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1 Purpose and scope

This specification describes the requirements to be proven by the supplier.

Project specific details are fixed at the project specification and the process data sheet.

2 Application in NIDEC plants

- This “Technical Supply Specification (TLV) for MAE, Electro-technical Equipment, Network Annex” is valid for the electrical equipment of machines, mechanical systems, and equipment, referred to as machines in the following; it supplements the currently valid norm DIN EN 60204-1.
- For better clarity, all section headings and thus also the structure from DIN EN 60204-1 (VDE 0113, part 1), November 1998, beginning with section 4, was adopted, even if no additions were incorporated.
- This requirement specification therefore expands DIN EN 60204-1 by the Nidec-specific requirements, sorted in the same structure.
- This general part can be supplemented by specific release lists of the ordering production plant, and possibly by machine- and task-specific supply specifications. Modified, and potentially additional regulations might apply for non-European operating facilities.

3 Level of confidentiality

This NIDEC standard specification is assessed as “public”.

In principle, the definitions of DIN EN 1070 and also the definitions of VDI 2854, if these are not yet included in DIN EN 1070 or do not contradict the definitions there, apply.

Definitions from DIN EN 60204-1, (VDE 0113, part 1) sections 3.1 to 3.57: valid in its entirety

Additional definitions by Nidec:

3.58: Setup: assembly of all units and individual parts at the setup location, as well as calibration and mounting.

3.59: Main switch: The main switch is a network isolating device according to DIN EN 60 204-1 (VDE 0113, part 1) section 5.3.2 a) to c).

3.60: Area switch: Area switches are used to switch off parts of the machine. Interventions should be possible without having to switch off the entire machine.

3.61: Repair switch: Analogous as area switch.

3.62: Release list: Customer's list of operating equipment that has been released for use.

3.63: EMERGENCY OFF: see DIN EN 418

4 General requirements

4.1 General observation

- If the supplier thinks that deviations from this supply specification are necessary or practical or if there are queries, these must be clarified with the customer. In the event of deviations from this supply specification, technical reasons must be specified. Approved deviations apply only to a specific contract and must be defined in writing.
- The supplier must inform itself about the local conditions. This takes place with the support of the customer and refers, e.g., to installation options, power supply, and the arrangement and setup of assemblies, such as control cabinets, coolant/lubricant systems, hydraulic units.
- In due time before the start of the assembly work at the customer's setup location, the supplier must submit appropriate documents, e.g., setup plans, assembly plans, scheduling plans, and personnel plans for approval.
- Before and during the execution of the work, scheduling and safety matters must be agreed upon with the customer's responsible coordinator in the sense of BGV_A1 (formerly VBG1), §6.
- For the expansion and/or changing of existing machines, the supplier is responsible for the whole function of the parts affected by the expansion/change.
- The documents provided to the supplier must be neither copied nor made available to third persons or utilized in any other way without the permission of the customer.
- During the guaranty phase, the supplier's customer service must be available on short notice for repair work. This notice period must be part of the quotation as a binding deadline commitment.
- The controller manufacturer's standard hardware and software may not be changed.
- The supplier must agree upon interfaces to other systems with the customer.
- Couplings via bus systems are defined specific to the company.
- Couplings via the I/O plane must have a potential-free design. For point-to-point connections, the power supply of the interfaces is realized by the corresponding sub-system; here, the signal receiver is powered with the necessary operating voltage by the signal transmitter.
- Individually usable machines in interlinked groups must have an autonomous design. Every autonomous machine has its own control system, control panel, and similar devices, and also a network isolating device. This also refers to machines that can be converted for other uses through minor change expenditure (e.g., different gripper).
- It must be agreed upon with the Nidec specialist department whether sample programs and standard function modules from Nidec are to be used. The same applies for symbol sets and operating structures for visualization. Additionally required packages and supplements are to be delivered by the contractor and agreed upon in writing with the responsible Nidec specialist department.
- Before the start of construction, the systems (among other things, the definition of the control system, emergency stop, and setup ranges, grounding concept, network topology, etc.) must be presented in detail for the responsible Nidec specialist department. The designations of the circuit groups in the layout and in the function description are provisional and will be defined after the contract is awarded.
- The circuit documents and circuit diagrams must be presented for approval to the responsible Nidec specialist department at least 4 weeks before the start of production of the control cabinets.
- All of the equipment (housing, cable ducts, etc.) must be cleaned of dirt and especially of drilling chips and similar sharp objects.

4.2 Selection of the equipment

- Only products as per the customer's release list may be used. These may be installed only in the unused condition and without any changes.
- The following are not permissible, e.g.:
 - Drilling of fastener holes
 - Removal of housing parts
 - Changes of shaft ends
- The setup and installation specifications of the device and system manufacturers must be adhered to.
- If later processing cannot be avoided, the affected component must be marked in the bill of materials and the production/change drawing must be included in the delivery. If components are used based on an exception approval, it must be verified that these or 100% compatible components will be able to be obtained within at least 10 years since the final acceptance. The lack of a guaranty leads to the procurement of a replacement part for each of the affected components. If this part fails demonstrably, Nidec reserves the right to charge the machine supplier with the conversion costs necessary due to the non-availability of replacement parts, even after this period.
- If display lamps are used, LEDs must be used.
- For the selection of the devices, it is sufficient to provide at least 20% reserve (e.g., slots, holes). After final acceptance, these must be available and reasonable arrangements must be made. Holes must be provided with plugs and slots must be provided with covers. Power supplies must not be connected in parallel. A power reserve of 20% must be available after completion of the final commissioning. This must be documented in writing by means of a measurement report.
- Movements must be queried individually and directly in all positions. Exceptions must be agreed upon with the responsible Nidec specialist department in writing.
- All sensors and actuators must be equipped with a visible switching state display.
- Depending on the environmental conditions (e.g., chips, weld pearls, stray light), the switching surfaces of the sensors must be arranged vertical or pointing downward or encapsulated.
- If lasers are used (laser light barriers), make sure that the laser beam does not endanger the operator and stays inside the machine. Suitable measures must be provided and, if necessary, agreed upon with Nidec. Laser class 1 must be used. The use of higher laser classes must be agreed upon in writing with the responsible Nidec specialist department.
- Components that are not in use (hardware, software, and documentation) must be removed. All options not in use must be removed from the documentation, hardware, and software. This also applies, e.g., to unneeded HMI figures. Excluded are program modules, functions, and HMI figures that correspond to the Nidec standard.
- All sensor and actuator lines must have a design that can be connected to the component.
- All cable ducts that are installed close to the floor and for which there is the possibility that they will be walked on must be selected so that the cable ducts withstand being walked on by a person of max. 150 kg.
- Control units must be selected so that an identical electrical and mechanical service life or an extensive adaptation to the service life of the machine is guaranteed corresponding to the switching frequency.
- Control units for electromagnetic drives, e.g., couplings, brakes, and magnetic valves, must be designed for a service life of at least 10 million switching cycles.

- All operating equipment must be operated only within the limits specified by the manufacturer. This relates to limits, e.g., for voltage, current, temperature, protection against impacts, vibration loading, oil mist, liquid vapors, and cooling requirements.
- Control units must be designed for a continuous current of at least 2 A. Excluded are control units that operate with a contactless method or act on the inputs of a contactless control system.
- Substances that are harmful to the environment or health must not be used (e.g., CFC, asbestos).
- The use of substances that impair wetting properties is forbidden.
- For the case that a fire alarm device must be installed, only the devices permitted by the Nidec fire department may be used. These are connected directly to the Nidec fire alarm system. The feedback coupling to the machine is realized by means of potential-free contacts. Here, the supplier provides a 2-channel interface. The possible fire risks must be presented to the supplier.

4.3 Electrical supply

4.3.1 General information

- The network voltage is defined specific to the location.
- The supplier must request information's on the electrical operating and network conditions at the machine's setup location with the support of the customer.
- The phase sequence of all low-voltage system, including three-phase current plug devices, is L1-L2-L3 (right-hand rotational field).

4.3.2 Alternating current supply

No amendments to DIN EN 60204-1

4.3.3 Direct current supply

No amendments to DIN EN 60204-1

4.3.4 On-board power supply

No amendments to DIN EN 60204-1

4.4 Physical environmental and operating conditions

4.4.1 General information

Operating equipment selection:

All electrical and electronic operating equipment must be selected or designed so that it is fully functional without special precautions in the given company networks, despite the existence of voltage fluctuations and current pulses.

4.4.2 Electromagnetic compatibility (EMC)

The network feedback generated by the equipment must be limited as per DIN EN 50 178 (VDE 0160).

To prevent overvoltage's when switching off inductors, such as couplings, brakes, and magnetic valves, limiting elements must be used that limit the voltage to a value permissible for control units and windings.

4.4.3 Ambient air temperature

If not required differently, the system must be designed for a temperature range from +10°C to +45°C.

4.4.4 Air humidity

If not required differently, the system must be designed for a relative air humidity from 15% to 95% without condensation.

4.4.5 Elevation

If not required differently, the system must be designed for an operating elevation from 0 to 2500 m above sea level.

4.4.6 Contamination

No amendments to DIN EN 60204-1

4.4.7 Ionizing and non-ionizing radiation

No amendments to DIN EN 60204-1

4.4.8 Vibration, shock, and continuous shock

No amendments to DIN EN 60204-1

4.5 Transport and storage

No amendments to DIN EN 60204-1

4.6 Handling devices

No amendments to DIN EN 60204-1

4.7 Installation and operation

No amendments to DIN EN 60204-1

5 Network connections and device for disconnection and switching-off

5.1 Network connections

The power feed to the control cabinet is realized on site. Cable connectors or cable threaded connections, including strain relief devices, are part of the scope of supply for the machine.

For the power feed to a single station, a CEE connector must be provided.

For an interconnected system consisting of multiple stations, the power feed to the control cabinet is realized on site. Cable connectors or cable threaded connections, including strain relief devices, are part of the scope of supply for the machine.

5.2 Terminals for connection to the external protective ground system

No amendments to DIN EN 60204-1

5.3 Network isolating device

e.g., main switch

5.3.1 General information

5.3.2 Types

No amendments to DIN EN 60204-1

5.3.3 Requirements

It must be possible to secure the main switch with at least 1 padlock, shackle diameter 8 mm.

- It must be possible to open the control cabinet door without switching off the main switch.
- Network isolation must be provided by means of a central main switch.
- This must be clarified in agreement with the customer.

Area switch/ repair switch

- It is differentiated on the outside from the technically identical main switch by the color of the handle and background and by corresponding lettering.

5.3.4 Handle

No amendments to DIN EN 60204-1

5.3.5 Excluded power circuits

Color marking of excluded power circuits that are not affected by the main switch, see 14.1.3.

5.4 Switch-off devices for preventing unexpected start-up

e.g., repair switch

5.5 Devices for isolating the electrical equipment

e.g., area switch

5.6 Protection from unauthorized, unintentional, and/or mistaken closing

No amendments to DIN EN 60204-1

6 Protection against electric shock

6.1 General information

No amendments to DIN EN 60204-1

6.2 Protection against direct contact

6.2.1 General information

6.2.2 Protection by housing (casing)

The conditions as per DIN EN 60204-1 apply (VDE 0113, part 1) section 6.2.2 a), wherein at least the protection class IP2X or IPXXB must be fulfilled in the entire housing.

All of the components and systems installed in the control cabinet must be constructed so that they are safe from contact as per VDE 0106.

6.2.3 Protection by isolation of active parts

6.2.4 Protection due to residual voltage

Active parts that have a residual voltage greater than 60 V after the power supply is switched off must be discharged to 60 V or less within a time of 5 s after the power supply is switched off, as long as this discharge value does not interfere with the proper operation of the equipment.

Components that have a stored charge of 60 μC or less are excluded from this requirement.

Where this defined discharge time influences the proper operation of the equipment, a continuous warning must be displayed at an easily visible location directly next to the housing containing the capacitors. It must indicate the danger and specify the time delay required until it is safe to open the housing. If pulling connectors or similar devices causes wires to be exposed (e.g., connector pins), the discharge time must not exceed 1 s. Otherwise, such wires must be protected against direct contact at least according to protection class IP2X or IPXXB. If neither a discharge time of 1 s nor protection of at least IP2X or IPXXB can be achieved (e.g., for folding current collectors of contact lines or slip ring elements, see 13.8.4), additional switching devices or appropriate warning devices must be provided.

6.2.5 Protection by covers

No amendments to DIN EN 60204-1

6.2.6 Protection by physical distance or obstacles

No amendments to DIN EN 60204-1

6.3 Protection from indirect contact

No amendments to DIN EN 60204-1

6.4 Protection by PELV

The generation of functional low voltages is realized by a power source with safe isolation (PELV).

6.4.1 General requirements

One side of the electric circuit must be connected to the protective ground system)

6.4.2 Power sources for PELV

No amendments to DIN EN 60204-1

7 Protection of the equipment

7.1 General information

No amendments to DIN EN 60204-1

7.2 Overcurrent protection

7.2.1 General information

No amendments to DIN EN 60204-1

7.2.2 Network connection line

The length of the cable must be defined with the customer according to the layout. The connection is realized by the supplier. The following cable must be used: H07RN-F

7.2.3 Main circuit

For protecting circuits, circuit breakers must be used.

If more than one phase is used, it must be guaranteed that all poles are disconnected.

7.2.4 Control circuit

Depending on the number of control circuits, an LS switch or a switching power supply with electronic protection must be used after consultation.

7.2.5 Plug socket circuit and associated conductors

Plug socket circuits must be protected individually with FI circuit breakers.

7.2.6 Lighting circuit

No amendments to DIN EN 60204-1

7.2.7 Transformers

See 7.2.4

7.2.8 Arrangement of overcurrent protection devices

No amendments to DIN EN 60204-1

7.2.9 Overcurrent protection devices

No amendments to DIN EN 60204-1

7.2.10 Rated and set values of the overcurrent protection devices

If multiple protection devices connected in series are used, a selective switch-off behavior must be guaranteed.

The respective set value must be documented in the circuit diagram.

7.3 Overload protection of motors

- Motors must be equipped with an overload protection device.
- The heating of motors over 2 kW with external cooling, with electronic rotational speed control/regulation, with high switching frequency (> 5/h), and for heavy startup must also be monitored by temperature sensors installed in all heat-critical windings, if at least one of the previous criteria is fulfilled.
- Thermal protection must be realized up to an amperage of 25 A with circuit breakers for motor protection (motors supplied from converters are excluded).
- The automatic restarting of a motor, after overload protection has been activated, must be prevented.
- Three-phase motors that are supplied from converters and are operated in continuous operation < nominal frequency must be dimensioned accordingly or equipped with external cooling.

7.4 Protection against abnormal temperatures

No amendments to DIN EN 60204-1

7.5 Protection from power supply interruption or voltage drop and voltage recovery

The loss of excitation of the couplings and brakes must not cause any hazardous operating conditions.

7.6 Motor overspeed protection

If there is the risk of damage or injury by the rotational speed exceeding or falling below the permissible speed for drives, tools, or workpieces, a device must be provided independent of the rotational speed regulation, that reliably and safely switches off the drive when the speed exceeds or falls below the permissible speed.

7.7 Short to ground/fault current protection

No amendments to DIN EN 60204-1

7.8 Rotational field monitoring

No amendments to DIN EN 60204-1

7.9 Protection against overvoltage due to lightning strike and due to switching operation

No amendments to DIN EN 60204-1

8 Potential equalization

8.1 General information

A grounding concept for the system must be prepared by the contractor. The grounding concept must highlight the layout and design of the shielding, grounding cables, and potential equalization points with comments and labels.

Here, the contractor must present a draft plan for approval to the responsible Nidec specialist department before the start of the project.

At all points in the system, the ground resistance must be less than the shielding resistance of shielded cables (e.g., profibus cable).

The circuit impedance values must be measured and documented.

8.2 Protective ground system

8.2.1 General information

- The protective ground must be connected with only a single cable to the protective conductor of the network connection (star-shaped grounding).
- All ground connections must be labeled individually.
- Protective ground connection points must be arranged so that they are visible for the operator and not covered on the body of the electrical equipment.

8.2.2 Protective ground conductor

No amendments to DIN EN 60204-1

8.2.3 Continuous connection of the protective ground system

No amendments to DIN EN 60204-1

8.2.4 Switching devices are prohibited in the protective ground system

No amendments to DIN EN 60204-1

8.2.5 Parts that do not have to be connected to the protective ground system

No amendments to DIN EN 60204-1

8.2.6 Interruption of the protective ground system

No amendments to DIN EN 60204-1

8.2.7 Protective ground conductor connection points

No amendments to DIN EN 60204-1

8.3 Potential equalization connections for functional reasons

No amendments to DIN EN 60204-1

9 Control circuits and control functions

9.1 Control circuits

9.1.1 Power supply of control circuits

Protection is realized preferably by means of circuit breakers.

- The connection points of transformers must be realized in the same way and quality as those of the fuses or series terminals; control transformers must have primary taps for 95% and 105% of the rated voltage.
- For direct-current voltage, a maximum ripple of 5% must be adhered to.
- To simplify the troubleshooting, auxiliary circuits must be appropriately divided and protected (e.g., in functional groups). Where required, the corresponding circuits must be locked.
- Transformers, rectifiers, and control units must be loaded only up to 70% of the permissible rated power. For testers, the generation of the test voltage must be released by the customer.
- Fuses must be equipped with visual displays for detecting when they have been activated. The activation of each individual fuse is also displayed via the HMI.

9.1.2 Control voltages

Magnetic valves, solenoid couplings, and brakes must be operated with 24 VDC.

As an exception, brake fans may be powered with the rated motor voltage.

9.1.3 Overcurrent protection

No amendments to DIN EN 60204-1

9.1.4 Connection of control units

No amendments to DIN EN 60204-1

9.2 Control functions

9.2.1 Start functions

For communications between multiple controllers or intelligent assemblies (e.g., for error monitoring), measures must be provided in the software that guarantee a synchronized start of all controllers. The measures taken must be described and documented.

In the manual or setup mode, it must be possible to switch all power supply and auxiliary devices (e.g., control voltage, hydraulics, coolant) individually.

9.2.2 Stop functions

Each machine must be equipped with a stop function of category 0 or 1 (see also 9.2.5.4).

9.2.3 Operating modes

No amendments to DIN EN 60204-1

9.2.4 Removal of technical safety measures

If isolating protective devices must be replaced by other protective devices, the pre-selection of the operating mode and protective device must be designed with a safe contact technique or in agreement with the customer with a programmable safety controller (see 9.2.5.4.2).

9.2.5 Operation

9.2.5.1 General information

- All actuators must be designed for a switch-on period of 100%.
- Solenoids must be designed so that they are only loaded with a maximum 80% of the listed holding force.
- Magnetic valves must be connected by means of plug connectors. The signal state must be displayed by means of LEDs on the connector or directly on the valve.
- Control units must not be linked with each other outside of the electronic controllers according to the circuitry. Exception: Safety-relevant functions and protective locks.
- The contacts of the control units must guarantee safe contact making also for the low currents of the controller inputs without additional circuitry measures.
- Control units must output and process signals with positive potential. (PNP)

9.2.5.2 Start

tbd

9.2.5.3 Stop

tbd

9.2.5.4 Operation in case of emergency (stopping in case of emergency, switching-off in case of emergency)

tbd

9.2.5.5 General information

Functional aspects according to DIN EN 418 must be adhered to.

9.2.5.5.1 Stopping in case of emergency

The use of programmable safety controllers must be agreed upon with the customer.

9.2.5.5.2 Switching-off in case of emergency

tbd

9.2.5.6 Monitoring of the command execution

tbd

9.2.5.7 Command devices with automatic reset (jog switch)

tbd

9.2.5.8 Two-hand switching

Functional aspects according to DIN EN 574 must be adhered to.

The use of two-hand switches must be agreed upon with the customer.

9.2.5.9 Enabling device

If protective devices must be removed for monitoring, testing, or setup, then enabling devices must be inserted.

The use and design of enabling devices must be agreed upon with the customer.

9.2.6 Combined start-stop control systems

No amendments to DIN EN 60204-1

9.2.7 Cable-less control systems

No amendments to DIN EN 60204-1

9.3 Protective locks

9.3.1 Closing (again) or resetting of locked protective devices

No amendments to DIN EN 60204-1

9.3.2 Path limiter

Robots require a mechanical axis limiter for impermissible areas. The use of EPS systems for robot safety must be agreed upon with the customer.

9.3.3 Operation of auxiliary devices

No amendments to DIN EN 60204-1

9.3.4 Locks between different operating functions and for movements in opposite directions

No amendments to DIN EN 60204-1

9.3.5 Counter current braking

No amendments to DIN EN 60204-1

9.4 Control functions in case of a fault

9.4.1 General requirements

Faults in the electronic system part must not negatively affect the effectiveness of safety circuits.

Superimposed movements (horizontal/vertical) that lead to machine damage must be locked accordingly in software in all operating modes.

9.4.2 Measures for reducing risk in case of a fault

No amendments to DIN EN 60204-1

9.4.3 Protection against faulty operation due to shorts to ground, voltage interruptions, or loss of electrical continuity.

No amendments to DIN EN 60204-1

10 Operator interface and control units mounted on the machine

10.1 General information

10.1.1 General requirements on devices

Command and control units, e.g., path sensors and manually actuated control devices, must not be used for the direct switching of magnets, couplings, and brakes. Excluded from this are switching functions in safety circuits.

For position and proximity switches, valves, etc., the actuated state must be displayed on the device or on the connector by means of LEDs.

10.1.2 Arrangement and installation

Control stations must be arranged so that all movements triggered from the stations are visible by the operator. If this is not possible, additional control stations must be set up. The use of portable control stations must be agreed upon with the customer.

A 20% reserve guidance must be provided that is to be closed with dummy plugs.

It must be possible to operate all of the devices required for operating the machine (e.g., changing the parameters), also controllers, time relays, and the like, without opening the switching device combination. The setting devices must be secured against unauthorized adjustments.

10.1.3 Protection against external influences

No amendments to DIN EN 60204-1

10.1.4 Path sensors

Preferably proximity switches are used. Proximity switches for 24 VDC are to be used only in a short-circuit-proof design protected against reverse polarity.

10.1.5 Portable and suspended control stations

Ergonomics must be taken into account. The arrangement must not produce any risk of injury.

10.2 Push-buttons

10.2.1 Colors

See Table 1.

10.2.2 Markings

No amendments to DIN EN 60204-1

10.3 Display lights and displays

Display lights must be agreed upon with the customer. These must be arranged in an easily visible location. For multiple system parts, a display light must be provided for each system part. These must be equipped with LEDs.

10.3.1 Application types

Displays: To bring attention to the operator that a certain task is to be performed, the color BLUE must be used.

10.3.2 Colors

An alarm column must be provided with colors that have the following meaning:

- YELLOW: Machine stopped (interrupt)
- GREEN: Machine running (automatic)
- BLUE: Material shortage

10.3.3 Blinking signals

No amendments to DIN EN 60204-1

10.4 Illuminated push-buttons

The use of illuminated push-buttons is limited to the application case “Confirmation” as per DIN EN 60204-1 (VDE 0113, part 1), section 10.3.

Color	Push-button	Illuminated push-button	Display lamp
RED	EMERGENCY OFF Stop/Off	-	Emergency
YELLOW	Abnormal Reset	-	Abnormal Warning
GREEN	Cycle start ON	-	Release Home position
BLUE	Reset Acknowledge	Confirm	Confirm
WHITE	ON	Confirm	Confirm General information
GRAY	-	-	-
BLACK	Jog mode	-	-

10.5 Rotating operating elements

No amendments to DIN EN 60204-1

10.6 Startup devices

No amendments to DIN EN 60204-1

10.7 Devices for stopping in case of emergency

No amendments to DIN EN 60204-1

10.8 Devices for shutdown in case of emergency

No amendments to DIN EN 60204-1

10.9 Displays

Automatic diagnostics of sequencers

Missing step enabling conditions in sequencers must be automatically displayed in the setup and automatic modes.

Actuated “emergency stop” devices and not-closed electrically locked protective devices must be displayed by individual alarms in a decentralized and also centralized way on the control panels.

11 Electronic equipment

11.1 General information

The network plug sockets and data sockets required for operating the programming devices must be led out from the control unit combinations.

If control unit combinations of machines are set up separately (e.g., on control cabinet platforms), then a socket for power and data connection for a programming device must also be installed on each (main) control station.

11.2 Basic requirements

11.2.1 Inputs and outputs

The number of slots for input/output assemblies must be selected so that there is a 20% reserve.

11.2.2 Potential equalization

No amendments to DIN EN 60204-1

11.3 Programmable equipment

11.3.1 Programmable control systems

DIN EN 61131 applies in all parts.

- The setup and installation specifications of the control system manufacturer must be adhered to as minimum requirements.
- Control system configurations (centralized or decentralized arrangement) must be machine-specific and require agreement with the customer.
- Storage capacitors for the program memory (for application programs) must be dimensioned so that for production machines, at least 10% and for special machines at least 20% remains free as a reserve for each central processing unit.
- It must also be possible to connect and disconnect programming devices while the machine is operating.
- The hardware (cables and interface cards) and software required for programming/configuring the devices/assemblies being used are part of the scope of supply of the machine, if not agreed upon differently with the manufacturer.

11.3.2 Memory maintenance and protection

No amendments to DIN EN 60204-1

11.3.3 Software checks

The user software must have a clearly understandable and maintenance-friendly design. Structured programming must be used. Fault detection and reporting must be part of the program structure.

11.3.4 Application in safety-related functions

No amendments to DIN EN 60204-1

12 Switching device: Arrangement, setup, and housing

12.1 General requirements

- The control unit combinations (control cabinet, housing, installation spaces) must be large enough that for later expansions in production machines, at least 10% and for special machines, at least 20% reserve space remains after commissioning. In detail, the reserve extends to the devices of the individual function groups and terminal strips, cable ducts, swivel frames, slots, and program memories.
- Control unit combinations must be equipped with eye screws for transporting the populated units.
- Structural parts and internal components must consist of at least flame-resistant materials.
- Control cabinets that are not screwed directly to the machine must be connected by means of plug connectors. Simple transport must be possible.
- Upright control cabinets must have a base of min. 100 mm.
- If the height cannot be adhered to for special reasons, components and assemblies at risk of penetrating water must be installed in the upper area of the control cabinet.

12.2 Arrangement and setup

12.2.1 Accessibility and maintenance

- All drive and actuators (couplings, brakes, motors, magnetic valves, and solenoids), as well as the associated terminal boxes and plug-in devices, must be mounted so that, in the installed state, testing and maintenance is easy also without special tools. Accessibility to other machine parts that must be serviced must not be negatively affected.
- Control units, e.g., contactors, time relays, and series terminals, must be fastened to cap rails as per DIN EN 50022 in horizontal arrangements.
- Control units are considered easily accessible if they can be replaced within 10 minutes without the use of special tools.
- Assemblies and devices must not be arranged in multiple planes or on the side walls.
- Control units must not be arranged behind swivel frames. Swivel frames must be populated only on one side (from the front). It must be possible to lock the settings of swivel frames.
- The installation location of the main switch must be agreed upon with the customer.
- Components must be arranged so that there is no mutual overlap.
- Electrical operating equipment, except for series terminals (see 14.1.1.5), must be arranged in control unit combinations so that within a group, the numbers increase from left to right and from top to bottom. This also applies to changes and reserved areas.

- The distance between the devices and the cable ducts must be at least 20 mm. For better heat dissipation, larger distances might also be necessary.
- Aisle widths and movement paths in front of switching device combinations must be dimensioned at least according to DIN VDE 0100, part 729.

12.2.2 Spatial separation or grouping

No amendments to DIN EN 60204-1

12.2.3 Effect of heat

- If control cabinet cooling is required, only recirculated air heat exchangers (air/air) or cooling units, each with temperature control, may be used. When the control cabinet doors are opened, the control cabinet cooling must be interrupted by the door switch. Filter fans and water-air heat exchangers may be used only after consultation. The condensed water must be discharged outside of the control cabinet and disposed of by an adequately dimensioned device.
- Functions of ventilation and air-conditioning devices must be monitored; faulty functions or failures must be reported, but must not cause stoppage of the system. Device-side diagnostics outputs must be evaluated by the control system.
- The electrical control system must be installed spatially separated from locations of heat-emitting devices and from magnetic fields according to specifications of the manufacturer.
- The total loss power per control device combination must be determined according to DIN VDE 0660-507 (VDE 0660, part 507) using manufacturer's specifications and recorded in the device arrangement plan. Appropriate cooling measures must be defined according to the determined total loss power. The maximum permissible control cabinet internal temperature is 10% below the maximum permissible operating temperature of the most temperature-sensitive component in the control cabinet.

12.3 Protection rating

- Completely installed control cabinets must correspond at least to the protection class IP54.
- Position and proximity switches must have, in the installed state, an overall protection class of at least IP65.

12.4 Housing, doors, and openings

- The doors (max. 600 mm wide per leaf) must have an opening angle of at least 130° and must be constructed so that line assembly of the control cabinets is possible.
- The opening angle of the doors must also be guaranteed after the control cabinets have been set up. The opening direction of the doors must be agreed upon with the customer.
- Cutouts in the doors or side walls must not negatively affect the stability of the control cabinet.
- The insides of the doors must be provided with pockets for holding the electrotechnical documents. The pockets must be constructed so that DIN A3 documents are largely enclosed. Permanent mounting must be provided.
- Starting at a height of 800 mm, door closures with push rods and handles, starting at 1600 mm, additional locking means, must be provided.
- Control cabinet dimensions, transport units, closures, and colors are defined specific to the company.
- Control cabinet dimensions must be agreed upon with the customer.
- Control cabinets must be equipped with two-way key bit closures.

- PC control cabinets must be opened by means of push-buttons. Access must be possible for electrotechnical laymen.
- Coloring/painting: Light gray as per RAL 7035

12.5 Access to control units

No amendments to DIN EN 60204-1

13 Conductors, cables, and lines

13.1 General requirements

- Only one conductor may be clamped to each series terminal per connection location.
- The terminals are numbered increasing from left to right and from bottom to top.
- Cross-connections may be produced only by means of bridges on adjacent series terminals. Wire bridges are not permissible.
- Analog signals must be carried in shielded cables.
- Shielded cables must be used for transmitting data, analog signals, and BUS systems. Deviations require approval of the customer.
- Data, bus, and measurement cables must be routed at a distance from other power cables or shielded accordingly.
- Motor cables of controlled drives (servos, frequency converters, and the like) must be designed according to project specifications of the converter manufacturer.
- Cables that are exposed to normal operating movements must be highly flexible according to the load and must be suitable for the respective use case. A normal operating movement is a movement that occurs on average more often than once per hour.
- A distribution of signals to signal distributor assemblies (e.g., bus modules, passive signal distributors) with Y distributor connectors or the like, is not permissible in order to have clear signal allocation.

13.2 Conductor

- For the cabling, flexible (multi-wire) conductors (wires) must be used.
- Multiple-wire cables must be used outside of control unit combinations. Single-wire insulated conductors (wires) are not permissible. This does not apply to additional protective ground and potential equalization conductors.

13.3 Insulation

- Conductors, cables, and lines with flame-resistant insulation must be used.
- Flexible metallic electric installation pipes or metal braided cables may be used only in exceptional cases, e.g., for protection against hot or abrasive particles. This does not apply to shielded cables (see also 14.5.4).
- In wet areas of oils, emulsions, and similar agents, PUR cables or cables with at least equivalent properties must be used.

13.4 Current capacity in normal operation

No amendments to DIN EN 60204-1

13.5 Voltage drop in conductors, cables, and lines

No amendments to DIN EN 60204-1

13.6 Minimum cross section

No amendments to DIN EN 60204-1

13.7 Flexible lines

No amendments to DIN EN 60204-1

13.8 Contact lines and slip ring elements

No amendments to DIN EN 60204-1

14 Wiring technology

14.1 Connections and cable routing

14.1.1 General requirements

- The installation is part of the scope of supply of the machine.
- A maximum of only two conductors per terminal may be connected to control units.
- Only one conductor may be clamped to each series terminal per connection location.
- Loose terminals must not be used.
- The terminals are numbered increasing from left to right and from bottom to top.
- All connections must be clamped and/or plugged in. Solder connections are not permissible. Data and measurement cables are excluded from this requirement. Analog signals must be carried in shielded cables. All conductor ends in screw connections must be provided with their own wire end sleeves and cable lugs (crimped connections).
- The screw terminals of all devices must be provided with pressure pads, securing clips, or clamp straps for protecting the conductor, i.e., direct contact between screws and conductors is not permissible.
- Cross-connections may be produced only by means of bridges on adjacent series terminals. Wire bridges are not permissible.
- For cables with more than 5 wires, these must be numbered.
- Only copper is permissible as the conductor material.

14.1.2 Routing of conductors, cables, and lines

Clamps, cable connectors, or other electrical operating equipment must not be used inside of electrical installation ducts or line ducts (cable ducts).

14.1.3 Conductors from different circuits

Conductors, cables, and lines from circuits that are not switched off by the main switch must be marked in orange throughout their entire run.

14.2 Identification of conductors

Outside of housings, cables and lines must be provided with permanent marking at the outlet from the housing. The marking must correspond to the specifications in the documentation.

14.3 Wiring within housings

All cables coming out from control unit combinations, terminal boxes, and/or connection boxes must lead to series terminals or terminal plug adapters.

14.4 Wiring outside of housings

14.4.1 General requirements

A separate cable must lead to each device. Loops are not permitted, except in bus systems.

14.4.2 External cable ducts

Each machine or each main switch area must be provided with its own installation path. Area switches are part of the main switch area.

Data, bus, and measurement cables must be installed separately from high-power lines and must have adequate shielding.

Cable ducts in the floor area are permissible only inside of metal constructions that can be walked on. In principle, cable trays must be provided with corresponding covers.

14.4.3 Connection to moving machine parts

For cables to moving or adjustable parts, power track chains that have adequate dimensions and are easy to open must be installed or cable loops must be provided. Here, the permissible bending radii specified by the manufacturers and the mounting specifications must be adhered to. The cables in the power track chains must be guided symmetrically in the longitudinal direction from the outside (large cross section) toward the inside (small cross section) loosely and without crossing. The hoses/cables must be guided separately (separating strips) and fixed at a high location on one side. Only cables that are released by the manufacturer for use in power track chains may be used. Chain elements must be individually exchangeable for opening.

Electrical cables must not be guided partially from the control cabinet through multiple chains to the actuator. Separating points must be agreed upon separately with the customer. Cables must be exchangeable without disassembling the connectors. Observe the minimum radius and mounting guidelines of drag lines according to the manufacturer (without twists).

14.4.4 Connection between devices on the machine

For preassembled data/bus cables, a separable cable flange for connector break-outs must be used for guiding the cable. Measurement cables, servo cables, bus cables, plug, and other shielded cables must be guided by means of separable feedthroughs into the control cabinet.

14.4.5 Connector/plug socket combinations

It must be possible to plug the cables at risk of breakage during normal operating movements on both sides.

Location variable electrical components of a machine must be connected by means of connector/socket combinations.

All actuators and sensors must have a pluggable design.

Only one conductor may be connected at each terminal/connection point of a connector/socket combination.

The replacement of individual cables must be possible easily and without disassembly of the connector/socket combinations.

14.4.6 Disassembly for shipment

Control cabinets, control panels, and accessories arranged separately from the machine must be connected by pluggable connecting cables.

14.4.7 Additional conductors

In cables from control unit combinations to terminal boxes or within control unit combinations or terminal boxes, 10% reserve wires must be available after commissioning according to the cross section and target.

Unused conductors (wires) must be guided individually to designated terminals or plug contacts. Where this is technically not possible, e.g., in connector/socket combinations, superfluous conductors must be isolated.

14.5 Cable ducts, connection boxes, and other boxes

14.5.1 General requirements

No amendments to DIN EN 60204-1

14.5.2 Percentage filling of ducts

Ducts may be filled only up to max. 65%.

14.5.3 Rigid metallic electric installation pipes and their connections

Electric installation pipes must be screwed on.

The use of angle brackets and T-brackets is not permitted.

14.5.4 Flexible metallic electric installation pipes and their connections

No amendments to DIN EN 60204-1

14.5.5 Flexible non-metallic electric installation pipes and connections

No amendments to DIN EN 60204-1

14.5.6 Electric installation ducts to be opened

No amendments to DIN EN 60204-1

14.5.7 Installation spaces in machines and electric installation ducts to be opened

No amendments to DIN EN 60204-1

14.5.8 Connection and other boxes

- Connection boxes must be used if
 - Cables must be branched off
 - A separation of cables with regard to transport or conversion of the machine is required or useful
 - A transition between flexible and very flexible cables must be created

- Individual devices are connected to fixed (cast) connection lines (e.g., sensors, proximity switches)
 - A central connection for an assembly or also for the entire machine must be created
- Terminal and connection boxes must be arranged so that the opening is accessible without disassembling other machine parts
 - Only terminals may be housed in connection boxes.
 - Only cables may be looped through in connection boxes.
 - Only non-metallic screws may be used in plastic housings.
 - Connection boxes and other boxes must have at least protection class IP44.

14.5.9 Motor connection boxes

No amendments to DIN EN 60204-1

14.6 Cable colors for function coding

Cable colors for function coding are defined as follows (except 14.1.3).

ProfiNet	green
Ethernet	gray
Profibus	violet

15 Electric motors and associated equipment

15.1 General requirements

The insulation of the motors must correspond to at least the thermal class “F” as per DIN IEC 85 (VDE 0301, part 1).

A rotational direction arrow must be clearly visible and placed next to the motor.

All drives and actuators must be designed for a switch-on period of 100%.

Up to an output power of 4 kW, the connection must be realized by means of a plug connection in the vicinity of the motor.

For conveyor belts, pumps, and fan drives, a repair switch must also be installed. As an alternative, a separating point can also take over this function.

For motors with transmissions, these must be installed so that any escaping transmission oil does not enter into the motor.

15.2 Motor housing

For motors, only the protection class IP44 or higher is permissible.

15.3 Motor dimensions

No amendments to DIN EN 60204-1

15.4 Motor arrangement and installation spaces

If air filters are used, these must have a maintenance-friendly arrangement and must be exchangeable with few movements. It must be possible to perform maintenance without disassembling other components.

15.5 Criteria for the motor selection

The rated power of the electric motors must be adapted to the mechanical power requirements of the machine. If a larger motor must be selected due to the power classification, the max. overdimensioning must be 30%.

15.6 Protective devices for mechanical brakes

No amendments to DIN EN 60204-1

15.7 Motor power rating plates

If the motor is installed so that its rating plate is not directly visible, a second rating plate must be mounted next to the motor so that it is clearly visible.

16 Accessories and lighting

16.1 Accessories

- The connections and designs of the lighting and the sockets in the control cabinet are defined specific to the plant.
- The control cabinet lighting must be switched for each cabinet panel by means of a separate door position switch.
- For powering the accessories (e.g., printers, data entry devices, data output devices), in addition to the data interfaces, plug-in devices according to DIN 49440, part 1 to part 6 must also be installed (each at least 2 units).
- The number of reserve plug sockets must be agreed upon with the customer.
- Plug devices for data interfaces must be provided with captive covers.
- The protection classes of the accessories must be adapted to the environmental conditions.

16.2 Workplace illumination for machines and accessories

16.2.1 General information

In the machine's working chamber, power for lighting according to DIN EN 1837 must be provided. Special attention must be given to a glare-free and blinding-free design. This must be clarified in agreement with the customer.

16.2.2 Power supply

If accessories are connected via a transformer or a power supply unit, only secondary voltages of 230 VAC, 50 Hz or 24 VDC are permissible.

16.2.3 Protection

No amendments to DIN EN 60204-1

16.2.4 Lamps

No amendments to DIN EN 60204-1

17 Markings, warning signs, and reference marks (operating equipment markings)

17.1 General information

No amendments to DIN EN 60204-1

17.2 Warning signs

Terminal boxes must be marked with a warning sign when necessary. Instruction signs and warning devices must not be used as a replacement for missing protection devices or structural deficiencies.

If laser systems are present, a corresponding warning sign with the laser class and the wavelength in use must be installed.

17.3 Function marking of the control equipment

The function marking of command and alarm devices must be installed directly over these devices. For machine-internal Ethernet networks, a marking of the IP address is required and for Profibus nodes, the Profibus address is required directly on the component.

17.4 Marking of the control equipment

The type plate of the switching device combinations must be mounted on the outside in the vicinity of the network connection or the main switch.

The font size and arrangement on the system must be selected so that the markings are also easily identified outside of the system.

17.5 Reference marks (operating equipment marking)

- The marking signs must not be mounted on the device itself and must not be lost if the devices are replaced.
- The marking must be permanent and attached so that it is visible when the device is completely set up. If covers or hoods are used, the device markings must be repeated.
- The labeling of name plates must be realized in a printed design. Hand-written markings are not permissible. White labels with black lettering must be used.
- Type plates and equipment labels must be attached rigidly to the device. These labels must not be fastened by adhesion.
- Terminal boxes must be marked on the outside with name plates on which the terminal strip numbers are indicated.
- Every cable and conductor end must be provided with a clear and permanent name plate.
- All inputs and outputs of electronic control systems must be marked with addresses. The markings must remain on the slots when assemblies are replaced.

18 Technical documentation

18.1 General information

- Technical documents must be compiled in folders or ring binders and provided with a table of contents and index. The format of the folder must correspond to the format of the paper.
- Circuitry documents must be prepared in the language used where the operator is located and in English.
- DIN EN 81346-2 must be applied for the marking of electrical operating equipment and the associated supplements.
- The approval method for the templates of the electrotechnical documents is defined specific to the company.
- Filling out the step fields in the electrotechnical documents is part of the scope of supply. Specifications on the labeling must be agreed upon with the customer.
- Changes, expansions, or modifications to existing machines must be designed with the original drawing and designation system if not agreed upon differently with the customer.
- All safety areas, personnel protection shutdown circuits, and robot hazardous areas must be documented in the system layout/system overview plan. This also relates in assembly lines to terminal boxes, motors, etc.
- For Ethernet networks within a machine (ProfiNet, camera networks), the IP addresses being used must be marked in the documentation.
- All descriptions that are developed for the documentation must be created with programs that must be agreed upon with the responsible specialist department.

18.2 Required specifications

In addition to the documents required in DIN EN 60204-1 (VDE 0113, part 1), control, system, and movement schematics must be delivered with DIN symbols, preferably in DIN A3 format, including the associated function, system, and movement descriptions.

18.3 Requirements on all documents

- The sheet format for circuit diagrams and connection diagrams, as well as the program documentation of the electronic control system (PC print outs) must be agreed upon with the customer.
 - For diagrams created on CAD systems, the definitions of the customer must be observed.
- For electronic control systems, system-relevant data carriers (e.g., CD-ROMs) must be delivered for data protection.
- SPS descriptions must be created:
 - For data modules: structure and content; for data words, the meaning and any boundaries
 - For functional modules: the effect, the parameterization, and any boundary case considerations
 - For program modules: the description of the effect
- The program print-outs and data carriers to be delivered must contain the programs required for the control system and documentation, must correspond to the current version, and must be reproducible on the programming devices available at the operator.

- Variant data, position data for servo drives, and parameterization in data modules must be secured on site off-line after completion of the commissioning.
- All documents for operation and visualization systems in use are part of the scope of supply. This includes, among other things
 - Licenses, manuals and system descriptions, installation disks, boot disks, drivers in use, the description of the structure/data storage and the interfaces.

18.4 Minimum specifications

No amendments to DIN EN 60204-1

18.5 Installation plan

18.5.1 Connection plan

- The signal exchange with other machines, chains, external devices, or higher-level systems must be shown and described together with the external connections.
- The description must include, among other things, the following specifications:
 - Designation of the reporting or receiving device according to the circuit diagram (e.g., circuit breaker 38Q1)
 - Function (e.g., spindle drive)
 - Activity (e.g., triggered)
 - Connection point (connector and terminal numbers)
 - Marker or data module address
- All terminal strips and connection cables to each other and to the control cabinets must be shown in an overview with specification of cable designation, cable number, wire quantity, and wire cross section.

18.5.2 Arrangement plan or arrangement table

DIN EN 61082-4 also applies

The local position and designation of control cabinets, terminal boxes, control stations, control units, command units, alarm units, drives, and other devices that are part of the electrical equipment must be visible from an arrangement plan.

For the use of bus systems, their routing must be documented in the system layouts. The connectors used in the individual segments of the bus routing must be marked in the hardware plan. The location of the control and technology cabinets, terminal strips, and consoles must be documented layout with the respective system, functional group, and location markings.

18.6 Block (system) circuit diagrams and function diagrams

No amendments to DIN EN 60204-1

18.7 Circuit diagrams

- The circuit diagram and its type of representation must correspond to the requirements specified in DIN EN 61082.
 - In the circuit diagram, bus structures and the hardware structure of the visualization system must be shown.

- For all of the intelligent assemblies (also PCs), the delivered hardware and firmware versions and the hardware settings (DIL switches) must be noted in the circuit diagram.
- For all of the electronic control systems or assemblies, complete circuit documents (internal circuit diagrams, if necessary with measured value specifications for the measuring points), oscillograms, and notes on the measuring devices to be used in the form available from the manufacturer. This also applies for the devices and assemblies shown in the circuit diagram as a “black box.”
- Grounding, shielding, and anti-interference measures must be shown in the circuit diagram, in the connection plan, and in the internal circuit diagrams of assemblies.

18.8 Operating instructions

The operating instructions must contain all of the information necessary for bringing the machine to a home position or for restarting the machine after a fault or interruption.

Furthermore, it is to describe the behavior of all the functions that are available at the control stations (and can be triggered both by means of switch elements and also by means of the visualization) and which mutual locks are to be taken into account if necessary.

A graphical protective area layout must be delivered in which the individual protective areas and the associated safety-oriented operating elements (e.g., EMERGENCY STOP button) are shown.

18.9 Maintenance instructions

- DIN 31051 and DIN 31052 also apply.
- To check for flawless functioning of the safety devices in use, corresponding documents that make it possible for the technical staff to perform the testing must be delivered with the documentation for the preventative maintenance or for the execution of the specified testing. This includes, among other things, adjustment instructions through information on test options, test programs, aids, limit values, contouring errors, and follow-up movements.
- For all devices and controls that can be parameterized, parameter lists/set values, where possible, must be delivered on data carriers. The parameters/set values that deviate from the standard settings of the component supplier must be marked in particular.
- A complete description for the protection and installation of operating systems, programs, and data must be delivered, with indication of all of the necessary aids and procedures.
- For all of the devices in which settings must be made for the exchange or a special procedure must be followed, this information must be presented in exchange instructions in the form of a checklist showing the correct sequence.
- For each device in use (e.g., drive, actuator, control assembly), the associated manuals/descriptions must also be supplied.

18.10 Bills of materials

- The bill of materials must be designed according to DIN 24420.
- Wear parts and replacement parts that the supplier obtains as purchase parts must be listed with the order date and name and address of the manufacturer or distributor. The name and address must also be listed in a separate list.
- All electronic operating equipment (device, function group, assembly) must be described in the data sheets or in the service manual. It must contain all of the necessary information, e.g., type designation, device or function description, wiring symbols, connection layout, parameterization, input values, output values, transmission behavior, power loss.

19 Testing and verification

19.1 General information

As an acceptance requirement, at least all of the testing and measurement records specified by laws and standards must be provided.

19.2 Continuous connection of the protective ground system

The measuring points must be marked and verified with reference to the measurement records.

19.3 Insulation resistance test

No amendments to DIN EN 60204-1

19.4 Voltage test

Simulations must show that an interrupted program can be properly resumed after voltage drops or losses of power. The operating personnel must be able to continue the production cycle or move the production equipment into the home position with the available command devices.

19.5 Protection against residual voltage

No amendments to DIN EN 60204-1

19.6 Function check

No amendments to DIN EN 60204-1

19.7 Review

No amendments to DIN EN 60204-1


20 Commissioning, technical acceptance, training

20.1 Commissioning

The commissioning is considered completed when all acceptance requirements have been fulfilled (see 20.2.2).

The programming and service devices required for the commissioning and programming are provided by the supplier itself.

During the commissioning, the current version of the software and hardware documentation (e.g., technical documents, program printouts, data carriers) must always be available on site for the operator.

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20.2 Technical acceptance

20.2.1 General information

- The acceptance methods are defined specific to the plant. The data protection must be demonstrated by erasing the original data, re-installing, and restarting the system.
- The supplier is responsible for meeting the present specifications, even if deficiencies or deviations are not detected during the acceptance.
- If deviations from the supply specifications that have not been approved in writing arise during the acceptance of the machine, the supplier must correct the deficiencies free of charge.

20.2.2 Acceptance requirements

- All of the technical values forming the basis of the contract must be adhered to. The flawless functioning of controlled processes and sequences must be verified by measurement records.
- The machine must be at an operating state temperature.
- Written confirmation is provided that the electrical equipment of the machine corresponds to the specifications of BGV_A2 (formerly VBG 4) (see BGV_A2 (formerly VBG 4), §5, section 4, e.g., on form ZH 1/293).
- The documentation was enclosed in duplicate in the delivery for each machine (of these, one revision copy for the supplier).
- For special machines, the specified documents are provided:
 - For machines in areas at risk of explosions, the completed test certification “Report on the testing of electrical equipment in areas at risk of explosions” and the guarantee that the electrical operating equipment in use corresponds to DIN EN 50014 (and VDE 0170/0171) are included. The supplier is responsible for the costs for testing and certification.

20.2.3 Submission of technical documents

For the acceptance, 1 set of technical documents including program printout and data carrier is to be submitted to the customer for each machine. These documents must include records of all changes and must therefore correspond to the current state of the technical equipment. This also includes the configuration file of scanners, servo motors, converters, etc.

One revision copy is used by the supplier for creating the final plans.

- At the latest 2 months after acceptance, the supplier provides the customer with all of the technical documents as the originals depending on the requirements of the customer.
- If the schedule is not adhered to at the fault of the supplier, the customer reserves the right to complete any missing documents at the cost of the supplier after a reasonable extension of time.
- The function checks of all safety devices and protective measures must be documented and submitted to the customer.

20.3 Training

Instruction on the machine must be performed for the operating and maintenance personnel. The duration is to be adapted to the requirements.

Among other things, the following topics must be discussed in detail:

- Overall function of the machine

- Automation concept
- Hardware configuration
- Installation concept
- Operating and reporting concept (e.g., operating and fault reports)
- Software structure
- Modules for units (unit modules, linking modules)
- Setup of the data coupling (e.g., data exchange between machine controller and higher-level control system)
- Explanation of possible interventions for changing parameters and texts, with execution of practice-oriented examples
- Troubleshooting and fault tracking with reference to the documentation, e.g., with the help of a programming device
- Safety functions and residual risks

The supplier has submitted, with its quotation, a proposal on the scope and costs for sufficient system training and hardware and software.

For performing the instruction/system training, documents from the documentation must be prepared accordingly and provided to the course participants.

After completion of the training, a written certificate of participation must be provided to the customer.

21 References / related documents

This requirement specification is part of the technical procurement specification machines, constructions and kites and may only be used in conjunction with this.

22 Specific remarks

None

23 Changes made since the previous edition

First edition with new number