tips with integrated fuses).

Conductive parts of cables with shield and of capacitors must be discharged using suitable resistors before touching and stored in a shorted out state.

## 13. Rules of conduct in case of electrical accidents

The following ground rule applies if the victim is still in contact with the electrical current:

**Do not touch the victim directly,  
not even with insulating gloves!**

You are also at risk from series body resistance!

**Rescue measures:**

- Switch off the installation (press emergency stop, if any)
- Clear the hazard area from persons without self-endangerment (use any rescue hoods)
- Check vital functions (consciousness, breathing/circulation)
- Make an emergency call "110"; state that it is an electrical accident!
- Apply first aid
- An emergency doctor must be called for accidents in electrical installations and equipment. He must be informed that it is an electrical accident. The VEFK or the installation manager must then be informed.

In the event of damage and malfunctions to electrical installations, the prevention of danger to persons and the limitation of damage have priority. If this is possible without risk, the switching status and the fault signals must be preserved until the cause of the problem has been clarified by the installation managers. Irregularities and damage to the electrical installations, even if found by accident, must be notified to the installation managers immediately.

## **14. Safety in electrical, magnetic and electromagnetic fields**

## 14.1 Basics

When operating inductive and conductive melting plants, magnetic, electrical and electromagnetic fields (EMF) are produced which could cause direct and indirect hazards.

Direct hazards could, for example, be irritation and thermal loads, and indirect hazards could be forces on ferromagnetic materials and reactions to contact voltages and electric shocks resulting from contact with conductive parts.

All employees, visitors, guests and employees of external enterprises must be protected from EMF hazards.



(7) Figure:11 Zoning (Source: BGR B11)

The accident prevention regulation "BGR B11- Electromagnetic Fields" lays down the permitted values for the protection of persons, which may not be exceeded. The values currently permitted by the accident prevention regulation for electromagnetic fields are selected such that when complied with, according to current state of the art, hazards to life and health can be excluded.

## 14.2 Zoning and measures

The fields determined on the basis of the risk assessment and documented must be analysed in accordance with annex 1 to the accident prevention regulation "BGR B11" and the installation or area assigned to one of the following exposure zones and the necessary measures implemented:

## **Exposure zone 2**

Exposure zone 2 comprises all areas at SCHOTT AG to which there are no access restrictions on the basis of electromagnetic fields. In general, this is all offices, social areas, traffic routes, storage areas and workshops.

The white line with the pacemaker prohibition sign (fig. 5) in exposure zone 2 indicates that the permitted levels for pacemakers are much lower. See also 14.4.

## **Exposure zone 1**

These are controlled zones and zones in which it is ensured by the operating mode and length of stay that the exposure is only temporarily above the permitted values of exposure zone 2, but below the increased exposure areas. In general, this includes power supply and high frequency facilities and electrical laboratories.

Controlled means that there is an access policy for zones, which must only be accessed or committed by authorised employees during operation.

Temporary means less than an average of eight hours per day, five days a week and 50 weeks a year.

For installations and devices exceeding the permitted values of exposure zone 2, operating instructions for safe conduct and handling must be issued. Employees must be instructed on the hazards occurring during their work and on protection measures before commencing work and afterwards at regular intervals, but at least once per year, by way of operating instructions.

## **Zones of increased exposure**

This is the controlled zone in which the permitted values of exposure zone 1 are exceeded.

Only limited exposure to authorised employees is permitted in this zone. The permitted time of exposure must be determined depending on the field strength and the frequency area and on the basis of BGVR 11 Annex 1.

Zones of increased exposure must be marked with warning signs.

Operating instructions for safe conduct and handling with devices and installations must also be issued in this zone and employees must be instructed on the hazards occurring as part of their work as well as protection measures.

## **Danger zone**

This is the controlled zone in which the permitted values for the zone of increased exposure are exceeded. Special measures for the protection of employees must be taken for these zones (see accident prevention regulation "BGR B11").

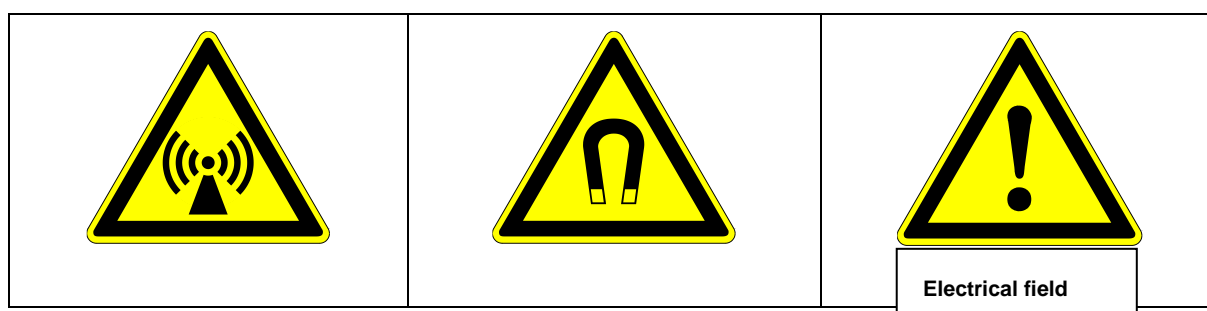
Danger zones must be marked and delimited by technical installations.



A summary of measures is presented in table 1.

Zone	Instruction	Operating instruction	Marking / restriction	Boundary
<b>Exposure zone 2</b>	Only indication of access restrictions to other zones	-	-	-
<b>Exposure zone 1</b>	Instruction on the hazards occurring and the protection measures prior to commencing work and at appropriate intervals (at least annually)	Operating instruction on safe handling of installations and devices exceeded the permitted values of exposure zone 2	Access policy	-
<b>Zones of increased exposure</b>			Marking required Access policy	-
<b>Danger zone</b>		As above, additional indications of protection distances (and the use of personal protection equipment if needed, e.g. when working on an active transmitting antenna)	Marking required Access policy Limited length of stay	Delimitation by technical installations (railings, warning lights, interlock system)

(8) Figure:12 Summary of protection measures (source: Mebedo GMBH)

### 14.3 Design and meaning of labelling



Warning of electromagnetic field	Warning of magnetic field	Warning of electrical field
BGV A8-W12	BGV A8-W13	BGV A8-W09 with supplement
		
Prohibited for persons with pacemakers	No unauthorised access	
BGV A8-P11	BGV A8-P06	

(9) Figure:13 *Design and meaning of labelling* (Source: Mebedo GMBH)

Signage can be supplemented by any necessary additional signs, such as

Short stays only 2h	Zone of increased exposure with a restriction on the length of stay to 2 hours per work shift
Danger zone	Zone of increased exposure with a restriction on the length of stay to 2 hours per work shift
Safety distance ..cm	Warning sign indicating the required safety distance

(10) Figure:14 *Required additional signs* (Source: Mebedo GMBH)

## 14.4 Persons with medical devices

Medical devices (active and passive) could be pacemakers, implanted insulin pumps and others.

BGR B11 expressly requires persons with medical devices must inform the employer of the presence of their medical devices. It is suggested that the occupational physician be informed. Only then can the employee advised of the possible hazards and required measures.

For persons with active medical devices, permitted values that must be strictly observed apply, which are described in standard E DIN VDE 0848-3-1 in detail. These are far below the permitted values for exposure zone 2, see the white line in figure 11. For example, a

permitted value of 0.7 mT for persons with pacemakers must not be exceeded in constant magnetic fields.

If the permitted values for active medical devices are exceeded, the zones must be marked with the prohibition sign "Prohibited for persons with pacemakers" (BGV A8-P11). Persons with medical devices are then prohibited from entering.  
For passive medical devices, permitted values have not yet been specified.

## **15. Important regulations and standards**

For the erection and operation of electrical installations at SCHOTT AG, the following regulations, which are of particular importance for personal safety, must primarily be followed:

DIN 31000 VDE 0100	General principles for the safe design of products
DIN VDE 0100	Erection of power installations with rated voltages below 1000 V
VDE 0100	Requirements for the erection of power installations with rated voltages below 1000 V
DIN VDE 0101	Power installations with rated voltages above 1 kV
DIN VDE 0105 - 100	Operation of power installations: General requirements
DIN VDE 0108 - 100	Safety lighting systems

DIN EN 50172	
DIN VDE 0132	Fire fighting in or near electrical installations
DIN VDE 0141	Earthing system for special power installations with rated voltages above 1 kV
VDE 0160 DIN EN 50178	Electronic equipment for use in power installations
DIN VDE 0165 ff	Installation of electronic apparatus in hazardous areas
DIN VDE 0185 ff	Lightning protection system
DIN VDE 0680 - 1 DIN EN 57680 - 1	Personnel protective equipment, protective devices and apparatus for work on electrically energized systems up to 1000 V
DIN VDE 0681	Operating, testing and safe-guarding devices for work on electrically energized systems with rated voltages exceeding 1000 V
DIN VDE 0682	Live Working, insulation level, hand tools, insulating sticks, protective clothing, voltage testers
DIN VDE 701-702	Testing of mobile devices, maintenance, alteration and testing of electrical devices/retesting of electric devices
GUV-V A1	Accident prevention regulation "General requirements"
BGV A3	Accident prevention regulation "Electrical installations and equipment"
BGR A3	Live working
BGR 104	Explosion protection rules
BGR B11	Electromagnetic fields

## 16. Safety requirements for information technology devices and systems

DIN VDE 0800 - 1	Telecommunications
DIN VDE 0804 -100 DIN EN 41003	Particular safety requirements for equipment to be connected to telecommunication networks
DIN VDE 0805 - 1 DIN EN 60950 - 1	Information technology equipment - Safety
DIN VDE 0833 - 1 / - 2 / - 3	Alarm systems for fire, intrusion and hold-up
DIN VDE 0837 ff	Safety of laser products
DIN VDE 0838 - 1 DIN EN 60555 - 1	Disturbances in supply systems caused by household appliances and similar electrical equipment.
DIN VDE 0843	Electromagnetic compatibility for industrial process measurement and control equipment
DIN VDE 0845	Protection of telecommunications systems against lightning, electrostatic discharges and over-voltages from



	electric power installations
DIN VDE 0847 - 1 DIN EN 57847 - 1	Measurement methods for the evaluation of electromagnetic compatibility (EMC)
DIN VDE 0848 - 1	Safety in electrical, magnetic and electromagnetic fields: definition, measurement and calculation methods
DIN VDE 0866 DIN EN 60215	Safety requirements for radio transmitting equipment
DIN VDE 0870 - 1	Electromagnetic interference (EMI)
DIN VDE 0875 - 1	Interference suppression of electrical apparatus and installations
DIN VDE 0878 - 2	Interference suppression of telecommunications installations and devices

## **17. Operating instructions (BA)**

The operating instruction (BA), unlike an operating manual, is a document which only indicates hazards. Operating instructions must be issued in Germany for biological materials, hazardous substances and their preparations, which contain above a certain percentage of these substances and for machines and other technical installations.

The following content for the operating instructions is suggested by the institutions for statutory accident insurance for example:

- Scope of application
- Risk to humans and the environment
- Protective measures and rules of conduct
- Conduct in case of malfunctions
- Conduct in case of accidents, first aid
- Proper disposal / maintenance (for machines / technical installations)
- Consequences of non-compliance

Operating instructions for substances and preparations may be derived from the safety data sheets prescribed for hazardous substances. Many institutions for statutory accident insurance describe this procedure in notices and aids.

References to the necessity for operating instructions can be found for example in the accident prevention regulations of the institution for statutory accident insurance (UVV or now BGV A1 Section 2), in the Occupational Health and Safety Act (ArbSchG Sections 4, 9 para. 1 and 12 para. 1), in the Ordinance on Industrial Safety and Health (BetrSichV Section 9), in the Ordinance on Biological Substances (BioStoffV Section 12) and in the Ordinance on Hazardous Substances (GefStoffV Section 14).

- The relevant VEFK has the operating instructions issued by Schott AG for viewing.

## **18. Work instructions (AA)**

A work instruction (AA) is a verbal instruction or a document which specify in more or less detail how certain tasks are to be carried out. Work instructions are linked to a certain process or a product or a workplace. They are an auxiliary tool for each employee so that they may fulfil their duties with the appropriate quality. The individual work steps are often recorded in flow charts or a kind of checklist.

The use of a standard work instruction is only advisable if the same errors are made despite the experience and qualification of the employee. Work instructions are also suitable as a good basis for the induction of new employees.

Each company can specify what a work instruction should look like. A statement to establish such an instruction: "Write it so that users can work with it!"

- The relevant VEFK has the work instructions issued by Schott AG for viewing.

## **19. Clearance slips (FS)**

**Clearance slips (FS)** are used so that works on electrical installations pursuant to VDE 0105-100 are only carried out with the approval of the installation managers and since after briefing and issuing to the work supervisor, the latter is responsible for safely carrying out the work at the worksite, the ultimate decision on cordoning off or marking remains with the work supervisor.

- The clearance slips prepared by Schott AG can be obtained from the relevant VEFK.

## **20. Checklists (CL)**

A **checklist (CL)** is a systemised list of individual points. The purpose of using checklists is to offer procedure models guaranteeing full and if applicable comparable execution of tasks, particularly for recurrent issues. The questions are closed questions which can be answered quickly and unequivocally.

- The checklists prepared by Schott AG can be obtained from the relevant VEFK.

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