# Contents

## Safety handbook

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Again and again, the practical implementation of safety requirements presents new challenges for plant designers and machine manufacturers. What frequently makes the design and planning stage more difficult is the fact that the safety requirements are continuously extended and tightened against the background of the CE label and compliance with the machine guidelines. ABB STOTZ-KONTAKT GmbH offers a comprehensive range of safety components for plant and machine manufacture. Depending on the type used, these components ensure safety directly at the machine, as well as in the switchgear cabinet. But ABB STOTZ KONTAKT also has a suitable product in stock for the safety of the complete system.

Apart from fulfilling the applicable standards and requirements, ABB products are “state of the art” so that the protection of people, machines and the environment can be optimally realised in machines and plants.

The safety components in ABB STOTZ-KONTAKT’s product range and their applications are exemplary:

… Plant safety,

… Machine safety,

… Switchgear cabinet safety.
Product overview

Safety handbook

Detect

Evaluate
General information

Regulations and Standards

Goal

The goal of safety technology is to keep the potential hazards for man and the environment as low as possible by applying and utilizing technology. However, this should be achieved without imposing unnecessary restrictions on industrial production, the use of machines and the production of chemical products. By applying internationally harmonized regulations, man and the environment should be uniformly protected to the same degree in all countries. At the same time, differences in competitive environments, due to different safety requirements, should be eliminated.

Basic principles of European legislation

Legislation states that we must focus our efforts “... at preserving and protecting the quality of the environment, and protecting human health through preventive actions” (Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances). It also demands “Health and safety at the workplace” (Workplace, health and safety legislation, ...). Legislation demands that this and similar goals are achieved for various areas (“Areas which are legislated”) in the EC Directives. In order to achieve these goals, legislation places demands on the operators and users of plants, and the manufacturers of equipment and machines. It also assigns the responsibility for possible injury.

The EC Directives

... Specify demands placed on plants and systems and their operators/users to protect the health and safety of personnel and the quality of the environment

... Define product features and characteristics to protect the health and safety of users

... Contain regulations about health and safety at the workplace (minimum requirements).

A new, global concept forms the (“new approach”, "global approach”) basis for the EC Directives:

... EC Directives only contain generally valid safety goals, and define fundamental safety requirements

... Legislation no longer specifies that specific standards have to be met

... Standards Committees, which have received the appropriate mandate from the EC Commission, can define technical details in the Standards. These Standards are harmonized under a specific Directive and are listed in the Official Journal of the EC. When the harmonized standards are fulfilled, then it is assumed that the associated safety requirements of the Directive are fulfilled. EC Directives specify that Member States recognize each other’s national regulations and laws.

The EC Directives have the same degree of importance, i.e. if several Directives apply for a specific piece of equipment, then the requirements of all of the relevant Directives have to be met (e.g. for a machine with electrical equipment, the Machinery Directive, Low-Voltage Directive and EMC Directive apply).

Other regulations apply to equipment where the EC Directives are not applicable. They include regulations and criteria for voluntary tests and certification.

Workplace health and safety legislation

Health and safety at the workplace is subject to national legislation, i.e. the national requirements must be observed, as other safety requirements can be derived from these.

Note: The Directives and laws, mentioned in this Manual, represent a selection in order to provide information about the essential goals and principles. This does not claim to be complete.
Regulations and Standards

General information

Standardization goals

The demand to make plants, machines and other equipment as safe as possible, in-line with state-of-the-art technology, comes from the responsibility of the manufacturers and users of equipment and products for their safety. State-of-the-art technology regarding all aspects which are of significance for safety, is described in the Standards. State-of-the-art technology is ensured by fulfilling the various relevant standards. This also ensures that the erector of a plant or system, or manufacturer of a machine or a piece of equipment, has fulfilled his responsibility for ensuring safety.

Functional safety

From the perspective of the object to be protected, safety can not be segregated. As the causes of hazards and the technical measures applied to avoid them can differ widely, a differentiation is now made between various types of safety, e.g. by specifying the cause of the potential hazard. For instance, “electrical safety” is used if protection has to be provided against hazards due to electricity, or “functional safety”, if the safety is dependent on the correct function.

This differentiation is now reflected in the new standardization in so much that there are special standards which are involved with functional safety. The area of safety of machinery, EN 954 (or ISO 13489) deals especially with safety-relevant parts of controls and therefore concentrates on the functional safety. IEC handles, in the pilot standard IEC 61508, the functional safety of electrical, electronic and programmable electronic systems, independent of any special application area.

In IEC 61508, functional safety is defined as “part of the overall safety relating to the EUC” and the EUC control system which depends on the correct functioning of the E/E/PE** safety-related systems, other safety-related systems and external risk reduction facilities”.

In order to achieve functional safety of a machine or a plant, the safety-relevant parts of the protective- and control devices must function correctly and, when a fault or failure occurs, the plant or system must remain in a safe condition or be brought into a safe state. To realize this, specific qualified technology is required, which fulfills the requirements specified in the relevant standards.

The requirements to achieve functional safety are based on the basic goals:

… avoid systematic faults
… control systematic faults
… control random faults or failures.

The measure for the achieved functional safety is the probability of dangerous failures, the fault tolerance and the quality which should be guaranteed by avoiding systematic faults. In the Standards, this is expressed using various terms. In IEC 61508: “Safety Integrity Level (SIL), in EN 954 (ISO 13489): Categories” and in DIN V 19250 and DIN V VDE 0801: “Requirement class” (AK).

* EUC: Equipment under control
** E/E/PE: Electrical, electronical, programmable electronical
Machine safety
Regulations and Standards

Machinery Directive (98/37/EC)*

With the introduction of a common European market, effective 01.01.1993, a decision was made to harmonize the national standards and regulations of all of the EC Member States. This meant that Machinery Directive, as an internal Directive, had to be implemented in the domestic legislation of the individual Member States. (For instance, in Germany, the contents of the Machinery Directive were implemented as the 9th Decree of the Equipment Safety Law.) For the Machinery Directive, this was realized with the goal to have unified protective goals and to reduce trading barriers. The application area of the Machinery Directive corresponds to its definition.

"Machinery also means an assembly of machines which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole".

The application area of the Machinery Directive thus ranges from a basic machine up to a complete plant. The Machinery Directive has 14 Articles and 7 Annexes. The basic health and safety requirements in Annex I of the Directive are mandatory for the safety of the machine. The protective goals must be implemented in a responsible fashion in order to fulfill the requirements for conformance with the Directive. The manufacturer of a machine must prove that the basic requirements are fulfilled. This proof is made easier by applying harmonized standards.

A certification technique is required for machines listed in Annex IV of the Machinery Directive, which represent a greater hazard potential.

Machinery Directive

| Application area, selling/marketing, free transfer of goods, protective clause | Art. 1 – Art. 7 |
| Certification technique | Art. 8 – Art. 9 |
| CE-marking, protection against arbitrary fulfillment | Art. 10 – Art. 12 |
| Coming into force, transitional regulations, cancellation of regulations | Art. 13 – Art. 14 |

Appendix Artikel

| I | Essential health and safety requirements relating to the design and construction of machinery and safety components |
| II | Contents of |
| | 1. EC Declaration of Conformity for machinery and safety components |
| | 2. Declaration by the manufacturer or his authorized representatives established in the community |
| III | CE conformity marking |
| IV | Types of machinery and safety components which the procedure referred to in article 8 (2) (b) and (c) must be applied |
| V | EC Declaration of Conformity |
| VI | EC type examination |
| VII | Minimum criteria to be taken into account by the Member States for the notification bodies |

* substitute 89/392/EC, 91/368/EC, 93/68/EC

Overview of the Machinery Directive (from 89/392/EC)
### Machine safety

#### Regulations and Standards

<table>
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<tr>
<th>Types of machinery and safety components for which the procedure referred to in Article 8, Paragraph 2, letters b) and c) must be applied</th>
</tr>
</thead>
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<tr>
<td><strong>A. Machinery</strong></td>
</tr>
<tr>
<td>1. Circular saws (single or multi-blade) for working with wood and analogous materials or for working with meat and analogous materials.</td>
</tr>
<tr>
<td>1.1. Sawing machines with fixed tool during operation, having a fixed bed with manual feed of the work-piece or with a demountable power feed.</td>
</tr>
<tr>
<td>1.2. Sawing machines with fixed tool during operation, having a manually operated reciprocating saw-bench or carriage.</td>
</tr>
<tr>
<td>1.3. Sawing machines with fixed tool during operation, having a built-in mechanical feed device for the work-pieces, with manual loading and/or unloading.</td>
</tr>
<tr>
<td>1.4. Sawing machines with movable tool during operation, with a mechanical feed device and manual loading and/or unloading.</td>
</tr>
<tr>
<td>3. Thicknessers for one-side dressing with manual loading and/or unloading for woodworking.</td>
</tr>
<tr>
<td>4. Band-saws with a fixed or mobile bed and band-saws with a mobile carriage, with manual loading and/or unloading, for working with wood and analogous materials or for working with meat and analogous materials.</td>
</tr>
<tr>
<td>5. Combined machines of the types referred to in 1 to 4 and 7 for working with wood and analogous materials.</td>
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<td>6. Hand-fed tenoning machines with several tool holders for woodworking.</td>
</tr>
<tr>
<td>8. Portable chainsaws for woodworking.</td>
</tr>
<tr>
<td>9. Presses, including press-brakes, for the cold working of metals, with manual loading and/or unloading, whose movable working parts may have a travel exceeding 6 mm and a speed exceeding 30 mm/s.</td>
</tr>
<tr>
<td>10. Injection or compression plastics-molding machines with manual loading or unloading.</td>
</tr>
<tr>
<td>11. Injection or compression rubber-molding machines with manual loading or unloading.</td>
</tr>
<tr>
<td>12. Machinery for underground working or the following types:</td>
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<tr>
<td>- machinery on rails: locomotives and brake-vans</td>
</tr>
<tr>
<td>- hydraulic-powered roof supports</td>
</tr>
<tr>
<td>- internal combustion engines to be fitted to machinery for underground working.</td>
</tr>
<tr>
<td>13. Manually-loaded trucks for the collection of household refuse incorporating a compression mechanism.</td>
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<td>14. Guards and detachable transmission shafts with universal joints as described in Section 3.4.7.</td>
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<td>15. Vehicles servicing lifts.</td>
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<td>16. Devices for the lifting of persons involving a risk of falling from a vertical height of more than 3 meters.</td>
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<td>17. Machines for the manufacture of pyrotechnics.</td>
</tr>
<tr>
<td><strong>B. Safety components</strong></td>
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<tr>
<td>1. Electro-sensitive devices designed specifically to detect persons in order to ensure their safety (non-material barriers, sensor mats, electromagnetic detectors, etc.)</td>
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<tr>
<td>2. Logic units which ensure the safety functions of bimanual controls.</td>
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<td>3. Automatic movable screens to protect the presses referred to in 9, 10 and 11</td>
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<td>4. Roll-over protection structures (ROPS)</td>
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<td>5. Falling-object protective structures (FOPS)</td>
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Annex IV of the Machinery Directive
Standards

To sell, market or operate/use products, these products must fulfill the basic safety requirements of the EC Directives. Standards can be extremely helpful when it involves fulfilling these safety requirements. In this case, a differentiation must be made between harmonized European standards and other technical rules and regulations which are known in the Directives as "National Standards".

Generally, all European Standards must be included, unchanged in the national standards of the Member States, independent of whether they are harmonized under the Machinery Directive or not. National standards handling the same subject must then be withdrawn.

Thus, within a period of time in Europe, a unified set of regulations will be created.

Harmonized European Standards

These are drawn-up by the two standards organizations CEN (Comité Européen de Normalisation) and CENELEC (Comité Européen de Normalisation Électrotechnique) as mandate from the EC Commission in order to fulfill the requirements of the EU Directives for a specific product. And they must be published in the official documentation of the European Communities. These Standards (EN Standards) are then transferred into the national standards unchanged. They are used to fulfill the basic health- and safety requirements and the protective goals specified in the Annex I of the Machinery Directive.

When using such standards, there is an "automatic presumption of conformity"; i.e. the manufacturer can be trusted to have fulfilled all of the safety aspects of the Directive as long as they are handled in the particular Standard.

However, not every European Standard is harmonized in this sense. The listing in the European documentation is decisive. The up-to-date version of these lists can always be called-up in the Internet (Address: http://www2.echo.lu/nasd/index.html).

The European Standards of CEN for the safety of machines are hierarchically structured as follows:

... A Standards; also known as Basic Standards.
... B Standards; also known as Group Standards.
... C Standards; also known as Product Standards.

The diagram above shows the structure.

Type A Standards/Basic Standards

As Standards contain basic terminology and definitions for all machines. This includes EN 292 "Safety of machinery – Basic concepts, general principles for design".

A Standards primarily address the party setting B- and C Standards. The techniques for minimizing risks, specified there, can however, also be helpful for manufacturers, if there are no relevant C Standards.

Type B Standards/Group Standards

These include all Standards with safety-related statements, which can involve several types of machines.

The B Standards also primarily address the party setting C Standards. However, they can also be helpful for manufacturers when designing and building machine if there are no relevant C Standards.

For B Standards, an additional subdivision was made, and more precisely in:

... Type B1 Standards for higher-level safety aspects, e.g. ergonomic design principles, safety distances from potential sources of danger, minimum clearances to prevent crushing of body parts.

... Type B2 Standards for safety equipment are specified for various machine types, e.g. EMERGENCY STOP equipment, two-hand controls,

interlocking/latching, contactless protective devices, safety-related parts of controls.
Machine safety

Regulations and Standards

Type C Standards/Product Standards

These involve the Machine-Specific Standards, e.g. for machine tools, woodworking machines, elevators, packaging machines, printing machines etc.

The European Standards are conceived, in order to avoid repeating general statements, which are already included in type A, or type B standards; as far as possible, reference to these are made in type C Standards.

In addition to machine-related requirements, Product Standards can also include requirements which, under certain circumstances, deviate from the Basic- and Group Standards. For the machine OEM, type C Standard/Product standards have the highest priority. It can be assumed that it therefore contains the basic requirements of Annex I of the Machinery Directive (automatic presumption of conformity).

If there is no Product Standard for a particular machine, then type B Standards can be applied as support when building a machine.

National Standards

If harmonized European Standards are not available, or they cannot be applied for certain reasons, then the manufacturer can utilize the “National Standards”. All of the other technical rules and regulations and European Standards, not listed in the European official documentation (non-harmonized), fall under this term of the Machinery Directive. Those not listed in official documentation can include, for example, still valid DIN Standards and VDE Regulations and are declared, also from the German government as “helpful to fulfill the Machinery Directive”.

However, when such standards are applied, the above mentioned “automatic presumption of conformity” does not apply. This means, that a risk analysis must be carried-out and proven and if necessary, risk reduction measures applied which makes the whole procedure more costly. These national standards are for example, used by notified bodies in order to identify whether a specific product fulfills the goals of the Machinery Directive.

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<th>Typ A</th>
<th>Basic safety standards</th>
<th>Basic design principles and terminology for machines</th>
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<td>Safety of machines: DIN EN 292-1</td>
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<td>Safety of machinery; basic terminology, general principles for design; technical principles and specifications: EN 292-2</td>
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<th>General higher-level safety aspects standards</th>
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<td>Minimum clearances to prevent parts of the body being crushed: EN 349</td>
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<td>Safety-relevant parts of control systems: EN 954-1</td>
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<td>Safety clearances against accessing dangerous locations with the upper limbs: EN 294</td>
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<td>Electrical equipment of machines: EN 60204-1</td>
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<td>Safety of machines inter-latching devices with and without tumbler: prEN 1088</td>
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<th>Reference to special protective devices</th>
<th>Generally handled safety-related devices</th>
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<td>Two-hand circuit: prEN 81-1</td>
<td>Light barriers: prEN 61496</td>
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<td>Emergency stop equipment, functional aspects – design guidelines – EN 418</td>
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<th>Typ C</th>
<th>Specialist Standards</th>
<th>Special safety features for individual machine groups</th>
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<td>Elevators: prEN 81-1</td>
<td>Elevators: prEN 81-1</td>
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<td></td>
<td>Pressing + shears: prEN 692, prEN963</td>
<td>Pressing + shears: prEN 692, prEN963</td>
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<td>Injection molding machines: EN 201</td>
<td>Injection molding machines: EN 201</td>
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<td>Food preparation machines: prEN 1672-1</td>
<td>Food preparation machines: prEN 1672-1</td>
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<td>Printing and paper machines: pr EN 1010</td>
<td>Printing and paper machines: pr EN 1010</td>
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<td>Machining centers: prEN 12417</td>
<td>Machining centers: prEN 12417</td>
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<td>Cable railways: prEN 1709</td>
<td>Cable railways: prEN 1709</td>
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<td>Automated production systems: prEN 1921</td>
<td>Automated production systems: prEN 1921</td>
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<td>etc.</td>
<td>etc.</td>
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</table>

European Standards for safety of machinery
Risk analysis/evaluation

As a result of their general design and functionality, machines and plants represent potential risks. Thus, the Machinery Directive requires a risk assessment for every machine and, if relevant, risk reduction, so that the remaining risk is less than the tolerable risk. The following Standards should be applied for the technique to assess these risks:

... EN 292 “Safety of machinery – Basic concepts, general principles for design”

... EN 1050 "Safety of machinery – Principles for risk assessment”

EN 292 mainly handles the risks to be evaluated and design principles to reduce risks. EN 1050 basically handles the iterative process with risk assessment and risk reduction to achieve safety.

Risk assessment

Risk assessment is a sequence of steps, which allows hazards, which are caused by machines, to be systematically investigated. Where necessary, the risk assessment phase is followed by risk reduction. The iterative process (refer to Graphic) is obtained by repeating this procedure. This allows potential hazards to be removed as far as possible, and allows the appropriate protective measures to be made.

The risk assessment includes:

... Risk analysis
  ... Determining the limits of the machine (EN 292, EN 1050 Paragraph 5)
  ... Identification of hazards (EN 292, EN 1050, Paragraph 6)
  ... Techniques to estimate risks (EN 1050, Paragraph 7)

... Risk evaluation (EN 1050, Paragraph 8)

After risk have been estimated, a risk evaluation is made as part of an iterative process to achieve safety. In this case, a decision has to be made whether it is necessary to reduce a risk. If the risk is to be further reduced, suitable protective measures must be selected and applied. The risk evaluation must then be repeated.

If the required degree of safety has still not been reached, measures are required to reduce the risk. Risk reduction and the selection of suitable protective measures are not part of the risk evaluation. Suitable protective measures must be used to reduce risks. If the protective measures involve interlocking/latching-control functions, then these must be configured in accordance with EN 954.

Standard EN 1050 calls this operation an iterative process to achieve safety.

Risk elements are defined as a support tool to evaluate risks. Graphic shows the inter-relationship of these risks elements.

Risk reduction and the selection of appropriate safety measures are not part of the risk assessment. For a further explanation, refer to Section 5 of EN 292-1 (1991) and EN 292-2.
Residual risk (EN 1050)

Safety is a relative term in our technical environment. Unfortunately, it is not possible to implement the so-called “zero risk guarantee” where nothing can happen under any circumstance. The residual risk is defined as: Risk, which remains after the protective measures have been implemented.

In this case, protective measures represent all of the measures to reduce risks.

Reducing risks

In addition to applying structural measures, risk reduction for a machine can also be realized using safety-relevant control functions. For these control functions, special requirements must be observed, which are described in EN 954-1, graduated according to the level of risk.

The requirements placed on safety-relevant parts of control systems are sub-divided into categories, graduated according to the level of risk. Techniques to select the suitable category as reference point for configuring the various safety-related parts of a control, are recommended in Annex B of EN 954-1.

Possible selection of the categories in accordance with EN 954-1
The adjacent table indicates a brief summary of the requirements for the various categories. The complete text for the requirements is contained in EN 954-1, Section 6.

Basic requirements to configure control systems are defined in the various categories. These are intended to make the systems tolerant to hardware faults. Additional aspects must be observed for more complex control systems, especially programmable electronic systems, so that

... random hardware failures can be controlled,

... systematic errors/faults in the hardware and software are avoided, and

... systematic errors/faults in the hardware and software can be controlled,

so that sufficient functional safety is achieved for safety-critical tasks. The necessary requirements are described in the German Draft Standard DIN V VDE 0801 and the International Standard IEC 61508. The scope of the required measures is also graduated corresponding to the risk reduction required.

### Safety Integrated

The measures which are required to make a complex control adequately functionally safe for safety tasks are extremely comprehensive and involve the complete development- and manufacturing process. Thus, controls such as these are specifically developed as "fail-safe" devices. Advant Controller CS 31-S with AC 31 Safety Fieldbus are examples of such control systems.

<table>
<thead>
<tr>
<th>Category 1)</th>
<th>Summary of requirements</th>
<th>System behaviour 2)</th>
<th>Principles to achieve safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Safety-related parts of control systems and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influence.</td>
<td>The occurrence of a fault can lead to the loss of the safety function.</td>
<td>Mainly characterized by selection of components.</td>
</tr>
<tr>
<td>1</td>
<td>Requirements of B shall apply. Well-tried components and well-tried safety principles shall be used.</td>
<td>The occurrence of a fault can lead to the loss of the safety function but the probability of occurrence is lower than for category B.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Requirements of B and the use of well-tried safety principles shall apply. Safety function shall be checked at suitable intervals by the machine control system.</td>
<td>... The occurrence of a fault can lead to the loss of the safety function between the checks. ... The loss of safety function is detected by the check.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that: ... a single fault in any of these parts does not lead to the loss of the safety function; and ... whenever reasonably practicable the single fault is detected.</td>
<td>... When the single fault occurs the safety function is always performed. ... Some but not all faults will be detected. ... Accumulation of undetected faults can lead to the loss of the safety function.</td>
<td>Mainly characterized by structure.</td>
</tr>
<tr>
<td>4</td>
<td>Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that: ... a single fault in any of these parts does not lead to a loss of the safety function; and ... the single fault is detected at or before the next demand upon the safety function. If this is not possible, then an accumulation of faults shall not lead to a loss of the safety function.</td>
<td>... When the faults occur the safety function is always performed. ... The faults will be detected in time to prevent the loss of the safety function.</td>
<td></td>
</tr>
</tbody>
</table>

1) The categories are not intended to be used in any given order or in any given hierarchy in respect of safety requirements.

2) The risk assessment will indicate whether the total or partial loss of the safety function(s) arising from faults is acceptable.
Machine safety

Regulations and Standards

Safety-related functions

The safety-related functions include, in addition to the classic functions:

- stop
- actions in an emergency situation

in the meantime, also more complex functions such as:

- speed limiting
- position limiting
- speed deviation etc.

The classic functions are defined in EN 60204-1 and are generally implemented using basic electromechanical components. Electronic programmable systems can also be used to implement more complex functions, if they fulfill the relevant standards (IEC 61508, EN 954 or DIN V VDE 0801).

Stop

Stop categories according to EN 60204-1

There are three stop categories, which are defined in EN 60204-1, independent of an emergency situation:

Stop Category 0
Uncontrolled stop; stopping by immediate removal of power to the machine actuators (e.g. motor).

Stop Category 1
Controlled stop; the power is only removed when the machine has come to a standstill.

Stop Category 2
Controlled stop, where power is still fed to the machine when it is at a standstill.

Emergency operations

The new EN 60204-1/11.98 (IEC 60204-1), harmonized with HD 384 (IEC 60364), has defined the following possible actions for emergency situations (EN 60204-1 Annex D):

Action in an emergency situation includes individually, or a combination of:

- EMERGENCY STOP
- EMERGENCY START
- EMERGENCY OFF
- EMERGENCY SWITCHING ON.

According to EN 60204-1 and EN 418, these functions are exclusively initiated by a conscious manual intervention. In the following text, only EMERGENCY OFF and EMERGENCY STOP will be discussed.

The latter fully corresponds to the same terminology in the EC Machinery Directive.

EMERGENCY OFF

This is an intervention (action) in an emergency situation, which disconnects the electrical power to a complete system or installation or part of it if there is a risk of electric shock or another risk caused by electricity (from EN 60204-1 Annex D).

Further, the following is defined in 9.2.5.4.3 of EN 60204-1:

Functional aspects to disconnect the power in an emergency situation are defined in IEC 60364-4-46 (identical to HD 384-4-46).

Power must be disconnected in an emergency situation, where:

- protection against direct contact (e.g. with contact cables, slip ring assemblies, switch-gear in electrical rooms) is only achieved by maintaining a clearance or barriers;
- other hazard or damage could occur as a result of electric power.

In an emergency situation, the power supply is disconnected from the machine which results in a Category 0 Stop.

If a Category 0 Stop is not permissible for a machine, then it may be necessary to provide other protection, e.g. against direct contact, so that power does not have to be disconnected in an emergency situation.

This means, that EMERGENCY OFF should be used where the risk analysis indicates a hazard due to electric voltage/power and therefore requires that the electric voltage is immediately disconnected from the complete machine.
In the application area of the EC, EMERGENCY OFF devices fall under the Low-voltage Directive 73/23/EEC, if they are not used in conjunction with machines. If they are used in conjunction with machines, then they come under the Machinery Directive 98/37/EC, as is true for all of the other electrical equipment.

EMERGENCY STOP
This is an action, in an emergency situation, which is defined to stop a process or movement which has become hazardous (from EN 60204-1 Annex D).

Further, in 9.2.5.4.2 of EN 60204-1 the following is defined:

Stop
In addition to the requirements for stop (refer to 9.2.5.3), the following requirements apply for an emergency stop:

… It must have priority over all other functions and actions in all operating modes;

… The power to the machine actuators, which could cause hazardous conditions, must be disconnected as quickly as possible without creating other hazards (e.g. using mechanical stopping/braking devices, which do not require an external supply by using counter-current braking) for Stop Category 1;

… Resetting may not initiate a restart.

Stopping in an emergency situation must either be effective as a Stop, Category 0 or Category 1 (refer to 9.2.2). The Stop Category in an emergency situation must be defined as a result of the risk evaluation for the machine.

To technically implement the EMERGENCY STOP, corresponding to the application recommendation in the foreword of EN 60204-1, the requirements of either EN 60204-1 or EN 954 and IEC 61508 can be applied. EN 60204-1 primarily requires that this is implemented using electromechanical components, as “basic” (programmable) electronic systems are not safe enough. By correctly applying EN 954 and, if required, IEC 61508, electronic- and programmable electronic components become functionally safe enough, that they can also be used to implement EMERGENCY STOP for all Categories.

Devices for EMERGENCY OFF and EMERGENCY STOP
In order to fulfill the protective goals, both of EN 60204-1 as well as EN 418, the following requirements are valid for both functions (also refer to 10.7 in EN 60204-1):

… When contacts switch, even with just a brief actuation, the control device must positively latch.

… It is not permissible that the machine can be restarted from a remote main operator control station without the hazard or danger first having been removed. The emergency stop device must be consciously released again locally.

Other safety-related functions
For all other safety-related functions, EN 60204-1 recommends that electromechanical components are used. With the argument that it is “presently difficult” to be able to secure the reliability of fault-free operation of a single-channel programmable electronic unit with sufficient confidence. This expressly refers to the time at which the associated text of the standard was drawn-up.

The application recommendation in the foreword of the new EN 60204-1 for this Chapter takes into account the progress which has been made in developing safety-relevant technology. It recommends that the “different” requirements of other relevant standards, e.g. IEC 61508, should be taken into consideration. When taking into account the requirements of these standards, it is possible to use electronic and programmable electronics, for example, a fail-safe Advant Controller 31-S in a safety-related fashion, even for complex functions.
Man – Machine

In order to simplify the interaction between man and machines, reference is made to Standards EN 60073 an DIN EN 60204.

Switches, pushbuttons and signaling lamps are, in the first instance, the machine components which are used as the interface between man and machine. These operator control elements are clearly and uniformly identified using color coding which has a very specific significance. This guarantees that the safety of operating personnel is increased and it is easier to handle and maintain the operating resources/plants and systems.

The colors for pushbuttons, the significance of the colors, explanations and application examples are shown in Graphic.

According to DIN EN 60204-1 (VDE 0113 Part 1) the following information has to be observed:

- The preferred colors for START/ON operator control devices should be White, Grey or Black, preferably White, Green can be used, Red may not be used.
- White, Grey and Black are the preferred colors for pushbutton control elements which initiate an operation while they are pressed, and end that operation when they are released (e.g. jogging).
- Green is reserved for functions which display a safe or normal operating condition.
- Yellow is reserved for functions which display an alarm or a non-standard (abnormal) condition.
- Blue is reserved for functions which require a specific action.
- Reset pushbuttons must be Blue, White, Grey or Black; if they also act as STOP/OFF pushbuttons, White, Green or Black are preferred, but preferably Black. It is not permissible to use Green.

The colors for the indicating lamps, their significance with reference to the status of the machine as well as their handling and application examples, are listed in Graphic (Page 18).

For illuminated pushbuttons, the information in Graphics (Page 17 and 18) applies. If problems are encountered when assigning suitable colors, White must be used. For EMERGENCY OFF devices, the color Red must not be dependent on the illumination status of the device.

Coding cables

The color coding of switches, pushbuttons and indicator lamps has been discussed in the previous Section. EN 60204 offers a higher degree of flexibility when coding cables. It specifies that cables at every connection must be able to be identified in conformance with the technical documentation ….”

It is sufficient if terminals are numbered, corresponding to the information in the circuit diagram, if the cable can be easily visually tracked. For complex controls, it is recommended that the internal wiring cables as well as the outgoing cables are coded so that after the cable has been disconnected from the terminal, it can be easily re-connected later to the same terminal. This is also recommended, for terminal locations

<table>
<thead>
<tr>
<th>Colour</th>
<th>Meaning</th>
<th>Explanation</th>
<th>Examples of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Emergency</td>
<td>Actuate in the event of a hazardous condition or emergency</td>
<td>EMERGENCY OFF; Initiation of emergency function</td>
</tr>
<tr>
<td>Yellow</td>
<td>Abnormal</td>
<td>Actuate in the event of an abnormal condition</td>
<td>Intervention to suppress abnormal condition; Intervention to restart an interrupted automatic cycle</td>
</tr>
<tr>
<td>Green</td>
<td>Normal</td>
<td>Actuate to initiate normal conditions</td>
<td>START/ON; however white should be preferably used</td>
</tr>
<tr>
<td>Blue</td>
<td>Mandatory</td>
<td>Actuate for a condition requiring mandatory action</td>
<td>Reset function</td>
</tr>
<tr>
<td>White</td>
<td>No specific meaning assigned</td>
<td>for general initiation of functions except for emergency stop (see note)</td>
<td>START/ON (preferred), STOP/OFF</td>
</tr>
<tr>
<td>Grey</td>
<td>START/ON, STOP/OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>START/ON, STOP/OFF (preferred)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note – Where a supplemental means of coding (e.g. shape, position, texture) is used for the identification of pushbutton actuators, then the same colour White, Grey or Black may be used for various functions (e.g. White for START/ON and for STOP/OFF actuators).
which have to be disconnected when the equipment is transported.

Using the wording in IEC 60204-1 1997, Paragraph
14.2.1 conductor core coding/identification, the Standards Committee wanted to make the following statement:

1. Each individual cable must be able to be identified, however, only in correspondence with the documentation. It is not necessary that every cable must be able to be identified without the documentation areas which are handled by the same personnel. These definitions cannot be generalized due to the wide application range of the Standard, from small individual machines (high unit volume standard products) up to large, complex machinery plants (unique equipment and systems).

Primarily, the avoidance of installation/assembly faults must be guaranteed using appropriate testing. Instead of many different colors, a single color can be used for the internal wiring. It should be color-coded as follows:

3. Black for main AC and DC circuits

3. Red for AC control circuits

3. Blue for DC control circuits

3. Orange for interlocking circuits, which are supplied from an external power source.

The above color assignment is recommended if a decision is made to just use color coding. The only mandatory specification is the color coding of the protective conductor and the neutral conductor. For all other cabling and wiring, one of the methods, listed in 14.2.4 can be selected (color, numbers or letters; or a combination of colors and numbers or colors and letters).

Protective conductor marking

The protective conductor must be uniquely identifiable as a result of its shape, location, coding or color. If it is only identified as a result of its color, then a two-color combination of green/yellow must be used along the whole length of the cable. The green/yellow color combination is exclusively reserved for protective conductors.

Neutral conductor marking

If a circuit has a color-coded neutral conductor, then light blue must be used. Light blue may not be used to code other cables if there is a danger of accidentally interchanging them.

If there is no neutral conductor, a light-blue conductor may be used for other purposes, but not as protective conductor.

### Protecting and Standards

#### Machine safety

<table>
<thead>
<tr>
<th>Colour</th>
<th>Meaning</th>
<th>Explanation</th>
<th>Action by operator</th>
<th>Examples of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Emergency</td>
<td>Hazardous condition</td>
<td>Immediate action to deal with hazardous condition (e.g. by operating emergency stop)</td>
<td>Pressure/temperature outside safe limits, voltage drop, voltage interruption, passing through a stop position</td>
</tr>
<tr>
<td>Yellow</td>
<td>Abnormal</td>
<td>Abnormal condition Impending critical condition</td>
<td>Monitoring and/or intervention (e.g. by re-establishing the intended function)</td>
<td>Pressure/temperature outside normal operating ranges; Tripping a protective device</td>
</tr>
<tr>
<td>Green</td>
<td>Normal</td>
<td>Normal condition</td>
<td>Optional</td>
<td>Pressure/temperature within the normal operating ranges, permissive signal to continue</td>
</tr>
<tr>
<td>Blue</td>
<td>Mandatory</td>
<td>Indication of a condition that requires action by the operator</td>
<td>Mandatory action</td>
<td>Prompt to enter, specified values</td>
</tr>
<tr>
<td>White</td>
<td>Neutral</td>
<td>Other conditions; may be used whenever doubt exists about the application of Red, Yellow, Green, Blue</td>
<td>Monitoring</td>
<td>General information</td>
</tr>
</tbody>
</table>

Colors for indicator lamps and their significance in accordance with EN 60204-1 (VDE 0113 Part 1): 06.93

1. Red

   - Immediate action
   - Pressure/temperature outside safe limits, voltage drop, voltage interruption, passing through a stop position

2. Yellow

   - Abnormal condition
   - Pressure/temperature outside normal operating ranges; Tripping a protective device

3. Green

   - Normal condition
   - Pressure/temperature within the normal operating ranges, permissive signal to continue

4. Blue

   - Indication of a condition that requires action by the operator
   - Mandatory action
   - Prompt to enter, specified values

5. White

   - Other conditions; may be used whenever doubt exists about the application of Red, Yellow, Green, Blue
   - Monitoring
   - General information

Colors for indicator lamps and their significance in accordance with EN 60204-1 (VDE 0113 Part 1): 06.93

1. Red

   - Emergency
   - Hazardous condition
   - Immediate action
   - Pressure/temperature outside safe limits, voltage drop, voltage interruption, passing through a stop position

2. Yellow

   - Abnormal condition
   - Abnormal condition Impending critical condition
   - Monitoring and/or intervention (e.g. by re-establishing the intended function)
   - Pressure/temperature outside normal operating ranges; Tripping a protective device

3. Green

   - Normal condition
   - Pressure/temperature within the normal operating ranges, permissive signal to continue

4. Blue

   - Indication of a condition that requires action by the operator
   - Mandatory action
   - Prompt to enter, specified values

5. White

   - Other conditions; may be used whenever doubt exists about the application of Red, Yellow, Green, Blue
   - Monitoring
   - General information

Colors for indicator lamps and their significance in accordance with EN 60204-1 (VDE 0113 Part 1): 06.93
Legislation Requirements in Europe

For the process industry, essentially the following EC Directives must be applied:


... Low-Voltage Directive

... Machinery Directive (98/37/EC)

... Pressure Equipment Directive (97/23/EC).

The latter is only relevant in so much that the devices used must fulfill this Directive. "The Directive on the other hand is not valid for assembling pressured devices at the user’s plant, for example, in industrial system under his responsibility."

At the same time, the health and safety at work laws (Refer to Page 1/2, “Workplace Health and Safety Legislation”) and accident prevention regulations must always be observed.

"Seveso Directive"

This EC Directive specifies, corresponding to the principles explained in the introduction, the safety goal.

"… preserving and protecting the quality of the environment, and protecting human health through preventive action;"

In order to achieve this goal, the following basic requirements have been drawn-up, which the Member States must ensure are fulfilled.

Concept to prevent severe accidents

The owner/operating company is responsible in drawing up a document setting out his major-accident prevention policy and to ensure that it is properly implemented. The major-accident prevention policy established by the owner/operating company shall be designed to guarantee a high level of protection for man and the environment by appropriate means, structures and management systems (Article 7 Paragraph 1).

The document must take into account the following basic principles.

... The concept to prevent severe accidents must be in written form.

... A safety management system, in which, among others, the following issues are regulated:

... Determining and evaluating the risks – defining and applying techniques to systematically determine hazards

... Operation monitoring – defining and applying techniques for safe operation, including the maintenance and service of the plants and systems.

... Quality assurance – defining and applying techniques to continuously ensure that the goals are achieved.

Safety report

The owner/operating company is responsible in generating a safety report, in which the following is defined,

... that the concept to prevent severe accidents has been implemented,

... that the hazards have been identified and all of the required measures to prevent these types of accidents and limiting the results for man and the environment, have been put in place, and

... the implementation, erection and installation and operation of all plants and systems is adequately safe and reliable.

Inspection

The regulatory bodies must set-up a system of inspections to systematically check the operational-, organizational and management-specific systems of the operation which will allow these regulatory bodies to confirm that the user can prove,

... that he has undertaken measures to prevent severe accidents, and

... he has provided adequate measures to limit the results of any accident

This EC Directive must be implemented on a national basis.
The first priority is to design the process so that it is intrinsically safe. Where this is not possible, then additional measures are required in order to reduce the remaining risk, as a result of the process, to a tolerable level. This can be realized using electronic controllers if these are suitable for the particular task. Electronic controllers are then suitable for securing the safety of the plant, if they have been especially designed for this purpose. The requirements are described in Standards.

Relevant standards for safety measures using process control technology

For safety measures using process control technology, e.g. in Germany, presently the following national standards must be applied:

- DIN V 19250 “Basic safety issues for control and instrumentation protective devices”
- DIN V 19251 “Instrumentation and control protective devices – requirements and measures for safety-related functioning”
- DIN V VDE 0801 “Basic rules for computers in systems with safety-related tasks.” The standards are also recognized in other European countries and appropriately applied, but however, this must be clarified on a case-for-case basis. The international standards for this application area are:
  - Draft IEC 61511 “Functional safety: safety instrumented systems for the process industry sector”.

IEC 61508 is a basic standard, primarily for developing sector-specific standards. It can be directly applied, if there is no specific standard for the associated application area.

Presently, in Germany, the above specified national standards are still valid. Today, instead of DIN V VDE 0801, IEC 61508 can be used. DIN V 19250 and 19251 are scheduled to be replaced by IEC 61511.
Reducing risks using process control technology

Measures are required to reduce risks, if a failure of the basic process control system can lead to a dangerous event or can cause the plant or system to go into a hazardous condition and if the resulting risk is unacceptably high. In this case, suitable protection measures must be taken either to sufficiently reduce the probability of a hazardous event occurring, or to reduce the extent of the damage. This can be realized using electronic controller-based safety instrumented systems, if these fulfil the safety requirements.

Risk reduction

As it is not possible to completely exclude certain risks, both from a technical and cost-effective standpoint, it is necessary not only to determine the existing risk, but also to define and specify a risk which can be tolerated. The measure for the safety integrity of the risk-reducing functions is then derived from the difference between these two factors.

... IEC 61508 defines “Safety Integrity Level” (SIL) as a target measure for the probability of failure for executing risk-reducing functions.

... Draft IEC 61511 uses the “Safety Integrity Level” (SIL), defined in IEC 61508 as a target measure for the probability of failure of the execution of the risk-reducing functions.
Regulations and Standards

Safety integrity levels according to IEC 61508: Target failure measure for a safety function, allocated to a safety-related system.

### Safety integrity level

<table>
<thead>
<tr>
<th>Safety integrity level</th>
<th>High demand or continuous mode of operation (Probability of a dangerous failure per hour)</th>
<th>Low demand mode of operation (Average probability of failure to perform its design function on demand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>$\geq 10^{-9}$ to $&lt; 10^{-8}$</td>
<td>$\geq 10^{-5}$ to $&lt; 10^{-4}$</td>
</tr>
<tr>
<td>3</td>
<td>$\geq 10^{-8}$ to $&lt; 10^{-7}$</td>
<td>$\geq 10^{-4}$ to $&lt; 10^{-3}$</td>
</tr>
<tr>
<td>2</td>
<td>$\geq 10^{-7}$ to $&lt; 10^{-6}$</td>
<td>$\geq 10^{-3}$ to $&lt; 10^{-2}$</td>
</tr>
<tr>
<td>1</td>
<td>$\geq 10^{-6}$ to $&lt; 10^{-5}$</td>
<td>$\geq 10^{-2}$ to $&lt; 10^{-1}$</td>
</tr>
</tbody>
</table>

Selecting the equipment and basics of the required features

Safety function

Risk reduction using electronic controllers is realized by defining functions for each possible hazardous event or each possible dangerous condition of the plant or system, which prevents the dangerous event occurring. These so-called "safety functions" are to maintain the plant or system in a safe state or to re-establish this safe state if a dangerous event could occur due to a failure or a disturbance in the plant or system. The safety function can also be used to reduce the extent of damage due to a hazardous event.

The definition of a safety function always includes the specification of the function itself (e.g., inhibiting the feed to a container, if the level has reached the upper limit), and the safety integrity, derived from the risk analysis.

Implementing the safety functions

Every safety function always includes the complete chain, from information acquisition, through information evaluation up to executing the required action.

Equipment involved, for example, failsafe PLCs, sensors and actuators etc. must fulfill, as a total, the determined SIL from the risk evaluation. If a unit is used at the same time for various safety functions, it must fulfill the highest SIL of the individual functions.

#### Requirement categories

<table>
<thead>
<tr>
<th>Requirement categories (DIN V 19250)</th>
<th>Category (EN 954-1)</th>
<th>Safety class (SIL) (IEC 61508)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1 - 2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2 - 3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Comparison of the requirement categories

(This comparison is for information purposes only, as the classifications cannot be transferred one to one.)

---

Risk graph and requirement classifications to DIN V 19250

#### Extent of loss

- **Injury**
  - seldom
  - frequent

- **Fatality**
  - seldom
  - frequent

- **Several fatalities**
  - seldom
  - frequent

- **Catastrophe**
  - seldom
  - frequent

#### Risk parameters

- **Probability**
  - relatively high
  - low
  - very low

- **Duration of stay**
  - possible
  - not possible

- **Risk avoidance**
  - possible
  - not possible

- **Risk graph and requirement classifications to DIN V 19250**

---

Evaluation unit, e.g. safety PLC
Regulations and Standards

Device characteristics and features

If PLCs are used for information processing, these must fulfill as “Safety-PLC” the requirements of the relevant standards and fulfill the specified SIL. They must also be certified by an independent tester. This is also valid for other complex devices where not all of the potential fault/failure modes can be specified, because they use microprocessor technology. The essential characteristics and features of a fail-safe PLC, which are requested in the standards with various graduated levels, are:

... When developing, manufacturing and servicing, specific measures and techniques must be applied so that systematic faults can be avoided.

... The PLC must be able to control systematic failures which occur during operation.

... The PLC must detect random hardware failures during operation and be able to control them.

... To be able to control a failure means that when the system detects a fault or failure, the safety function, defined for this case (e.g. shutdown the plant), is reliably executed.

Application

When using a fail-safe PLC, only the conditions, defined in the associated Safety Manual, and if relevant, additional conditions of the certificate, must be maintained. For the peripheral devices which are to be connected (e.g. sensors and actuators), in addition, the requirements in the standards (IEC 61508 and IEC 61511) must also be taken into account regarding the following aspects:

... Systematic faults must be avoided, e.g. configuring-, installations- and handling faults

... Random faults or failures must be detected and controlled.
Furnaces

Regulations and Standards

EC Directives

Furnaces and burners are subject to the relevant directives due to their application and the devices which are used. There are no specific EC Directives for furnaces. Furnaces are subject, where relevant, to application-specific directives. Industrial thermo-processing equipment are, for example, classified as machines under the Machinery Directive.

Standards

Industrial thermo-processing equipment
There is a European draft standard for these systems, which was drawn-up under a mandate of the Machinery Directive, and more precisely, prEN 746 “Industrial thermo-processing equipment” with

- Part 1: General safety requirements of industrial thermo-processing equipment
- Part 2: Safety requirements for combustion and fuel handling systems.

prEN 746 can be applied to industrial thermo-processing equipment, for example

- Metal producing and processing
- Glassworks,
- Ceramic plants,
- Cement-, lime-, and gypsum plants,
- Chemical plants,
- Incinerators etc.

This refers to EN 60204-1 and EN 654-1 as well as, for safety-relevant electronic systems, also to IEC 61508.

Furnaces
For furnaces, which do not belong to industrial thermo-processing equipment, and are not used to heat process liquids and gases in the chemical industry, there are the following general standards for electrical equipment – the European Draft Standard

- prEN 50156 “Electrical equipment for furnaces Part 1: Requirements for application design and installation”

and the German Standard

- DIN VDE 0116

The following Standards are available for burners:

- prEN 676 gas burners;
- EN 230 oil-vapor burner in a mono-block design;
- EN 267 oil burners;
- EN 298 automation equipment for furnaces for gas burners and gas units with and without blower.

EMERGENCY OFF for furnaces

For equipping furnaces with devices to switch-off in an emergency situation, prEN 50156 specifies that EN 60204-1 and EN 954-1 must be observed so that the appropriate EC Directives are fulfilled.

The regulations are also involved with the associated equipment for storage, preparation and pumping fuels.
Push buttons
**EMERGENCY OFF control devices**

**Push buttons**

Relevant standards

- IEC 60947-5-5 (Requirements for fulfilling the machine guidelines)
- EN 60204-1 (Safety of machines – Electrical equipment of machines)
- EN 60947-5-1 (Low-voltage switchgear with positive opening contacts)
- EN 999 (Approach speed)
- EN 292-1 (Safety of machines – General design guidelines)
- EN 954-1 (Safety of machines – Safety-related parts of control systems)

Product safety through new standards

The EMERGENCY OFF operating devices from ABB are tested according to the new standard for electrical EMERGENCY OFF devices with mechanical latching, IEC 60947-5-5 (1997-11), and the corresponding guidelines EN 60204.

The following tests have to be passed in order for the standard to be fulfilled:

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous test</td>
<td>6,050 cycles. This is not a test of the mechanical service life, which is 100,000 operations.</td>
</tr>
<tr>
<td>Robustness</td>
<td>A force of 113 N on three axes.</td>
</tr>
<tr>
<td>Environmental test</td>
<td>Heat and cold, high air humidity and 5% NaCl solution</td>
</tr>
<tr>
<td>High voltage test</td>
<td>2,500 V</td>
</tr>
<tr>
<td>Reset test</td>
<td>Tensile force &lt;50 N, Torque &gt;50 N</td>
</tr>
<tr>
<td>Shock test</td>
<td>15 g</td>
</tr>
<tr>
<td>Vibration test</td>
<td>2 h at 50 m/s²</td>
</tr>
<tr>
<td>Positive opening contacts</td>
<td>according to IEC 947-5-1, K.2.2</td>
</tr>
</tbody>
</table>

Category B, 1, 2: acc. to EN 954-1

- Using with a contact block
  - Using with a fail-safe Advant 31-S
  - Using with safety combination C 57x

Use of two switching elements. A dual-channel control is absolutely necessary for this category when used for fail-safe evaluation and diagnostics equipment.

- Using with a contact block
  - Using with a fail-safe Advant 31-S
  - Using with safety combination C 57x

- Using with a contact block
  - Using with a fail-safe Advant 31-S
  - Using with safety combination C 57x

- Using with a contact block
  - Using with a fail-safe Advant 31-S
  - Using with safety combination C 57x
EMERGENCY OFF control devices

Push buttons

Assembled stations

ABB has two enclosure systems for the installation of pushbuttons in situ:
Insulated enclosure providing protection-rating IP65
Metal enclosure providing protection-rating IP67

While the insulated enclosure can withstand all normal internal and external loads, the metal enclosure made of lightweight metal provides increased loading capacity with respect to leaks and mechanical stresses.

Apart from the individual enclosures, ABB also offers a range of the most common combinations of in-situ controls ready assembled ex stock. Furthermore, it is also possible for customer specific, tailor made and pre-assembled in-situ controls to be produced to order.

Accessories

ABB’s comprehensive range of accessories enables virtually all the combinations of pushbuttons found in practice to be simply and inexpensively realised.

The following in-situ controls are available pre-assembled ex stock:

- Insulated enclosure with 1 control (grey/black enclosure)
- 1x pushbutton with 1NO or 2NO
- 1x mushroom button 2NC
- EMERGENCY OFF controls 2NC (yellow/black enclosure)
- Insulated enclosure with 2 controls (grey/black enclosure)
- 2x pushbutton with 1NO or 2NO
- Insulated enclosure with 3 controls (grey/black enclosure)
- 3x pushbutton with 1NO or 2NO
- 2x pushbutton with 1x indicator light
- Metal enclosure with 1 control (grey enclosure)
- EMERGENCY OFF pushbutton 2NC
Push buttons

Signal towers and signal beacons

Signal Tower K 70

... Rapid assembly of the signal elements due to bayonet system

... Simple replacement of defective bulbs in every stage

... Flexible composition of the signal elements possible

... Up to 5 elements possible – max. 10 elements with double angle

... Lightening elements can be fitted at every stage

... Use of up to 5 lightening elements

... High protection rating, IP54 for all optical and acoustic signal elements

... LED elements for long service life

Colour selection to IEC 73, Version 4, 1991 – Description and colours for pushbuttons/Signal beacons and information with respect to use of the colours (extract from the standard):

<table>
<thead>
<tr>
<th>Colour</th>
<th>Pushbutton/Significance</th>
<th>Indicator light/Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Risk: Act urgently</td>
<td>Serious risk: Dangerous condition</td>
</tr>
<tr>
<td>Amber</td>
<td>Attention: Measures necessary</td>
<td>Attention/Imminent critical state</td>
</tr>
<tr>
<td>Green</td>
<td>Normal condition, Measures for normalisation or securing</td>
<td>Normal condition or safe</td>
</tr>
<tr>
<td>Blue</td>
<td>Predetermined significance</td>
<td>Status, which requires a defined action</td>
</tr>
<tr>
<td>White, grey, black</td>
<td>No special significance</td>
<td>No special significance</td>
</tr>
</tbody>
</table>
Position switches LS-Serie

Push buttons

Relevant standards

... EN 1088 (Latching devices in conjunction with isolating protective devices)

... EN 60947-5-1 (Low-voltage switchgear with positive opening contacts)

... prEN 999 (Approach speed)

... EN 292-1 (Safety of machines – General design guidelines)

... EN 954-1 (Safety of machines – Safety-related parts of control systems)

... EN 60204-1 (Safety of machines – Electrical equipment of machines)

Product spectrum

Position switches LS-Series can be used for:

... Monitoring protective equipment with hinges, such as hinged doors, flaps, covers etc.

... Monitoring protective equipment which can be moved sideways, for example, sliding doors, protective screens etc.

... Detecting hazardous movements of machine parts.

Every category can be achieved by using

ABB position switches LS-Series are optimally harmonized with the requirements for the highest degree of safety and offer the following advantages:

... Positive opening of the NC contacts

... Version with/without separate actuator

... Increased safety using additional latching (tumbler mechanism)

... High degree of protection IP 65/67

... Standard enclosure, also in accordance with DIN EN 50047 and 50041

... Different actuators

... Electrically insulated contacts with moving double contacts.

Position switches LS-Series are supplied with separate actuators or without actuator. The actuator elements are shown for the particular switch types.

Positive opening operation of the contacts (EN 60947-5-1)

Positive opening operation is specified in accordance with DIN VDE 0660 Part 200 and is the same as IEC 947-5-1-3 and EN 60947-5-1.

For the electrical equipment of machines, the positive opening of NC contacts is expressively specified in all safety circuits. It is designated according to IEC 947-5-1-3 by the following character (personnel protective funktion).
Position switches

Push buttons

Product spectrum

Plastic casing

... Double casing
... IP 65 protection degree
... Complying with:
  – EN 50047 standard for 30 mm width 1 cable conduit Pg11
  – EN 50041 standard for 40 mm width 1 cable conduit Pg13.5

Metal casing

... IP 66 protection degree
... Complying width
  – EN 50041 standard for 40 mm width 1 cable conduit Pg 13.5
  – Without normalisation for 60 mm width 3 cable conduits Pg 13.5

Actuators

... Safety key, plunger, roller plunger, roller lever, adjustable lever, or spring rod

Contact blocks

... Two electrically separated moving contacts, “Zb shape”
... Snap action or slow contact dependent action
... Positive opening operation of N.C. contact(s)

The limit switches are delivered completely assembled, ready for installation.

Many variants (Casing, actuators or contact blocks) are available on request.

Foot switches

Foot switches with cover

... Double insulation
... IP 65 protection degree
... Actuation: free movement; locked in normal position; latched in low position

Mini foot switches

... IP 40 protection degree
... Free movement
Advant Controller 31-S
Save intelligence

Advant Controller 31-S

A control for safety and restart functions

The Advant® Controller 31-S can be used to design and standardise small, decentralised control units. With a control centre, the safety and restart functions are supported simultaneously. Safety signals are locally linked with the safety control centre via the AC31 safety field bus.

Certification

The Advant Controller 31-S is certified to international standards:

- DIN V 19250: Basic safety issues for control and instrumentation protective devices Requirements category (AK) 1-4
- EN 954-1: Safety of machines, Category 3
- DIN VDE 0116: Electrical equipment for burner systems. Requirements for safety-oriented electronic components, Item 8.7
- DIN EN 298: Automation equipment for furnaces for gas burners and gas units with and without blower, Items 8, 9, 10
- NFPA 8501: Standard for boiler functions with a burner
- NFPA 8502: Standard for the prevention of furnace explosions/implosions in boilers with several burners

Areas of application

The Advant Controller 31-S is a safety-orientated control system which is suitable for a diverse range of uses in plant and machines. Typical applications are e.g.:

- Burner and boiler controls
- Fuel engineering, gas consumption equipment
- Storage and conveying equipment, mixing technology
- Machine manufacture, e.g. for printing and packaging machines
- Construction and container cranes
- Plant manufacture, environmental engineering
- Road traffic signal systems, tunnel construction
- Process locks and safety devices

System topology with modular construction
# Advant Controller 31-S

Safety-oriented automation device for programming software 907 PC 33/331/338

<table>
<thead>
<tr>
<th>Type</th>
<th>07 KT 94-S</th>
<th>07 KT 93-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order number</td>
<td>GJR 525 2100 R 2161</td>
<td>GJR 525 1300 R 2171</td>
</tr>
<tr>
<td>Weight per item</td>
<td>0.25 kg</td>
<td>0.25 kg</td>
</tr>
<tr>
<td>Programm memory</td>
<td>480 kbyte</td>
<td>56 kbyte</td>
</tr>
<tr>
<td>Processing time (35% word, 65% bit)</td>
<td>0.2 ms</td>
<td>0.7 ms</td>
</tr>
<tr>
<td>Integrated digital I/O</td>
<td>24/16/8</td>
<td>24/16</td>
</tr>
<tr>
<td>Decentralised digital I/O</td>
<td>max. 992</td>
<td>max. 992</td>
</tr>
<tr>
<td>Integrated AI (not-S)</td>
<td>8 (±10 V, ±5 V, 0…10 V, 0…5 V, 0…20 mA, 4…20 mA, -50°C…+400°C, -30°C…+70°C or as DI)</td>
<td>-</td>
</tr>
<tr>
<td>Integrated AO (not-S)</td>
<td>4 (±10 V, 0…20 mA, 4…20 mA or as DO)</td>
<td>-</td>
</tr>
<tr>
<td>Decentralised analogue I/O</td>
<td>max. 96/96</td>
<td>max. 96/96</td>
</tr>
<tr>
<td>MODBUS connection</td>
<td>2 x integrated via coupler</td>
<td>integrated</td>
</tr>
<tr>
<td>ARCNET connection</td>
<td>integrated</td>
<td>integrated</td>
</tr>
<tr>
<td>Integrated safety field bus</td>
<td>AC31 safety field bus</td>
<td>AC31 safety field bus</td>
</tr>
<tr>
<td>Smart Media Card</td>
<td>Secures user program and data</td>
<td>-</td>
</tr>
<tr>
<td>Sequencers per 16 steps</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>Number of times</td>
<td>free via software</td>
<td>free via software</td>
</tr>
<tr>
<td>Number of counters</td>
<td>free via software</td>
<td>free via software</td>
</tr>
<tr>
<td>Real time clock</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 V DC</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Safety field bus</td>
<td>AC31 safety field bus, RS 485-BUS, 2 wire cable (twisted, screened) max. 31 in-situ modules, max. cable length 500 m (2000 m with Repeater), also via optical fibre (via converter) Cycle time for 31 modules with 8 digital inputs or outputs: 12 ms</td>
<td>AC31 safety field bus, RS 485-BUS, 2 wire cable (twisted, screened) max. 31 in-situ modules, max. cable length 500 m (2000 m with Repeater), also via optical fibre (via converter) Cycle time for 31 modules with 8 digital inputs or outputs: 12 ms</td>
</tr>
<tr>
<td>Mechanical construction</td>
<td>Modules in plastic enclosure, fixing via top-hat rail 35 mm to DIN EN 50 022 or using screws on assembly panel</td>
<td>Modules in plastic enclosure, fixing via top-hat rail 35 mm to DIN EN 50 022 or using screws on assembly panel</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>Cycle monitoring, battery monitoring, identification of syntax errors, checksum monitoring</td>
<td>Cycle monitoring, battery monitoring, identification of syntax errors, checksum monitoring</td>
</tr>
<tr>
<td>Dimensions (W x H x D)</td>
<td>240 x 140 x 85 mm</td>
<td>240 x 140 x 85 mm</td>
</tr>
</tbody>
</table>

Depth of device: 85 mm
COM 1 interface jack is placed lower so that the required installation depth doesn’t increase even for plugged in interface cables. If top-hat rails are used the installation depth increases by the overall depth of the rails.

(Dimensions for assembly drill holes are printed in bold type.)
### Advant Controller 31-S

#### Safety-related input/output modules

<table>
<thead>
<tr>
<th>Type</th>
<th>07 DI 90-S Safe inputs</th>
<th>07 DO 90-S Safe outputs</th>
<th>07 AI 90-S Safe analogue inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order number</td>
<td>GJR 525 0900 R 0202</td>
<td>GJR 525 0800 R 0202</td>
<td>GJR 525 1200 R 0202</td>
</tr>
<tr>
<td>Weight kg</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Number of digital channels</td>
<td>8</td>
<td>8</td>
<td>–</td>
</tr>
<tr>
<td>Number of analogue inputs</td>
<td>–</td>
<td>–</td>
<td>4</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Signal level/Measuring range</td>
<td>Short circuit after ZP: 0 ... 15 % of UP (0 ... 3.6 V at UP = 24 V) 0-Signal: 15 ... 35 % of UP (+3.6 ... 8.4 V at UP = 24 V) undefined level: 35 ... 65 % of UP (+8.4 ... 15.6 V at UP = 24 V) 1-Signal: 65 ... 85 % of UP (+15.6 ... 20.4 V at UP = 24 V) Short circuit after UP: 85 ... 100 % of UP (+20.4 ... 24.0 V at UP = 24 V)</td>
<td>0-Signal: 0 ... 3 V 1-Signal: &gt; UP - 2.5 V Monitoring 0-Signal: Output level &gt; 8 V (5 V typical) at starting state 0 (0-Signal) lead to internal error (device switches off)</td>
<td>4 ... 20 mA Error message &quot;Range - underflow&quot;: if input current &lt; 3.6 mA Error message &quot;overrange&quot;: if input current &gt; 20.4 mA</td>
</tr>
<tr>
<td>Potential separation against system bus</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Number of modules per line max. 8</td>
<td>max. 16</td>
<td>max. 6</td>
<td></td>
</tr>
<tr>
<td>max. switching current of the transistor outputs</td>
<td>–</td>
<td>0.5 A, short-circuit proof</td>
<td>–</td>
</tr>
<tr>
<td>Resolution</td>
<td>–</td>
<td>–</td>
<td>12 bit</td>
</tr>
<tr>
<td>Dimensions</td>
<td>120 x 140 x 85 mm</td>
<td>120 x 140 x 85 mm</td>
<td>120 x 140 x 85 mm</td>
</tr>
</tbody>
</table>

Depth of device: 85 mm if top hat rails are used, the installation depth increases by the overall depth of the rails.

(Dimensions for assembly drill holes are printed in bold type.)

#### Programming and test software, additional package

<table>
<thead>
<tr>
<th>Type</th>
<th>907 PC 33</th>
<th>907 PC 331</th>
<th>907 PC 338</th>
<th>907 PC 339</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>German</td>
<td>GJR 520 3900 R 0302</td>
<td>GJR 520 4500 R 0402</td>
<td>GJR 520 6700 R 0102</td>
</tr>
<tr>
<td>English</td>
<td>GJR 520 4000 R 0302</td>
<td>GJR 520 4600 R 0402</td>
<td>GJR 520 6800 R 0102</td>
<td>GJR 520 7600 R 0102</td>
</tr>
<tr>
<td>Description</td>
<td>Programming and test software</td>
<td>Programming and test software in AWL, FBS, KOP, system-specific part incl. software on disc, documentation</td>
<td>Additional package of safety functions for 07 KT 93-S incl. safety manual</td>
<td>Additional package of safety functions for 07 KT 94-S incl. safety manual</td>
</tr>
</tbody>
</table>
Safety control devices
Safety control devices

Rules for application

Safety Combinations types C 57x und C 581

The complete program of safety combinations has been especially designed for the requirements of state-of-the art safety technology. Safety combinations can be simply used to configure safety circuits, as the devices fulfill EN 60204-1 (VDE 0113 Part 1) and are certified by the German Trade Association (BG), German Statutory Industrial Accident Insurance Association (BIA) and the Swiss Accident Insurance Institution (SUVA).

Applications

Safety combinations cover wide range of possible applications. These include monitoring EMERGENCY-STOP and protective door devices. It is also possible to monitor press control systems.

Safety Combinations tend to be used for somewhat less complex safety circuits as conventional switching technology used with electromechanical contacts. Safety circuits using PLC technology (Advant Controller 31-S) can be used for more complex plants and systems with a high functional scope (e.g. with a diagnostics function when an EMERGENCY OFF is initiated). A fail-safe Advant Controller 31-S is frequently used if a Advant Controller is used for the non-safety-relevant control of the plant or system.

Positively-driven contacts, a plus for safety

Relays are often used for safety circuits. The special feature of ABB safety combinations is the fact that contactors or safety relays use positively driven contacts. In this case, ABB offer two Versions of safety combinations, and more specifically, using contactors (CC 570) or relays (C 571...C 581).

Contactor-type safety combinations (C 570)

Contactors have a high switching capacity. For safety combinations, rated operating currents of 6 A are possible for AC-1, and for DC-13, up to 6 A, and a thermal continuous current up to 10 A. This is also valid up to 55°C when mounted in a cabinet without having to derate the devices. With this performance data, you can optimally configure every safety circuit, and it is even possible to switch smaller drives directly using a safety combination. With a safety combination, additional main contactors are not required to switch higher ratings. That naturally saves costs.

Furthermore, high switching currents also mean more safety and safety combinations use auxiliary contactors with an extremely high contact reliability. Statistically, only 1 contact fault occurs every 100 million switching operations. These low fault statistics significantly increase the plant availability.

Relay-type safety combinations (C 571...C 581)

In recent years, the trend in low-voltage technology has been towards miniaturization of the switching devices. With newly-developed, smaller devices, it was possible to increasingly accommodate more functionality in a cabinet. It was therefore a logical step that when it came to safety technology, that there would also be demand for smaller, more compact safety combinations. ABB fulfilled this enhanced safety demand by using space-saving safety relays with positively-driven contacts. These safety relays switch so that they are intrinsically fail-safe. In this case, 2 contacts, which are independent of one another, have to be switched in series; normally so-called NO contacts of monostable relays are used. If a contact was to weld, then the 2nd contact, connected in series, is used to disconnect the circuit. A positively-driven NC contact is used to signal the fault, in this case the welded NO contact. This NC contact is actuated in synchronism with the NO contact. For example, if the NO contact is closed, then the NC contact, which is provided for monitoring, must be open and vice versa. Using these paired, positively-driven contacts, it is ensured that the safety relay also drops-out, if all of the contacts of the circuit to be protected are welded.

With this new-type of contact arrangement, the safety relay has positively-driven contacts, which are tested and recognized by SUVA and which fully conform to Standard ZH1/457.

The relay safety combinations C57x and 581 can be used in ambient temperatures of up to 60°C, up to 70°C with some restrictions when mounted in-line.

Many switching functions can be implemented using the series of C 57x and 581 safety combination. The following program overview shows the spectrum of devices available:
The safety combinations Series C 57x and C 581 consist of:

... Basic units  
... Expansion units, and  
... Press-control units.

Basic units

These are used to safely monitor EMERGENCY OFF devices and protective doors. The basic units have, in addition to instantaneous enabling contacts, also off-delayed enabling contacts. Depending on the device version, delay times of between 0.5 and 300 s are available.

A sealable protective cover can be provided to protect against unauthorized changes to the selected delay time.

EMERGENCY OFF devices must have priority over all of the other functions. The power feed to the machine drives, which can cause hazardous conditions, must be shut down as quickly as possible without creating other hazards. When the drives are reset, a restart may not be initiated. EMERGENCY OFF must act as stop, Category 0 or Category 1.

The basic safety combination units can be used for EMERGENCY OFF applications up to a maximum of Category 4 according to EN 954-1. Depending on the external circuitry and how the cables are routed to the sensors, Category 3 or Category 4 can be achieved.

Protective door monitoring according to EN 1088 makes a differentiation between latching, isolating protective devices, and latching isolating protective devices with tumbler.
Safety control devices

Rules for application

Safety combinations series are also used here. Control systems up to Category 4 according to EN 954-1 can be configured.

Expansion units

Expansion units may not be used separately in safety circuits, and they must be combined with a basic C 57x and 581 safety combination unit. An enabling contact of the basic unit is required to connect an expansion unit. The category of a control system with expansion unit corresponds to the category of the basic unit.

Presses and punches

The two-hand control device is a device where both hands of the operator must be simultaneously used. This protects the operator from hazards.

The overtravel tester is used for linear-driven presses and punches in accordance with VBG 7n5.2. It only checks once at the test stroke

… that the operator control elements have been correctly connected

… for external cable interruptions and breaks

… if the components which are cyclically monitored, have failed.

The overtravel tester can only be used in conjunction with a two-hand control device.

The press control devices and overtravel testers are suitable for installation in control system for eccentric, hydraulic and spindle presses. They can be used up to Category 4 in accordance with EN 954-1. Type III C according to EN 574 can be especially used for presses.
Type series C 57x

Safety control devices

**EMERGENCY OFF control gear and safety door watchdog C 570**

- 1-channel protective circuit
- Feedback cycle for monitoring external contactors
- LED indication for mains and operations
- Output: 4 NO and 2 NC positively driven
- Overall width: 75 mm
- Made up of contactor relays, switching capacity AC-1/AC-12: GA

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 570</td>
<td>24 V AC</td>
<td>1 SAR 501 042 R 0002</td>
<td>0.960 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 501 042 R 0004</td>
<td>0.960 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 501 042 R 0005</td>
<td>0.960 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 501 042 R 0003</td>
<td>0.960 kg</td>
</tr>
</tbody>
</table>

**EMERGENCY OFF control gear and safety door watchdog C 572**

- 1- or 2-channel protective circuit
- Automatic start/Monitored start
- 24 V DC at EMERGENCY OFF pushbutton or position switch
- Crossfault detection at the EMERGENCY OFF pushbutton or position switch
- Feedback cycle for monitoring external contactors
- LED indication for mains, channel 1 and 2
- Output: 3 NO and 2 NC positively driven
- Overall width: 45 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 572</td>
<td>24 V AC</td>
<td>1 SAR 501 032 R 0002</td>
<td>0.360 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 501 032 R 0004</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 501 032 R 0005</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 501 032 R 0003</td>
<td>0.360 kg</td>
</tr>
</tbody>
</table>

+ Attachment
Safety control devices

**Type series C 57x**

**EMERGENCY OFF control gear and safety door watchdog C 571**

- 1- or 2-channel protective circuit
- Automatic start/Monitored start
- Operational voltage $U_2$ at the EMERGENCY OFF pushbutton or position switch
- Feedback cycle for monitoring external contactors
- LED indication for mains, Channel 1 and 2
- Output: 2 S positively driven
- Overall width: 22.5 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_2$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 571</td>
<td>24 V AC/DC</td>
<td>1 SAR 501 020 R 0001</td>
<td>0.240 kg</td>
</tr>
</tbody>
</table>

**EMERGENCY OFF control gear and safety door watchdog C 573**

- 1- or 2-channel protective circuit
- Operational voltage $U_e$ at the EMERGENCY OFF pushbutton or position switch
- Feedback cycle for monitoring external contactors
- LED indication for mains, Channel 1 and 2
- Output: 3 NO, 1 NC positively driven
- Overall width: 22.5 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_e$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 573</td>
<td>24 V AC/DC</td>
<td>1 SAR 501 031 R 0001</td>
<td>0.240 kg</td>
</tr>
</tbody>
</table>

+ Attachment

- M 3.5
  - 0.8 ... 1.2 Nm
  - 7 ... 11 lb in
- 1 x $0.5 ... 4.0$ mm²
- 2 x $0.5 ... 2.5$ mm²
- 1 x $0.5 ... 2.5$ mm²
- 2 x $0.5 ... 1.5$ mm²
- AWG
  - 2 x 20 to 14
**Type series C 57x**

**Safety control devices**

**EMERGENCY OFF control gear and safety door watchdog with time delay C 574**

- 1- or 2-channel protective circuit
- Feedback cycle for monitoring external contactors
- LED indication for mains, Channel 1/2, delayed Channel 1/2
- Output: 2 NO, 1 NC time delayed
- Overall width: 45 mm

- Monitored start
  - Release time $t_v$ 0.5 to 30 s infinitely adjustable

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 574</td>
<td>24 V AC</td>
<td>1 SAR 503 041 R 0002</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 503 041 R 0004</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 503 041 R 0005</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 503 041 R 0003</td>
<td>0.450 kg</td>
</tr>
</tbody>
</table>

- Automatic start
  - Release time $t_v$ 0.5 to 30 s infinitely adjustable

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 574</td>
<td>24 V AC</td>
<td>1 SAR 503 141 R 0002</td>
<td>0.430 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 503 141 R 0004</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 503 141 R 0005</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 503 141 R 0003</td>
<td>0.430 kg</td>
</tr>
</tbody>
</table>

- Monitored start
  - Release time $t_v$ 0.05 to 30 s infinitely adjustable

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 574</td>
<td>24 V AC</td>
<td>1 SAR 533 241 R 0002</td>
<td>0.430 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 533 241 R 0004</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 533 241 R 0005</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 533 241 R 0003</td>
<td>0.430 kg</td>
</tr>
</tbody>
</table>

- Automatic start
  - Release time $t_v$ 0.05 to 30 s infinitely adjustable

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 574</td>
<td>24 V AC</td>
<td>1 SAR 533 141 R 0002</td>
<td>0.430 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 533 141 R 0004</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 533 141 R 0005</td>
<td>0.600 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 533 141 R 0003</td>
<td>0.430 kg</td>
</tr>
</tbody>
</table>

---

**Attachment and cover plate**

- 1 x (0.5 ... 2.5) mm²
- 2 x (0.5 ... 1.5) mm²
- 0.8 ... 1.2 Nm
- 20 to 14 AWG
Type series C 57x

Safety control devices

EMERGENCY OFF control gear and safety door watchdog C 576

- Automatic start
- Crossfault detection at the EMERGENCY OFF pushbutton or position switch
- 24 V DC at the EMERGENCY OFF pushbutton
- 2-channel protective circuit
- Feedback cycle for monitoring external contactors
- LED indication for mains, Channel 1, Channel 2 and mains
- Output: 2 NO positively driven
- Overall width: 22.5 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage Uc</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 576</td>
<td>24 V AC/DC</td>
<td>1 SAR 501 120 R 0001</td>
<td>0.240 kg</td>
</tr>
</tbody>
</table>

EMERGENCY OFF control gear and safety door watchdog C 577

- Monitored start
- Crossfault detection at the EMERGENCY OFF pushbutton or position switch
- 24 V DC at the EMERGENCY OFF pushbutton
- 2-channel protective circuit
- Feedback cycle for monitoring external contactors
- LED indication for mains, Channel 1, Channel 2 and mains
- Output: 2 NO positively driven
- Overall width: 22.5 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage Uc</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 577</td>
<td>24 V AC/DC</td>
<td>1 SAR 501 220 R 0001</td>
<td>0.240 kg</td>
</tr>
</tbody>
</table>
Type series C 57x

Safety control devices

Two-hand control C 575

- For switching on presses (e.g. in conjunction with follow-up testing device C 578)
- 24 V DC at the two-hand switches
- Feedback cycle for monitoring external contactors
- 5 LED output indicators for mains, S1 ON, S1 OFF, S2 ON, S2 OFF
- Simultaneity monitoring: 0.5 s
- Output: 2 NO, 2 NC positively driven
- Overall width: 45 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 575</td>
<td>24 V AC</td>
<td>1 SAR 504 022 R 0002</td>
<td>0.350 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 504 022 R 0004</td>
<td>0.350 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 504 022 R 0005</td>
<td>0.350 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 504 022 R 0003</td>
<td>0.350 kg</td>
</tr>
</tbody>
</table>

Dribbling inspection and test equipment C 578

- Crossfault detection at the EMERGENCY OFF pushbutton or position switch
- 24 V DC at the EMERGENCY OFF pushbutton
- Feedback cycle for monitoring external contactors
- LED indication for mains and release
- Output: 3 NO, 1 NC positively driven
- Controlled start
- Overall width: 45 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 578</td>
<td>24 V AC</td>
<td>1 SAR 505 031 R 0002</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 505 031 R 0004</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 505 031 R 0005</td>
<td>0.450 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 505 031 R 0003</td>
<td>0.450 kg</td>
</tr>
</tbody>
</table>
Safety control devices

Series C 57x und C 580

Extension device for extending the contact extension of the safety control device C 579

... Release contact of the basic device is required to connect to the extension device
... LED displays for mains, Channel 1 and 2
... 4 NO positively driven
... Overall width: 22.5 mm

<table>
<thead>
<tr>
<th>Type</th>
<th>Control voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 579</td>
<td>24 V AC/DC</td>
<td>1 SAR 502 040 R 0001</td>
<td>0.240 kg</td>
</tr>
</tbody>
</table>

Relay for monitoring underspeeds C 580

... Monitoring underspeed, stoppage, tripping or transport errors
... Speed pick up via three-core or NAMUR detecting element, contact or voltage
... Delay adjustable from 100 ms to 10 min in four time ranges
... On delay adjustable from 0.3 to 30 s
... LED indication of the voltage supply and the relay output

<table>
<thead>
<tr>
<th>Type</th>
<th>Supply voltage $U_c$</th>
<th>Order number</th>
<th>Weight per item</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 580</td>
<td>24 V AC</td>
<td>1 SAR 480 010 R 0002</td>
<td>0.255 kg</td>
</tr>
<tr>
<td></td>
<td>110 V AC</td>
<td>1 SAR 480 010 R 0004</td>
<td>0.255 kg</td>
</tr>
<tr>
<td></td>
<td>230 V AC</td>
<td>1 SAR 480 010 R 0005</td>
<td>0.255 kg</td>
</tr>
<tr>
<td></td>
<td>24 V DC</td>
<td>1 SAR 480 010 R 0001</td>
<td>0.255 kg</td>
</tr>
</tbody>
</table>

Without locking

With locking
## Technical data/Certifications

### Safety control devices

#### Technical data

<table>
<thead>
<tr>
<th>Type</th>
<th>C 570</th>
<th>C 571</th>
<th>C 572</th>
<th>C 573</th>
<th>C 574</th>
<th>C 575</th>
<th>C 576</th>
<th>C577</th>
<th>C 578</th>
<th>C 579</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-channel connection</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-channel connection</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Crossfault safety</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Test certificates

- BIA, SUVA (BG, SUVA; UL, CSA)

#### Safety category to EN 954-1

- (3) 2) (4) 3)

#### Mechanical service life

- 3 million switching cycles

#### Rated insulation voltage $U_i$

- 250 V - control circuit
- 400 V - output contacts

#### Rated impulse withstand voltage $U_{imp}$

- 1.5 kV - control circuit
- 4 kV - output contacts

#### Permissible ambient temperature

- For operations: -25 to +55 °C
- For storage: -25 to +60 °C (suitable for side by side construction)

#### Protection category to EN 60 529

- IP 20

#### Fouling factor

- 3

#### Rated power DC/AC

- 6 W
- 1.5 W
- 3 W
- 4 W
- 1.5 W
- 3 W
- 1.5 W
- 4 W
- 1.5 W

#### Switching rate

- 500/h for AC-15 and DC-13
- 1 000/h for load with $I_e$

#### Shock resistance

- Rectangular impulse: 10/5 and 6/10 g/ms
- Sinusoidal impulse: 8 g / 10 ms
- Half sinus to IEC 60 068

#### Short circuit protection

- Fuse links for release/signalling contacts: NH, NEOZED, DIAZED
- Operating classes: NH Type 3 NA, DIAZED Type 5 SB, NEOZED Type 5 SE 6 A
- gl7gG

#### Wire ranges

- Fine-wired with wire end ferrules: 2x (0.5 – 1.5) mm² or 2x (0.5 – 2.5) mm²
- Single-cored: 2x (0.5 – 2.5) mm² or 2x (0.5 – 4.0) mm²

#### Tightening torque

- Clamping piece M 3.5: 0.8 to 1.2 Nm

#### Electrical service life for $I_e$

- 100,000 switching cycles

#### Rated operational current to IEC 60 947-5-1

- AC-activation: 6 A up to 230 V / 4 A
- DC-activation: 5 A
- 115 V / 5 A
- 230 V / 5 A
- 24 V / 2 A
- 115 V / 0.2 A
- 230 V / 0.1 A

#### Thermal continuous current $I_{th}$ at:

- UT 70 °C: 4.0 A
- UT 60 °C: 4.5 A
- UT 50 °C: 5.0 A

#### Permissible normal position

- any

#### Device width in mm

- 75
- 22.5
- 45
- 22.5
- 45
- 22.5
- 22.5
- 45
- 22.5

#### Certifications

<table>
<thead>
<tr>
<th>Committee</th>
<th>C 570</th>
<th>C 571</th>
<th>C 572</th>
<th>C 573</th>
<th>C 574</th>
<th>C 575</th>
<th>C 576</th>
<th>C 577</th>
<th>C 578</th>
<th>C 579</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Employers’ Insurance Association BG, Electronics Committee</td>
<td>-</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TÜV Rheinland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>SA Sweden</td>
<td>yes</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>UL</td>
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<td>yes</td>
<td>yes</td>
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<tr>
<td>CSA</td>
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<tr>
<td>BA</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>Suva</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1) Possible with additional external measures
2) Only applies for undelayed contacts, Category 3 applies for time delayed contacts
3) Applied for
4) IP 20 terminals, IP 40 enclosure
5) Fusing supply: C 570: G-fuse flint/carrier, circuit breaker A, B, C-characteristics

■ Granted
☒ Applied for
Selection tables/Accessories

Safety control devices

Selection table according to the risk category (EN 954-1)

<table>
<thead>
<tr>
<th>Category</th>
<th>C 570</th>
<th>C 571</th>
<th>C 572</th>
<th>C 573</th>
<th>C 574</th>
<th>C 575</th>
<th>C 576</th>
<th>C 577</th>
<th>C 578</th>
<th>C 579</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Possible with additional external measures.
2) Only applies for undelayed categories. Category 3 applies for delayed contacts.

Selection table according to device properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>C 570</th>
<th>C 571</th>
<th>C 572</th>
<th>C 573</th>
<th>C 574</th>
<th>C 575</th>
<th>C 576</th>
<th>C 577</th>
<th>C 578</th>
<th>C 579</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMERGENCY OFF</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
</tr>
<tr>
<td>Safety doors</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Mats</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Two-hand operation e.g. pressing</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Feedback cycle for monitoring external contactors</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
</tr>
<tr>
<td>Single-channel</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Two-channel</td>
<td>–</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Crossfault monitoring</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>24 V DC at the EMERGENCY OFF position switch</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Operational voltage at the EMERGENCY position switch</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Number of release contacts</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Number of time-delayed release contacts</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Number of signalling contacts</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Overall width in mm</td>
<td>75</td>
<td>22.5</td>
<td>45</td>
<td>22.5</td>
<td>45</td>
<td>45</td>
<td>22.5</td>
<td>45</td>
<td>22.5</td>
<td>45</td>
</tr>
<tr>
<td>Check dribbling e.g. pressing</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Automatic start</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Controlled start</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>yes</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

3) Contact extension
4) 2 semi-conductor A

Accessories

Cover plate sealable

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
<th>Order number</th>
<th>Packaging unit each</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 560.10</td>
<td>For securing against unauthorised adjustments</td>
<td>1 SAR 390 000 R 1000</td>
<td>5 sets</td>
</tr>
</tbody>
</table>

Attachment for screw fixing

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
<th>Order number</th>
<th>Packaging unit each</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 560.20</td>
<td>Assembly of the safety relay C 571 – C 579 without top DIN-rail assembly panel</td>
<td>1 SAR 390 000 R 2000</td>
<td>5 sets each with 2 items</td>
</tr>
</tbody>
</table>
Safety control devices

Dimension drawings

C 570

C 571, C 573, C 576, C 577, C 579
Safety control devices

C 572, C 574, C 575, C 578

C 580
Series C 67xx

Safety control devices

Series C 67xx electronic safety relay

... Monitoring device for connected sensors (e.g. position switch, EMERGENCY OFF pushbutton) and
actuators (positively driven standard small contactors)
... electronic selection of the actuators, therefore no wear
... Sensors supplied with 24 V DC
... no contact failure for currents up to 17 V, 1 mA
... short circuit save
... High operating frequency
... Small overall width, overall depth / low weight

Basic device C 6700

... without own safe outputs
... in conjunction with positively driven actuators: max. category 3 to EN 954-1
... Overall width 22.5 mm
... $U_i = 24$ V DC
... $U_e = 24$ V DC
... $I_e = 0.5$ A DC 13

Safety device C 6701

... with electronic outputs
... direct switching off of consumers possible: up to Category 3 or 4 to EN 954-1
... Overall width 22.5 mm
... $U_i = 24$ V DC
... $U_e = 24$ V DC
... $I_e = 1.5$ A DC 13

Safety device C 6702

... with electronic outputs
... direct switching off of consumers possible: up to Category 3 to EN 954-1
... Stop categories 0 and 1
... Adjustable time delay 0.05 – 3 s or 0.5 – 30 s
... Overall width 22.5 mm
... $U_i = 24$ V DC
... $U_e = 24$ V DC
... $I_e = 1.5$ A DC 13
# Series C 67xx

Safety control devices

## Selection table according to device properties / order data

<table>
<thead>
<tr>
<th>Type</th>
<th>C 6700</th>
<th>C 6701</th>
<th>C 6702</th>
<th>C 6702</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>1 SAR 510 120 R 0003</td>
<td>1 SAR 511 320 R 0003</td>
<td>1 SAR 543 320 R 0003</td>
<td>1 SAR 513 320 R 0003</td>
</tr>
<tr>
<td>Automatic start</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Monitored start</td>
<td>-</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Single-channel</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Two-channel</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>EMERGENCY OFF</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Safety door</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Release contact potential free stop-Cat. 0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Release contact potential free stop-Cat. 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Release contact electronic stop-Cat. 0</td>
<td>2&lt;sup&gt;1)&lt;/sup&gt;</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Release contact electronic stop-Cat. 1</td>
<td>-</td>
<td>-</td>
<td>1, tv = 0.05 – 3 s</td>
<td>1, tv = 0.05 – 30 s</td>
</tr>
<tr>
<td>Enclosure width in mm</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
</tr>
<tr>
<td>Signalling contacts</td>
<td>-</td>
<td>2&lt;sup&gt;2)&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Achievable category to EN 954-1</td>
<td>B</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td></td>
<td>1</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Rated control feed voltage U&lt;sub&gt;s&lt;/sub&gt;</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
</tr>
</tbody>
</table>

1<sup>)</sup> Outputs are only safe in conjunction with external contactors
2<sup>)</sup> Release contact can be used as signalling contact.
EMERGENCY OFF device

EN 60204 Part 1 specifies that when a hazardous situation occurs, a machine must be stopped as quickly as possible using EMERGENCY OFF.

According to EN 60204-1, stop Categories 0 and 1 are permitted.

There are 2 ways to fulfill these requirements:

… Directly using an EMERGENCY OFF switch

… Using an arrangement of control circuits which allows all of the appropriate main circuits to be reliably and safely disconnected with one single command.

Protective door monitoring

Protective equipment is used to ensure the safety of operating personnel. If protective equipment is removed or opened, then all movements which cause these hazards must be permanently and effectively stopped. The machine can only be entered after it has come to a complete final stop.

Redundancy

Redundancy is present if there are more control- or drive lines than actually required to fulfill a specific function. Using redundancy, it is possible to reduce the probability that a single fault in an electrical circuit will result in a hazardous condition. For safety-related circuits, for reasons of redundancy, at least 2 switching devices than are required (input circuit/sensor control and load circuit/actuators).

Two-channel configuration

EN 60204 does not expressly specify two-channel configurations. The Standard states that the Category, according to EN 954-1, must be defined using a risk analysis. A two-channel EMERGENCY OFF circuit is used in environments with a high degree of dirt accumulation.

Cross-circuit safety/ cross-circuit identification

With a two-channel control configuration, a device can identify a cross-circuit or a connection between the two externally operated control elements (e.g. EMERGENCY OFF or limit switch). If a cross-circuit occurs due to a damaged connecting cable, then the device goes into the safe initial condition.

The cross-circuit identification is realized using different potentials in the momentary-contact circuit.

Ground-fault detection

The device identifies a connection between the sensor cable and ground potential and it goes into a safe condition. The device becomes operational again after the fault has been removed.

Diversity

In order to minimize the probability that faults and failures can result in hazardous conditions, diversity is required. This is either achieved using different functional principles or by using different devices. In safety circuits, this is achieved by combining NC and NO contacts.

Enabling contacts

Enabling contacts are safety contacts, which are always realized as NO contacts. This means that if the safety combination is in the ON condition, the enabling contacts must be closed. Enabling contacts may also be used for signaling.

Signaling contacts

Signaling contacts can either be realized as NC contact or as NO contact. However, it is not permissible that they are used for enabling circuits.

“Ready ON”

ON button “Ready ON” are used to enable safety combinations.

After the main switch (circuit-breaker) of the machine has been closed or the safety combination has been initiated, the ON button “Ready ON” must be actuated, so that the safety combination is enabled.
Safety control devices

Automatic start

In this case, the connecting terminals of the safety combination for the ON button “Ready ON” are jumpered. The safety combination automatically enables itself, as soon as the shutdown condition has been removed (e.g. after the protective door is re-closed). This circuit is not permissible for EMERGENCY OFF circuits and for door monitoring functions, even if a hazardous condition cannot occur.

Cable lengths

In a machine or a system, generally several sensors, such as EMERGENCY OFF switches and position switches are used to monitor protective doors. Depending on the complexity of the machine or system, long cables may be required to connect-up the sensor systems. In order that the safety combinations operate error-free, it must be ensured that certain cable lengths are not exceeded.

The permissible cable length is dependent on 3 factors.

1. Short-circuit shutdown

When a short-circuit occurs between the sensor cables or a short-circuit in the device, the safety combination must safely shut down and the device may not be damaged.

2. Safety switch-on

The voltage available at the relay coils within the unit must be high enough, so that the response voltage is reliably reached. If this is not the case, then the safety combination cannot go into safe operation. The safe condition is not jeopardized, however it is not possible to operate the plant or system.

3. Safety shutdown

The voltage at the relay coils inside the unit must be low enough so that the drop-out voltage is safely fallen below. This is especially important for AC operation, where although the sensors are shut down, sufficient current can flow as a result of cable capacitances so that the relay cannot drop-out. For this reason, for relay-type safety combinations, the sensor cables are always fed with DC.
## Terminology

### Safety control devices

The following calculation uses as an example the C 577 relay

**Assumed values:**
- **Cable:** 2 x 2.5 mm²
- **Voltage drop:** 5 %
- **Specific conductivity for Cu:** 49.3 S/m.mm² (bei 55 °C)
- **Cable capacitance:** 170 nF/km

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Calculation</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cross-circuit shutdown</td>
<td>$R_L = \frac{22.8 \text{ V}}{0.55 \text{ A}} - 22 \Omega = 19.5 \Omega$</td>
<td>$I = 19.5 \Omega \cdot 2.5 \text{ mm}^2 \cdot 49.3 \frac{\text{ Sm}}{\text{ mm}^2} = 2403 \text{ m}$</td>
</tr>
<tr>
<td>2. Safety switch-on</td>
<td>$R_L = \frac{22.8 \text{ V} \cdot 400 \Omega}{20.4 \text{ V}} - 400 \Omega - 22 \Omega = 25 \Omega$</td>
<td>$I = 25 \Omega \cdot 2.5 \text{ mm}^2 \cdot 49.3 \frac{\text{ Sm}}{\text{ mm}^2} = 3081 \text{ m}$</td>
</tr>
<tr>
<td>3. Safety shutdown</td>
<td>$C_L = \frac{1}{\omega \cdot R_L}$</td>
<td>$R_L = -400 \Omega - 22 \Omega = 25 \Omega$</td>
</tr>
</tbody>
</table>

**Result**

To determine the single cable length, the lowest value of the 3 possibilities shown above, should be used. In this case it involves an outgoing and incoming cable. The maximum single cable length for this particular example is

$I = \frac{2403 \text{ m}}{2} = 1200 \text{ m}$

---

**Example to calculate the cable length**

---

![Graph showing possible single cable lengths for sensors C 571/C 572/C 573/C 574/C 575/C 576/C 577/C 578](image-url)

Possible single cable lengths for sensors C 571/C 572/C 573/C 574/C 575/C 576/C 577/C 578
### Terminology

#### Safety control devices

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Limiting using a fuse to interrupt the short-circuit (VDE 0636)</td>
<td></td>
<td>158 m</td>
<td>158 m</td>
<td>747 m</td>
<td>1569 m</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Voltage drop 5%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2. Limiting to guarantee safety switch-on of the units</td>
<td>Maximum permissible single cable length due to the ohmic voltage drop (distance)</td>
<td></td>
<td></td>
<td></td>
<td>296 m</td>
<td>296 m</td>
<td>6124 m</td>
<td>27166 m</td>
<td></td>
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<tr>
<td>3. Limiting to guarantee safety shutdown of the units</td>
<td>Maximum permissible single cable length due to the cable capacitance (distance)</td>
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<td></td>
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<tr>
<td>4. Combination of Points 1 to 3</td>
<td>Permissible single cable length (distance)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Maximum permissible cable lengths for contactor safety combinations

The following data is assumed when calculating the cable lengths:

- Voltage drop 5%
- Copper cable, 2 x 2.5 mm²
  - with $K = 49.3 \frac{m}{\Omega \cdot \text{mm}²}$ (at 55°C)
- Capacitance 170 nF/km
- Line supply frequency 50 Hz (this is only relevant for AC-operated units) external to the block
- 2 A gL fuse outside the block (the required short-circuit current, which causes the fuse to rupture at the latest after 5 s, is 9 A)
- Series impedance 0.1 W (control transformer, feeder cable etc.).
Circuit examples
Switch safely

Circuit examples

The following circuit examples have been harmonized with the German Trade Association (BG) and have been approved.

... Contactor circuits
... Safety combinations using contactors using safety relays

Suitable for:
... EMERGENCY OFF
... Protective door monitoring functions
... Press controls

EMERGENCY OFF circuits for extremely simple machines

EMERGENCY OFF switch
The EMERGENCY OFF function may only be fed through an EMERGENCY OFF switch for extremely simple machines, depending on the result of a risk analysis. In this particular case, only Stop Category 0 is possible. Such an EMERGENCY OFF switch switches, contrary to usual EMERGENCY OFF pushbuttons, the main circuit (circuit diagram 1).

An EMERGENCY OFF switch must be configured, so that

... There is only one EMERGENCY OFF switch;

... the EMERGENCY OFF switch is located in the supply to those circuits which can result in hazardous motion in the system. The complete power supply to all of the circuits does not have to be interrupted;

... the EMERGENCY OFF switch must be able to interrupt the current of the largest motor when the motor stalls;

... the sum of the currents of all of the loads which must be disconnected using the EMERGENCY OFF switch must be able to be safely interrupted.

An EMERGENCY OFF switch may

... be manually actuated;

... act on an undervoltage release via one or several EMERGENCY OFF control devices (circuit diagram 1);

... be provided with overload- and/or short-circuit releases (version as circuit-breaker);

... be simultaneously used as main switch, if it additionally fulfills the requirements for a main switch (however, a main switch must disconnect all circuits).

An example for such an EMERGENCY OFF switch for extremely simple machines is illustrated in circuit diagram 2.

Circuit diagram 1: EMERGENCY OFF switch with manual actuation or remote actuation via undervoltage release

Circuit diagram 2: Example of a machine control with EMERGENCY OFF switch (this is only permissible with some restrictions)
Switch safely

Circuit examples

 generally, a so-called EMERGENCY OFF contactor is not permitted. Such a contactor is only permissible in precisely defined exceptional cases: This contactor may only be used as an EMERGENCY-STOP contactor in the branch to be shutdown. Additional contactors in series are not permitted. This means that this concept is restricted for applications on extremely simple machines (refer to circuit diagram 3).

An EMERGENCY OFF contactor must be configured, so that

- each EMERGENCY OFF contactor must be immediately de-energized by the EMERGENCY OFF control device;
- there are no additional contactors in series.

Safety circuits using individual contactors

Configured using two auxiliary contactors
Safety circuits of any complexity can be configured using auxiliary contactors. Up to several years ago, the circuit with two auxiliary contactors and overlapping auxiliary contacts (circuit diagram 4) was considered to be state-of-the-art.

This circuit offers redundancy. However, due to the fact that the contacts are not positively driven, the two auxiliary contactors do not mutually monitor each other for correct functioning. This means, that if a contact welds, this fault is not detected and the circuit still continues to function.

A subsequent fault in the second contactor could completely disable the combination. This would mean that the level of safety would no longer be guaranteed. Thus, today, this circuit is no longer used (circuit diagram 4).

Using three auxiliary contactors
Today, circuits with three auxiliary contactors represent state-of-the-art technology. Three auxiliary contactors, with positively-driven contacts are used, as shown in circuit diagram 5. The three auxiliary contactors guarantee redundancy and function monitoring. The positively-driven contacts guarantee that the auxiliary contactors mutually monitor themselves. Faults are therefore detected and the circuit can not longer be closed after shutdown, therefore eliminating subsequent faults.

With this circuit, using today’s state-of-the-art technology, it can be assumed that if the auxiliary contactors incorrectly function this will not result in a hazardous status in the system.
Switch safely

Circuit examples

Connecting several EMERGENCY OFF control devices

In the previous circuit diagrams, only one EMERGENCY OFF device was shown. Generally, there are several EMERGENCY OFF control devices (e.g. at different locations) on a machine. The contacts of these EMERGENCY OFF control devices are then connected in series.

Several auxiliary contactors are combined to form a safety circuit in the form of the C 57x contactor safety combinations. Naturally, the circuits can also be implemented using individual contactors.

Circuit examples to monitor protective devices

Circuits to monitor protective devices use position switches. Various possibilities of the different devices are shown in the examples for EMERGENCY OFF. These circuit examples will not be repeated here as the EMERGENCY OFF control device is only replaced by one or two position switches per protective device.

Classification in Categories according to EN 954-1

The classification of circuits into categories according to EN 954-1 has now been made clear using the previous examples.

The classification below, is valid when the wiring is correctly realized according to the published circuit diagrams, also under difficult ambient conditions, for example dirty industrial environments (pollution level 3).

If special care is taken connecting-up the wiring, it may be possible to achieve a higher safety category, e.g. using separate cables or routing the cable to EMERGENCY OFF contacts and position switches so that it is mechanically protected (e.g. in special cable ducts). Thus, Category 4 can be achieved without having a cross-circuit proof configuration, under the assumption, that the appropriate peripheral devices are used.

The internal circuit diagrams are valid for DC-operated devices. The AC-operated combinations essentially correspond to those for DC operation. Only the polarity protection diode V1 is eliminated and a bridge rectifier is located in front of every contactor. This mean that AC-operated contactor safety combinations can also be used for DC voltages with some restrictions.

<table>
<thead>
<tr>
<th>Category acc. to EN 954-1</th>
<th>Circuit version</th>
<th>Possible equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, 1, 2</td>
<td>Single channel</td>
<td>Possible with all basic- and expansion devices</td>
</tr>
<tr>
<td>3</td>
<td>Two channel</td>
<td>C 571 - C 575 also in conjunction with one or several expansion units</td>
</tr>
<tr>
<td>4</td>
<td>Two channel and cross-circuit proof</td>
<td>C 572/C 574/C 575 also in conjunction with one or several expansion units.</td>
</tr>
</tbody>
</table>
Immediately after the power returns (it is not necessary to open and close the protective device):

The “Ready ON” is not required (jumper X5–X6), if the resulting automatic reclosure (restart) does not represent potential danger.
Relay safety combinations C 57x

Circuit examples

Function description

**Power-on**
Connect the power, the "Power" LED is lit, EMERGENCY OFF closed, C1 is charged, press ON, C1 is charged, V1 are energized, K2 starts, K1 + K2 latch, "Channel 1" and "Channel 2" LEDs are lit.

**ON monitoring**
ON is pressed → fault! EMERGENCY OFF closed, V1 immediately start K2, C1 is not charged → K1 does not start. Only the "Channel 2" LED is lit.

**Cross-circuit**
If EMERGENCY OFF 1 and EMERGENCY OFF 2 are short-

Circuit diagrams:

1. **Circuit diagram 11:** Internal circuit diagram of the C 573
2. **Circuit diagram 12:** Internal circuit diagram of the C 577
3. **Circuit diagram 13:** Function description C 577
Relay safety combinations C 57x

Circuit examples

The following circuit diagrams have been harmonized with the German Trade Association (BG) and also approved.

**EMERGENCY OFF (EMERGENCY-STOP) circuits**

Circuit diagram 14: C 571/C 573 for EMERGENCY OFF, Category 2, single-channel, with feedback circuit

Circuit diagram 15: C 571/C 573 for EMERGENCY OFF, Category 3 (4), two-channel, with feedback circuit

Circuit diagram 16: C 577 for EMERGENCY OFF, Category 4, two-channel, with feedback circuit, monitored start

---

Circuit diagram 14:
- **C 571/C 573**
- EMERGENCY OFF
- K1, K2, K3
- A1, Y1
- Y2
- 24 V AC/DC
- L/+
- N/-

Circuit diagram 15:
- **C 571/C 573**
- EMERGENCY OFF
- K1, K2
- A1, Y1
- Y2
- 24 V AC/DC
- L/+
- N/-

Circuit diagram 16:
- **C 577**
- EMERGENCY OFF
- K1, K2
- Y11, Y12, A2
- Y13, Y14
- 24 V AC/DC
- L/+
- N/-
Relay safety combinations C 57x

Circuit examples

Circuit diagram 17: C 572 EMERGENCY OFF, Category 2, single-channel, according to EN 954-1, monitored start

Circuit diagram 18: C 572 EMERGENCY OFF, Category 4, two-channel, according EN 954-1, monitored start

Circuit diagram 19: C 574 EMERGENCY OFF, Category 2, two-channel, according EN 954-1, monitored start
Relay safety combinations C 57x

Circuit examples

Circuit diagram 20: C 574 EMERGENCY OFF, Category 3, two-channel, according EN 954-1, monitored start

Circuit diagram 21: C 574 with switch off in Stop-cat. 1, Category 3 acc. EN 954-1, two-channel, with feedback control loop, monitored start

Circuit diagram 22: C 577 expanded by C 579 for EMERGENCY OFF, Category 4 acc. to EN 954-1, two-channel, with feedback circuit
Circuit examples

Circuit diagram 23: C 572 expanded by C 579 for EMERGENCY OFF, Category 4 acc. to EN 954-1, two-channel, monitored start

Circuit diagram 24: C 574 expanded by C 579 for EMERGENCY OFF, Category 4 acc. to EN 954-1, two-channel, monitored start
Relay safety combinations C 57x

Circuit examples

Protective door monitoring

Circuit diagram 25: C 571/C 573 for protective door monitoring (2 protective doors are cascaded, each with 1 position switch), Category 2 acc. to EN 954-1, single-channel with feedback circuit, autostart.

Circuit diagram 26: C 571/C 573 for protective door monitoring with tumbler (2 protective doors are cascaded, each with 2 position switches with tumbler), Category 2 acc. to EN 954-1, single-channel with feedback circuit, autostart.
Circuit examples

Circuit diagram 27: C 571/C 573 for protective door monitoring (2 protective doors are cascaded, each with 2 position switches), Category 3 (4) acc. to EN 954-1, two-channel with feedback circuit, autostart (∞ for Category 4 – the cable has to be routed so that it is especially protected)

Circuit diagram 28: C 576 for protective door monitoring (2 protective doors are cascaded, each with 1 position switch), Category 4 acc. to EN 954-1, two-channel with feedback circuit, autostart
Relay safety combinations C 57x

Circuit examples

Circuit diagram 29: C 572 for protective door monitoring (2 protective doors are cascaded, each with 1 position switch), autostart, Category 2 acc. to EN 954-1, single-channel, with feedback circuit

Circuit diagram 30: C 572 for protective door monitoring with 2 position switches, autostart, Category 4 acc. to EN 954-1, two-channel, with feedback circuit
Circuit examples

Circuit diagram 31: C 574 for protective door monitoring (2 protective doors are cascaded, each 1 position switch), stop Category 1, Category 2 acc. to EN 954-1, single-channel, with feedback circuit, autostart

Circuit diagram 32: C 574 for protective door monitoring with 2 position switches, stop Category 1, Category 3 acc. to EN 954-1, two-channel, with feedback circuit, autostart
Circuit examples

Circuit diagram 33: C 572 expanded by C 579 for protective door monitoring with 2 position switches, Category 4 acc. to EN 954-1, two-channel, with feedback circuit, autostart
Circuit examples

Press control devices

Circuit diagram 34: Internal circuit diagram of the C 575 two-hand control device

Circuit diagram 35: C 575 two-hand control device, Category 4 acc. to EN 954-1

Operating voltage A1 L/+  
Outputs 13, 14 Enable circuit 1 (NO contact)  
23, 24 Enable circuit 2 (NO contact)  
31, 32 NC contact  
41, 42 NC contact  
Inputs Y11, Y12 Feedback circuit  
Y21, Y22, Y23 Pushbutton S1  
Y31, Y32, Y33 Pushbutton S2

➀ Power supply unit  
➁ PTC fuse  
➂ Control logic  
➃ Channel 1  
➄ Channel 2  
➅ Safety circuits

S1, S2 buttons on the two-hand operating console  
H1 Signaling lamps  
K1, K2 must be contactors with positively-driven contacts
Circuit examples

Relay safety combinations C 57x

Circuit diagram 36: Internal circuit diagram of the C 578 overtravel tester

Circuit diagram 37: C 575 two-hand control device in conjunction with a C 578 overtravel tester to monitor the overtravel in linear hydraulic-, pneumatic- and spindle presses acc. to VBG 7 n 5.2 § 11, Category 4 acc. to EN 954-1
**Circuit examples**

**Sequence after the press has been powered-up:**

1. The hydraulic pump is powered-up with S5, the ram is moved up to upper dead center, if required, using S6.
2. Press S1, S2 at the two-hand operating console until the position switch for the test cams (S4) opens.
3. Release S1, S2
4. Depress S1, S2 again: Signal lamp H1 lights-up (bright), if the overtravel is OK.
5. Release S1, S2: The ram returns to the upper dead center.
6. If the overtravel is OK, all of the outputs remain active until the control voltage is disconnected.

**Fault situation**

If the cam actuates position switch S4, then the signal lamp H1 is not lit-up. The machine part, which is potentially hazardous, can then only be moved to the upper dead center using S6.

This press can then no longer be used. Contact the technician to check the press.

A more detailed description of the function of the C 575 two-hand control device is provided in the Instruction Manual, Order No. 1 SAC 105 798 S 4001.

---

**Overtravel OK**

1. Power ($U_5$) on.
2. S5 is pressed, K1 pulls-in (latches).
3. S6 is pressed, K2 pulls-in (the ram moves upwards in the manual mode).
4. The upper dead center is reached, S3 is actuated.
5. S6 is released, K2 drops-out.
6. S1 and S2 are pressed on the two-hand operating console, the two-hand control device C 575 outputs an enable signal, K3 and K4 pull-in.
7. The ram moves downward, S3 is no longer actuated.
8. Test cams are reached, S4 is actuated, K3 drops-out.
9. **The ram remains stationary**, S1, S2 are released, K4 drops-out.
10. S1, S2 are pressed, K4 pulls-in again, H1 lights up.
11. S1, S2 are released, K4 drops-out. K2 pulls-in, the ram moves upwards.
12. S4 is no longer actuated.
13. Upper dead center is reached, S3 is actuated.
14. S1 and S2 are pressed, K2 drops-out, K3 and K4 pull-in.
15. The ram moves downwards, S3 is no longer actuated.
16. S1, S2 are released, K3 and K4 open. K2 pulls-in, points 14 to 16 are repeated at each stroke of the press.
Function schematic of the press control. The permissible overtravel “s” corresponds to the length of the cam which actuates position switch S4. According to ZH 1/456, the press manufacturer must define “s”. 

**Overtravel too long**

1. Power (Uₜ) on.
2. S5 is pressed, K1 pulls-in (latches).
3. S6 is pressed, K2 pulls-in (the ram moves upwards in the manual mode).
4. The upper dead center is reached, S3 is actuated.
5. S6 is released, K2 drops-out.
6. S1 and S2 on the two-hand operating console are pressed, the C 575 two-hand control device outputs enable signals, K3 and K4 pull-in.
7. The ram moves downwards, S3 is no longer actuated.
8. Test cams are reaches, S4 is depressed, K3 drops-out.
9. **The ram does not remain stationary**, S4 is no longer actuated (is passed-over), K3 pulls-in.
10. S1 and S2 are released, K3 and K4 drop-out.
11. S1 and S2 are actuated, K4 zieht pulls-in again. Overtravel tester is inhibited.
Relay safety combinations C 580

Circuit examples

Circuit diagram 38: Relay for monitoring underspeeds C 580

A1 – A2 Voltage supply
11 – 12 – 14 Output relay (R)
+24 V – E – O V Three wire detecting element PNP
E – O V Voltage input
8 V 2 – Y2 Contact input/Namur detecting element
Electronic safety relay C 67xx

Circuit examples

Circuit diagram 39: Principle internal wiring diagram of the electronic safety relay C 6701

Circuit diagram 40: Principle wiring diagram of a safe load feeder with C 6700 and positively driven small contactors.
Appendix
Certificate of Compliance

Certificate Number: 702751

Date Issued: April 27, 2000

Issued to: ABB Schalt-Und Steuerungstechnik GmbH
Eppelheimer Strasse 82
Heidelberg, D-69120
GERMANY

The products listed below are eligible to bear the CSA Mark

Issued by: Carole Lemay
Montréal, QC Canada

Signature:

PRODUCTS

CLASS 3211 03 - INDUSTRIAL CONTROL EQUIPMENT - Motor Controllers - Auxiliary Devices

- Auxiliary switch, open types, Type HK4-W rated B600, R600 (1NO + 1NC) same polarity
  Type HK4-11 rated C300, R300 (1NO + 1NC) opposite polarity, 1A, 240V ac general use.
- Auxiliary switch, open types, Types HKS4-11 or HKC4-11(1 NO and 1 NC), HKS4-20 or
  HKC4-20, (2 NO) and HKS4-02 or HKC4-02 are rated A600 Q300 opposite polarity.
- Alum switch, open type, Types SK-11 (2NO and 2NC) rated A600 Q300, 10A 240V ac general
  use.
- Undervoltage tripping units, open type, Series UA4 or AA4, operating voltage 300V ac max, 240V dc
  max.
- Backup combination unit, open type, C570, coil voltage 24Vdc, 240V ac max, contacts 6A
  240V ac, 1/4 hp 120V ac 1 ph, 3/4 hp 120V ac 3 ph, 1/2 hp 240V ac 1 ph, 1-1/2 hp 240V ac 3
  ph code rated A300, Q300.
- Solid State Motor Protector, Type C505 and C506 with the following ratings, Control Voltage 24
  Vdc, 24V up to 240V ac/dc, 110 up to 120V ac, 220 up to 240V ac or 110 up to 120V/220 up to 240V
  ac. Output ratings B300/R300, for use with PTC thermistors.

Notes:
1. The type designation may be completed with suffixes indicating electrical and mechanical details.
2. Certified as component for use only in certified equipment where the acceptability of the combination is to be determined by the Canadian Standards Association.
Baumusterprüfbescheinigung

Name und Anschrift des Bescheinigungsinhabers: ABB Schalt- und Steuerungstechnik GmbH
Eppelheimer Straße 92
69123 Heidelberg
(Auftraggeber)

Name und Anschrift des Herstellers: siehe Auftraggeber

Zweck des Auftraggebers: Zahlen der Prüf- und Zertifizierungsstelle: 23.520.25/06-3-34/03-14 Gom-Cw
Ausstellungsdatum: 1. März 1999

Produktbezeichnung: Sicherheitskombination

Typ: C571

Bestimmungsgemäße Verwendung:

Prüfgrundlage:
- "Niederspannungsrichtlinie" (52.97)
- "ENR" (52.97)
- "Grundzüge für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen" (52.97)

Bemerkungen: Die obigen Produktfehler erfüllen die Anforderungen der Kategorie 4 nach DIN EN 504-1 (52.97).
Die in der Betriebsanleitung dargestellten Außenbeschriftungen wurden überprüft und ermöglichen die bestimmtgemäße Funktion der Sicherheitskombination.


Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

GS-Prüfbescheinigung

Name und Anschrift des Bescheinigungsinhabers: ABB Schalt- und Steuerungstechnik GmbH
Eppelheimer Straße 92
69123 Heidelberg
(Auftraggeber)

Name und Anschrift des Herstellers: siehe Auftraggeber

Zweck des Auftraggebers: Zahlen der Prüf- und Zertifizierungsstelle: 23.520.25/06-3-34/03-14 Gom-Cw

Produktbezeichnung: Sicherheitskombination

Typ: C571

Bestimmungsgemäße Verwendung:

Prüfgrundlage:
- "Niederspannungsrichtlinie" (52.97)
- "ENR" (52.97)
- "Grundzüge für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen" (52.97)

Bemerkungen: Die obigen Produktfehler erfüllen die Anforderungen der Kategorie 4 nach DIN EN 504-1 (52.97).
Die in der Betriebsanleitung dargestellten Außenbeschriftungen wurden überprüft und ermöglichen die bestimmtgemäße Funktion der Sicherheitskombination.


Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.
Certificate of Compliance

Certificate: LR 74379

Date Issued: November 5, 1999

Issued to: ABB Schalt-Und Steuerungstechnik GmbH,
Eppelheimer Strasse 82,
Heidelberg, D-69123 Germany
Attention: Mr. Werner Booser

The products listed below are eligible to bear the CSA Mark shown

Issued by: N. Graham

Signature: _____________________________

PRODUCTS

CLASS 3211 03 - INDUSTRIAL CONTROL EQUIPMENT - Motor Controllers - Auxiliary Devices

Extra low voltage Class 2, enclosure Type 4.
- Solid state time relays, open type, Types ISAR followed by -3100, -3700, -3200, -3400, -3300, -3500, -3600 may be followed by -11, -12, -13, -20, -26, -17, -10, -14, -15; 24 up to 250V ac/dc, output pilot duty B300/R300.
- Safety relays, Types C571, C572, C573, C577, C578, C579, output ratings B300, R300, control voltage 24V dc, 24-230V ac or 24V ac/dc.
- Auxiliary switch, open types ISAM401902R1001 (INO and INC), ISAM401902R1002 (INO) and ISAM401902R1003 (2NO) and ISAM401902R1002 rated A600 Q300 opposite polarity; Types ISAM401901R1002 rated B600 R300 (INO and INC) same polarity; Type ISAM401901R1001 rated C300 R300 (INO and INC) opposite polarity, 1A 240V ac special use.

Note: Certified for use in equipment where the acceptability of the combination is to be determined by the Canadian Standards Association.
- Shunt release, open type, Types ISAM401905R1001, ISAM401905R1002, ISAM401905R1003, ISAM401906R1001, ISAM401906R1002 operating voltage 500V ac max, 415V dc max.
- Undervoltage tripping units, open type, ISAM401905R1001, ISAM401905R1002, ISAM401905R1003, ISAM401905R1002, ISAM401906R1002, operating voltage 300V ac max, 240V dc max.

MARKINGS

The Company name, type designation, complete electrical rating, file number '74379', and CSA Monogram.

DGD/NIWP 96/09/13
GS-Prüfbescheinigung

Name und Anschrift des Bescheinigungsinhabers:
ABB Schalt- und Steuerungstechnik GmbH
Eppelheimer Straße 82
69123 Heidelberg

Name und Anschrift des Herstellers:
siehe Auftraggeber

Zeichen des Auftraggebers: 23.520.25/66-48-14 Gamma
Zeichen der Prüf- und Zertifizierungsstelle: 99142
Ausstellungsdatum: 30.07.1999

Produktbezeichnung: Sicherheitskombination
Typ: C 572

Bestimmungsgemäße Verwendung:

Prüfgrundlage: 73/23/EWG
89/336/EWG
GS-ET-20
* Niederspannungsrichtlinie *
* EMV-Richtlinie *
* Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen *

Bemerkungen:
Das o. g. Produkt erfüllt die Anforderungen der Kategorie 4 nach DIN EN 954-1 (03.97).
Die Benutzerinformation dargestellten Außenbelastungen wurden überprüft und ermöglichen die in bestimmtm gemäße Funktion der Sicherheitskombination.

Das geprüfte Baumbuster stimmt mit den in § 3 Absatz 1 der Gerätesicherheitsgesetzes genannten Anforderungen überein.
Das Baumbuster entspricht somit auch den einschlägigen Bestimmungen der Richtlinie 98/37/EG (Maschinen). Der Bescheinigungsinhaber ist berechtigt, das umseit abgestellte GS-Zeichen an den mit dem geprüften Baumbuster übereinstimmenden Produkten anzubringen. Der Bescheinigungsinhaber hat dabei die umseit aufgeführten Bedingungen zu beachten.
Diese Bescheinigung einschließlich der Befugnis zur Anbringung des GS-Zeichens wird spätestens ungültig am
31.12.2003

Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Unterschrift (Dr. Ing. Gertrud)
GS-Prüfbescheinigung

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<th>Name und Anschrift des Bescheinigungsempfängers:</th>
<th>ABB Schalt- und Steuerungstechnik GmbH</th>
<th>Eppelheimer Strasse 82</th>
<th>69123 Heidelberg</th>
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Produktbezeichnung: Sicherheitskombination

Typ: C 577

Bestimmungsgemäß: In Kombination mit den Grundgeräten C 571, 572, 573, 577 und 578.

Prüfgrundlage:

- Niederspannungsrichtlinie
- EMV-Richtlinie
- Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen

(02.97)

Bemerkungen:

Die eingeschränkte Gültigkeit der Kategorie 4 nach DIN EN 50574-1 (02.97) ist abhängig von der Kategorie des Grundgerätes; die Kategorie des Grundgerätes kann vom Erweiterungsausweis nicht überschritten werden.

Die in der Betriebsanleitung dargestellten Außenbeschaltungen wurden überprüft und ermöglichen die bestmögliche Funktion der Sicherheitskombination.

Das geprüfte Baumuster entspricht den einschlägigen Bestimmungen der Richtlinie 90/376/EG (Maschinen).


Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Baumusterprüfbescheinigung

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<th>Zeichen der Prüf- und Zertifizierungsstelle:</th>
<th>Ausstellungsdatum:</th>
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</table>

Produktbezeichnung: Erweiterungbausteine

Typ: C 579

Bestimmungsgemäß: In Kombination mit den Grundgeräten C 571, 572, 573, 577 und 578.

Prüfgrundlage:

- Niederspannungsrichtlinie
- EMV-Richtlinie
- Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen

(02.97)

Bemerkungen:

Die eingeschränkte Gültigkeit der Kategorie 4 nach DIN EN 50574-1 (02.97) ist abhängig von der Kategorie des Grundgerätes; die Kategorie des Grundgerätes kann vom Erweiterungsausweis nicht überschritten werden.

Die in der Betriebsanleitung dargestellten Außenbeschaltungen wurden überprüft und ermöglichen die bestmögliche Funktion des Erweiterungsbauwerkes.

Das geprüfte Baumuster entspricht den einschlägigen Bestimmungen der Richtlinie 90/376/EG (Maschinen).


Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.
Fachauschuß Elektrotechnik
Prüf- und Zertifizierungsstelle
im BG-PRÜFZERT
Hauptverband der gewerblichen
Berufsorganisationsen

GS-Prüfbescheinigung

Name und Anschrift des Bescheinigungshabers:
ABB Schalt- und Steuerungstechnik GmbH
Eppelheimer Str. 82
69123 Heidelberg

Name und Anschrift des Herstellers:
siehe Auftraggeber

Zeichen des Auftraggebers:
Zeichen der Prüf- und Zertifizierungsstelle:
23.520.25/06.46-14 Gom-ro
Ausstellungsdatum: 30.07.1999

Produktbezeichnung:
Erweiterungsbaustein

Typ:
C 579

Bestimmungsgemäße Verwendung:
In Kombination mit den Grundgeräten C 571, 572, 573, 577 und 578.

Prüfgrundlage:
72/336/EWG
"Niederspannungsrichtlinie" *
EMV-Richtlinie *
"Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombination"

Bemerkungen:
Die zu realisierende Kategorie nach DIN EN 854-1 (03.97) ist abhängig von der Kategorie des Grundgerätes, die Kategorie des Grundgerätes kann vom Erweiterungsgerät nicht überschritten werden.

Das geprüfte Baustein stimmt mit den in § 3 Abz. 1 des Gerätesicherheitsgesetzes genannten Anforderungen überein. Das Baustein entspricht somit auch den einschlägigen Bestimmungen der Richtlinie 90/692/EWG (Maschinen). Der Bescheinigungshaber ist berechtigt, das umseitig abgebildete GS-Zeichen an dem mit dem geprüften Baustein überreinstimmenden Produkt anzubringen. Der Bescheinigungshaber hat dabei die umseitig aufgeführten Bedingungen zu beachten. Diese Bescheinigung einschließlich der Berechtigung zur Anbringung des GS-Zeichens wird spätestens ungültig am:
31.12.2003

Weiteres über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Konsignat: (Unterschrift, Stempel)

Postadresse:
Postfach 51 05 80
50941 Köln

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Stuttgarter Str. 130
50969 Köln

Tel: 02 21/97 78-0
Fax: 02 21/97 78-3 86

SST Schriftführer

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(22.07.99)
Zertifikat
Nr.: Z2 00 12 20206 003

ABB Schalt- u. Steuerungstechnik GmbH
Eppeleimer Str. 82
69123 Heidelberg

mit der Fertigungsstelle
20206

ist berechtigt, nachfolgend genanntes Produkt mit dem Zeichen

gemäß Zeichenliste zu kennzeichnen. Umseitige Hinweise sind zu beachten.

Produkt: Sicherheitsergänztes programmierbares elektronisches System

Modell: Advant Controller 31-S

Kennzeichen:
Systemstruktur:
CPU: 1001 Struktur mit diversären
Anwenderprogrammierstechniken
EIA Modult: 1002 Struktur

Versorgungsspannung:
24 V DC

Anmerkung: Text im Prüffzept: „Funktionale Sicherheit“

Das Produkt entspricht den zutreffenden sicherheitsrelevanten Anforderungen und
bezeichneten Eigenschaften und wurde geprüft nach:

- 98/37/EG Maschinennrichtlinie
- 89/392/EWG EMV Richtlinie
- IEC 1131-2:1992

Der Anhang Nr. 10032339 ist notwendiger Bestandteil dieses Zertifikats. Das Produkt
erfüllt die Sicherheitsanforderungen nur, wenn die Maßgaben der jeweils aktuellen
Revision dieses Anhanges eingehalten werden.

Freigaben mit der obigen Zertifikats-Nr. durch die
Zertifizierungsstelle von TÜV PRODUCT SERVICE GmbH.

Organisationseinheit: ASE-40SE / Müller
Datum: 07.12.2000

TÜV PRODUCT SERVICE GMBH · Zertifizierstelle · Ridlerstrasse 65 · D-80339 München