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1. General information

1.1. Specifications on the selection of equipment

- All built-in devices at least IP2x (finger touch-safe).
- Motors in efficiency class IE 3 according to IEC 60034.
- All equipment with CE mark.
- Circuit diagrams and parts lists must be agreed with the client before commencing assembly.
- Only use self-extinguishing materials (e.g. cables).



1.2. General requirements

- Only the same type of components of the same make may be used for the same functional purposes within an installation.
- The contractor must obtain information regarding the local conditions from the client. This includes:
 - Possibility of installation
 - Power supply
 - Assignment and establishment of components groups
- The control concept must be cleared with the client before the start of construction.
- When expanding and/or modifying existing machines, the contractor shall be responsible for the overall function of the scopes concerned by the expansion/modification.
- For alterations of existing installations/machines, all components in the switchgear assembly and peripheral components no longer required must be dismantled and the documentation updated accordingly.
- The points of document LV_GP_02-1 Checklist according to EN 60204 Annex B (Installation) apply between the client and the contractor.

1.3. Compliance with the following directives, laws, ordinances and standards

- Machinery Directive 2006/42/EC, including CE marking, conformity assessment, risk assessment and documentation
- Low Voltage Directive 2006/95/EC, including CE marking, conformity assessment and documentation
- EMC Directive 2004/108/EC
- Product Safety Act (ProdSG)
- Electromagnetic Compatibility Act (EMVG)
- 1st and 9th Ordinance on the ProdSG
- DIN EN ISO 12100:2010-03
- DIN EN ISO 13849-1/-2
- DIN EN ISO 13850
- DIN EN ISO 13855
- DIN EN ISO 13857
- DIN EN 60204-1
- DIN EN 61439-1/-2
- DIN EN 61346

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- If there is a harmonised European C standard published by the EU in the Official Journal concerning Directive 2006/42/EC for the machine, this must be complied with. Any deviations from this must be arranged beforehand.

2. Electrical apparatus

2.1. Electrical supply

- Electrotechnical apparatus must be provided for the connection to a TN-S system (400/230 V AC).
- The phase sequence for all low-voltage systems is: L1-L2-L3 (clockwise rotating field) The assignment of wire colours is: Brown: L1, black: L2, grey: L3, blue: N, green/yellow: PE.
- When using harmonic generators, such as any type of inverter, the shift factor $\cos \varphi$ must be maintained within the limits of 0.95 to 1 and the power factor λ (lambda) within the limits of 0.90 to 1 for all operating conditions.

2.2. Apparatus protection

2.2.1. Overload protection device

- When using several protection devices connected in series, selective breaking capacity must be guaranteed.

2.2.2. Overload protection of motors

- Only one motor may be connected to an overload protection device. The automatic restart of a motor following an overload protection response must be prevented.



2.2.3. Surge protection

- Type 2 surge protection devices must be provided in the switchgear assemblies of the machines. These must be arranged so as to ensure that the upstream protection device triggers a shutdown in the event of a defective arrester and that any hazards to persons from contact voltages are excluded.
- The total termination length of surge protection devices must not be more than 0.5 m from the entry point. The connection lines must be connected directly and using the shortest possible distance and should not be routed near the control electronics. V wiring must be used if possible.
- In order to protect delicate devices located more than 5 m (line length) from the type 2 SPD, type 3 surge protection devices will again be required, which will then protect the next 5 m of the corresponding electrical circuit.

2.3. Equipotential bonding

- Every individual conductive component in the installation must be connected to each other by way of an equipotential bonding protection device.
- The minimum cross-section for the additional equipotential bonding is 2.5 mm Cu or 16 mm Al, if protection against mechanical damage has been provided, 4 mm Cu or 16 mm Al, if protection against mechanical damage is not provided. For connections

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between two electrical bodies, the cross-section is the same as the cross-section of the smallest protective conductor.

- All conductive parts of a switchgear assembly (e.g. control cabinet and control cabinet door) must be connected to each other via an equipotential bonding conductor

2.4. Switchgear assemblies

- Switchgear assemblies must comply with the requirements of DIN EN 61439-1/-2. The contractor must carry out and document the required design verification and part verification.
- The switchgear assemblies (control cabinets, housings, installation rooms) must be designed with at least 10% of reserve space for subsequent expansions after commissioning.
- All drive elements and the association junction boxes and plug devices must be assembled in such a way that it is easily possible for inspections and maintenance operations to be undertaken without special tools when assembled.
- All control cabinets must be provided with locking mechanisms to be defined and, if required, provided by the client.

2.5. Wiring technology



2.5.1. General requirements

- Series terminals must be used for the connection of lines. Only one conductor may be terminated to each series terminal for each connection point. The connection of two conductors is only permitted if the terminal is designed for this purpose. Only one protective conductor per terminal connection point may be connected.
- Loose terminals may not be used.
- All conductor ends in screw terminals must be provided with wire end ferrules or cable lugs (crimp connections).

2.5.2. Routing and wiring of cables and lines

- No terminals, line connectors or other electrical equipment may be used within electrical installation ducts and line ducts.
- Signalling and operator control units in the distribution unit door must be integrated in the wiring in a flexible tube.
- The wiring must correspond to the circuit diagram, i.e. the wiring sequence must correspond to the drawing sequence in the individual plan sections from top to bottom and from left to right.
- A profile rail to fasten the incoming and outgoing lines must be installed in the switchgear assembly. The ends of the cables/lines must be relieved from tensile forces in the control cabinet with a cable clamp rail with cable clamps.

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2.5.3. Wire colours

Voltage type	Wire colour	Colour labelling
Main current 230/400V ~/-	black	BK
Neutral conductor N	light blue	BU
Protective conductor PEN/PE	green-yellow	GNYE
Control voltage 230V	red	RD
Control voltage N	red	RD
Control voltage 24V DC	dark blue	BU
Control voltage 60V DC	purple	VT
Low voltage 24-60V AC	grey	GY
External voltage	orange	OG
Measuring signal	white	WH
GLT/DDC	brown	BN

3. Identification and warnings

3.1. Device tags

- Labels must be applied in such a way that they are not lost when the device is changed.
- Labelling must be permanent and affixed in such a way that it is visible when the device is installed. The labelling must be repeated on hoods and cover plates. All devices outside installation spaces must be marked with engraved, embossed or etched labels. These labels may not be affixed with glue.



3.2. Functional labelling

- Functional labelling must be applied immediately adjacent to the associated command and signal devices.
- The inscription must be engraved in areas with heavy soiling. These labels may not be affixed with glue.

3.3. Warnings

- All distribution cabinets and terminal boxed must be labelled with warning sign W08 warning of hazardous electrical voltage (according to BGV A8 and DIN 4844-2)

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4. Documentation



Test specification: Machinery Directive 2006/42/EC, DIN EN 60204-1 point 17,

- Labelling
 - Cable labelling according to method R (e.g. W23-1) or CR (e.g. A1/X1:2) (VDE 0040-4)
 - Equipment identification according to DIN EN 61346
 - Labelling power supply outside under main switch and inside on the terminal block with entry point
(station, block, field or distribution, outlet or fuse, cable type)

The following documents must be provided in three copies on paper and 1x on data carriers in a format editable by the client (*.doc; *.xls; *.dwg, except protocols or certificates):



- Operating manual in German and in original language
- Functional description
 - Description (including connection plans) of protection devices, the interlocking functions and the locking of separating protection devices against hazards, particularly for machines working together in a coordinated manner.
 - Description of the technical protection measures and the means provided to deactivate the technical protection measures, e.g. for maintenance or erection
- Information
 - on programming with functional diagrams
 - on processes
 - on classification (PLr) and dimensioning (PL) of the safety functions according to DIN EN ISO 13849-1 (incl. "Sistema" project)
 - of the inspection intervals
 - on frequency and process of functional testing
 - and instructions on settings, maintenance and repair, especially for installations and circuits with a protective function
- Plans and drawings (DIN VDE 0040-1) according to type of service to be provided such as
 - function diagrams, overview diagrams, current flow diagrams, terminal diagrams, wiring diagrams, construction diagrams, layout diagrams, equipotential bonding diagrams, cable route diagrams, site plan, earthing diagram etc. including EPLAN source code
- According to DIN VDE 0100-510, circuit diagrams must include:
 - Type and cross section of conductors
 - Length of the circuits
 - Type and rating of protective equipment
 - Rated current or adjustment value of the protective device
 - Short circuit currents and short circuit breaking capability to be expected
 - Information on connected appliances, origin of lines and feeders
- Parts lists

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- Complete programming with password and editable file format with comment files including source code
- Replacement/wear parts lists
- Tool lists
- Maintenance instructions, regulations, protocols
- Component descriptions
- Data sheets, technical documentation according to DIN EN 61439-1 point 6.2.1
- Specialist company declaration
- Protocols with measured values from the initial inspection pursuant to DIN EN 60201-1
- Protocols on functional test of safety technology - emergency stop and protective devices (BWS)
- Factory certificates, acceptance protocols
- Settings of protective equipment
- For leakage currents higher than 10 mA,
 - the value of the protective conductor current must be stated
 - Declaration that erection was undertaken in conformity with DIN VDE 0100-444 point 7.5.3.2
- Proof of heating limits in switchgear assemblies according to DIN EN 61439-1
- Mathematical proof of the design of protection devices (e.g. 24V circuits, or for cables larger than 25 mm²)
- EC declaration of conformity / declaration of incorporation (for incomplete machines)
- Risk assessment
- Certificate of competence of the inspector according to TRBS 1203
- Proof of instruction / briefing of operating and support staff
- VIN plate outside, clearly legible and permanent
 - Company name and full address of the machine designation,
 - CE marking (with the exception of incomplete machines)
 - Series or type designation, serial number if applicable,
- Further information on VIN plate or in the circuit diagrams
 - Standard
 - Current / frequency
 - Measurement operating voltage
 - Measurement insulation voltage
 - Measurement voltage of auxiliary circuits
 - Load current, peak currents, permitted voltage drops
 - Requirement for the electrical supply
 - Protection against short circuiting
 - Protection rating and protection class
 - Year of construction
 - Operation and surrounding conditions
 - Ambient temperature limits
 - Relative humidity
 - Degree of pollution
 - Lighting
 - Vibration
 - Any special operating conditions

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- Mains system
- Dimensions, weight

5. Inspection

Inspection according to DIN EN 60204-1 point 18 must be carried out by a competent inspector according to TRBS 1203 with a calibrated measurement instrument, and documented with the measurement values.

The inspection comprises the following measures:

- Visual check
- Test of conductivity of protective conductor and live lines
- Test of fault loop impedance with suitability of the overload protection device according to table 9
- Test of protection from indirect contact (poss. additional PE)
- Test of insulation resistance
- Voltage check
- Test of protection against residual voltage
- Function test of switch component combinations, safety installations

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