

# Safety Guidelines for Direct Drives



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# 1 Danger and Warning Concept

The following signs are used in this documentation to alert you to dangers:



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## Danger

This symbol appears whenever death, serious bodily injury or property damage **will occur** if you fail to take the necessary precautions.

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## Warning

This symbol appears whenever death, serious bodily injury or property damage **may occur** if you fail to take the necessary precautions.

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## Caution

This symbol appears whenever minor bodily injury or property damage **may occur** if you fail to take the necessary precautions.

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## Caution

This warning (without the warning triangle) means that property damage **may occur** if you fail to take the necessary precautions.

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## Attention

This warning means that failure to heed the instructions **can** lead to an undesirable result or condition.

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## 2 General Safety Guidelines

These safety guidelines apply for handling direct drives and their components. Please read these safety guidelines carefully to avoid accidents and/or property damage.



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### Danger

**There is a danger of death, serious bodily injury and/or property damage if the safety guidelines and instructions are not heeded and complied with.**

It is imperative to observe these safety guidelines!

Observe all the warning and instruction signs!

Make sure that your end product satisfies all the pertinent standards and legal specifications. The respectively applicable national, local and machine-specific safety regulations and requirements must also be taken into account!

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### 2.1 Personnel Requirements

*Qualified personnel* in the sense of this publication and the warnings on the product refer to persons entrusted with the handling of the product and possessing the appropriate qualifications for their activities such as:

- training or instruction or authorization to switch circuits and devices on and off, earth and label them according to safety standards
- training or instruction according to safety standards in the care and use of appropriate safety equipment
- training in first aid measures



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### Danger

**There is a danger of death, serious bodily injury and/or property damage when untrained personnel is allowed to handle direct drives and/or their components.**

Only personnel who are familiar with and who observe the safety guidelines are allowed to handle direct drives and their components.

Installation, commissioning, operation and maintenance may only be performed by qualified, trained and instructed personnel.

In case of danger of crushing due to strong magnetic fields (see chapter 2.3), all work must be performed by at least two persons.

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### Important



Make sure that the information about the sources of danger and the safety measures is available at all times! Keep all the descriptions and safety guidelines concerning direct drives and their components if possible!

All descriptions and safety guidelines can also be requested from the motor manufacturer.

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## 2.2 Use for the Intended Purpose



### Danger

**There is a danger of death, serious bodily injury and/or serious property damage when direct drives and their components are used for a purpose for which they were not intended.**

Direct drives are designed for industrial or commercial machines. It is prohibited to use them in areas where there is a risk of explosion (Ex-zone) unless they are designed expressly for this purpose (observe the separately enclosed additional instructions where applicable). If increased demands (e.g. touch protection for children's hands) are made in special cases – for use in non-commercial systems, these conditions must be ensured on the machine side during installation.

Direct drives and their components may only be used for the applications specified by the manufacturer. Please contact your Siemens branch responsible if you have any questions on this matter.

## 2.3 Danger from Strong Magnetic Fields

Strong magnetic fields occur in the secondary parts and rotors of direct drives due to the permanent magnets they contain. The magnetic field strength of direct drives results exclusively from the magnetic fields of the secondary parts or rotors in the de-energized state.

Electromagnetic fields of the primary part or stator occur additionally during operation.



### Danger

**Strong magnetic fields can directly affect persons and cause damage.**

The BGR B11 "Electromagnetic Fields" must be observed in the Federal Republic of Germany! In other countries the respectively applicable national and local regulations and requirements must be taken into account!

The handling of direct drives or secondary parts and rotors is generally prohibited for all persons with pacemakers, metallic implants and foreign objects that conduct electricity or magnetism. A medical report is necessary for any exceptions to this ruling. Unique access controls must be complied with according to the magnetic fields at the place of work and the boundaries of the permissible areas must be clearly identified.

Humans have no sensory organs for picking up magnetic fields and have no experience with them as a rule. Therefore magnetic forces of attraction emanating from strong magnetic fields are often underestimated. They may be several kN in the vicinity of the secondary parts (distance less than 100 mm). – That is equivalent to crushing your foot with a weight of several 100 kg!



### Danger

**Strong attractive forces on magnetizable materials lead to a great danger of crushing in the vicinity of the secondary parts (distance less than 100 mm).**

Do not underestimate the strength of the attractive forces!

All work must be performed by at least two persons.

Do not carry any objects made of magnetizable materials (e.g. steel or iron) and/or permanent magnets close to a secondary part or rotor!

For the event of accidents when working with permanent magnets, the following objects must be on hand to free clamped body parts (hands, fingers, feet etc.):

- a hammer (about 3 kg) made of solid, non-magnetizable material
- two pointed wedges (wedge angle approx. 10° -15°) made of solid, non-magnetizable material (e.g. hard wood)

**Danger**

Any movement of electrically conductive materials in relation to permanent magnets leads to induced voltages. **Electrical shock hazard!**

Movement of primary parts in relation to secondary parts or stators in relation to rotors (and vice versa) must be avoided.

**Caution**

**Magnetic fields can lead to loss of data on magnetic or electronic data media.**

Do not carry any magnetic or electronic data media on your person!

### 2.3.1 First Aid in the case of Accidents Involving Permanent Magnets

- Stay calm!
- Press the EMERGENCY STOP if the machine is still on
- Administer / call for FIRST AID
- To free clamped parts of the body (hands, fingers, feet...) separate attracted parts!
  - Drive the wedge into the separating rift with the hammer
  - Free part of body (hand, finger, foot)...
- Call DOCTOR if necessary

## 2.4 Posting of Warning Signs

All danger areas must be identified by well visible warning and prohibiting signs (pictograms) in the immediate vicinity of the danger. The associated texts must be available in the language of the country in which the product is used. Table 2-1 and Table 2-2 show the relevant warning and prohibiting signs for handling direct drives.

Table 2-1 Warning signs according to BGV A8 and DIN 4844-2 and their meanings









Sign	Meaning	Sign	Meaning
	Warning hazardous electric voltage (D-W008)		Warning strong magnetic field (D-W013)
	Warning hot surfaces (D-W026)		Warning hand injuries (D-W027)

Table 2-2 Prohibiting signs according to BGV A8 and DIN 4844-2 and their meaning

Sign	Meaning	Sign	Meaning
	No pacemakers (D-P011)		No metal implants (D-P016)
	No metal objects or watches (D-P020)		No magnetic or electronic data media (D-P021)

## 3 Special Safety Guidelines

The perfect and safe operation of direct drives is dependent on proper transport, storage, installation, assembly and maintenance as well as protection against soiling and contact with aggressive materials.

### 3.1 Guidelines for Storage and Transport

**Danger**

**Improper storage and/or transport can cause death, serious bodily injury and/or property damage.**

Never store or transport unpacked direct drives and components! Only use undamaged original packaging!

When transporting machines or machine parts with pre-assembled motors, protect the component from moving unintentionally!

The storage locations of parts with permanent magnets (secondary parts, rotors) must be marked with pictograms from Table 2-1 and Table 2-2 .

Keep storage areas dry and protected from heat and cold.

Comply with warning instructions on the packaging!

Wear safety shoes and work gloves!

The packaging of the direct drives and their components provides reliable protection during transport and storage especially against the strong magnetic forces of secondary parts and rotors.

**Important**

Keep the packaging of direct drives and their components where possible!

Original packaging can also be requested from the motor manufacturer.

### 3.2 Guidelines for Installation

**Danger**

**You may have to handle unpacked secondary parts or rotors close by when installing direct drives or components. The danger from strong magnetic fields is particularly high in this case.**

Only remove the packaging from the motor components immediately prior to installation.

Never place metals on magnet surfaces and vice versa!

Never use magnetizable tools. If these tools are required, then they must be held firmly with both hands and moved slowly towards the direct drive.

Prevent unintentional movement of pre-assembled direct drives.

Only perform installation work in a disconnected, de-energized state. Electrical shock hazard!

**Caution**

**Sharp edges can cause cuts.**

Wear work gloves!

**Caution**

**Falling objects can injure feet.**

Wear safety shoes!

**Warning**

Defective connecting cables can cause electrical shock and/or property damage, e.g. by fire.

When installing, make sure the connecting cables are

- not damaged
  - not under tension
  - cannot be caught up in moving parts.
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### 3.3 Guidelines for Electrical Connection

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**Danger**

**Electric devices may be under voltage. There is an electrical shock hazard!**

Observe the regulations for working on electrical installations! The following safety rules for working on electrical installations in accordance with DIN VDE-0105-100 must be observed especially:

- only work on de-energized installations
- switch off
- secure against switching back on
- make sure there is no current and voltage
- earth and short-circuit
- cover or cordon off adjacent live parts
- release for work
- connect PE conductor first and disconnect last!

All circuits must meet the requirements of *safe electrical disconnection* in accordance with VDE 0160 / EN 50178.

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**Danger**

**There is a danger of death, serious bodily injury (electrical shock) and/or property damage if direct drives are connected incorrectly.**

Direct drives may only be connected according to instructions. Direct connection of the motors to the three-phase current network is not permissible.

See the technical manual of the converter system used!

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### 3.4 Guidelines for Commissioning

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**Danger**

**There is a danger of death, serious bodily injury and/or property damage if a machine is commissioned which does not meet the recognized safety requirements.**

Commissioning is prohibited until such time as it is ensured that the machine installed in the direct drive satisfies the conditions of the Machine Directive 98/37/EC.

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**3 Special Safety Guidelines**

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**Danger**

**In case of unforeseeable movements of the motor, there is a danger of death, serious bodily injury (crushing) and/or property damage.**

Never reach into the moving parts of the machine when it is switched on!

Keep persons away from moving parts and areas where there is a danger of crushing!

Make sure the machine can move unobstructed!

Check the commutation before switching on! Also observe the instructions of the used converter systems!

Limit the motor currents!

Set the speed limit to low values!

Monitor the end positions of the motor!

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**Warning**

**The surface temperature of the motors may be more than 100 °C (212 °F). Danger of burns!**

Make sure the cooling system is working properly if available!

Do not touch the motor directly during/after use!

Temperature-sensitive parts (electric cables, electronic components) may not be placed on hot surfaces.

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**Attention**

**The motor may overheat without temperature protection.**

**Before switching on for the first time (for testing), check whether the temperature protection is effective!**

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### 3.5 Guidelines for Operation

**Danger**

**Machine parts driven by direct drives pose considerable danger of injury – e.g. by crushing – due to the very high speed and acceleration and the low friction and self-inhibition.**

Keep persons clear of the moving parts and areas of the axes where there is a danger of crushing!

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**Caution**

**Improper operation can lead to serious property damage.**

Check continuously whether the temperature protection is effective!

Keep the motor area free from foreign bodies (chips, particles, liquids, oils, screws, tools, etc.)!

Listen for noise!

If there are accuracy problems with the workpiece, check the freedom of movement and the current consumption of the motor. Accuracy problems may also have other causes, e.g. the machine design.

Make sure the cooling system is working properly if available!

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## 3.6 Guidelines for Maintenance, Service and Repair

### 3.6.1 Maintenance

Direct drives are almost maintenance-free. Observing the following instructions will prolong the life of your motor:

- Check the freedom of movement regularly.
- Clear foreign bodies (e.g. chips) regularly from the motor area.
- Check the general condition of the motor components regularly.
- Check the current consumption in the defined test cycle
- Check the symmetry of the coil resistors regularly

Since operating conditions differ greatly, no intervals for inspection and maintenance work can be specified.



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**Danger**

**There is a danger of death, serious bodily injury and/or property damage when maintenance work is performed with the machine switched on.**

Always switch off power to the machine before working on areas with moving parts!

All work on the electrical system may only be performed with the power disconnected!

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**Warning**

**The coolant and motor need some time to cool down. There is a danger of burns when working on the motor shortly after operation!**

Do not work on the motor until you have made sure there is no danger of burns!

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### 3.6.2 Service and Repair



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**Danger**

**There is a danger of death, serious bodily injury and/or property damage when service and repair work is performed by inexperienced personnel.**

All service and repair work on the motor must be performed by the SIEMENS Service Centers.

For addresses of SIEMENS Service Centers see

<http://www.automation.siemens.com/partner/index.asp>.

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## 3.7 Guidelines for Disposal



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**Danger**

**Death, serious bodily injury and/or property damage may result from improper disposal of direct drives or their components (especially secondary parts or rotors).**

Direct drives and their components must be disposed of properly. Make particularly sure that secondary parts and rotors are completely demagnetized!

Direct drives and their components will be taken back by the manufacturer in the original packaging for proper disposal. Costs for transport and disposal will be charged to the sender.

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