HIRSCHMANN
AUTOMOTIVE

Technical Delivery Regulation

E05 – Electrical Systems and Controls

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This standard governs the requirements for the documentation and the general regulations for the delivery of systems.

Revision status:
This delivery regulation E05 replaces all previous regulations.

Version:	Page no.:	Description of change:	Date:
E01	Complete	Created, Kapeller Daniel	01.03.2005
E02	Complete	Revised, Donadeo E.	01.05.2010
E03	Complete	Revised, Markovic L./ Jenny M.	24.01.2013
E03	Complete	Revised, Ritzberger D. / Moschek T. / Hesse M.	31.07.2013
E04	Complete	Revised, Laterner L. / Moschek T.	05.12.2016
E05	7, 9, 14, 16	Revised by Laterner L. / Fischer M.	24.01.2018

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1. General

1.1. Area of Application

This Hirschmann factory standard specifies the delivery regulations for the electrotechnical equipment of machines, systems and production facilities.

1.2. Deviations

Deviations from this delivery specification which may appear necessary or appropriate to the manufacturer, require written approval from Hirschmann Automotive.

1.3. Standards/Regulations

In addition to the requirements specified in this technical delivery specification, the contractor is fully responsible for all requirements applicable to their service arising from regulations (e.g. EC directives, regulations and other applicable laws) as well as from standards and generally accepted rules of technology, even if this technical delivery specification does not specify such in detail. As far as regulations, standards and technical rules are referenced in this technical delivery specification, the contractor themselves must check whether they are applicable for their work and whether other regulations, standards and rules are also to be adhered to. If in doubt, the contractor must immediately contact the client.
In addition, the contractor shall immediately notify the client if the contractor recognises or identifies, on the basis of their knowledge, that the service to be rendered by the contractor is not suitable for the intended purpose or suited only to a limited extent.

1.4. Measurement protocols

A record of the electrical safety of the equipment shall be drawn up and supplied.

1.5. Instruction and training of maintenance personnel

Successfully performed training and instruction of the client's maintenance personnel is to be documented by the contractor (scope, name of the participants, signature of the trainer and the participants). If, due to the fault of the contractor, the client's operating and maintenance personnel are insufficiently or incorrectly trained, the contractor shall ensure the availability of the machine/ machinery by use of its own personnel at no cost to the client until the required level of training is reached.

The training of the client's operating and maintenance personnel is included in the machine/machinery delivery scope. The contractor has to agree with the client the place, date and duration as well as the topics of the training.
Separate training of the operating and maintenance personnel is to be carried out.

The following topics must be extensively and bindingly dealt with for the training:

- Overall function of the machine/mechanical system
- Automation concept
- Hardware structure
- Installation concept
- Operating and reporting concept (e.g. operating and fault messages)
- Software structure
- Modules for units (unit module, connecting module)
- Structure of the data coupling (e.g. data exchange between machine controller and superordinate controller)
- Explanation of the access options to change parameters and texts (inc. the performance of practical examples)
- Troubleshooting and tracking using the documentation, e.g. with the help of a programming device
- Safety and protective equipment
- Restrictions of the machine/mechanical system

The contractor has to submit an offer, in coordination with the client, regarding the scope and costs of system training in hardware and software, mechanically and electrically (e.g. for function and overview of the machine/machinery, CNC control, PLC control, drives, measuring systems and measuring devices, hardware and software of the machine/machinery).

2. Energy supply

2.1. Operating supply voltage

The standard operating supply voltage is 230/400V 50 Hz / 50 Hz (+/- 10%) in the TN-C-S system. Furthermore, different supply concepts can exist (e.g. installation location, Mexico 230/400V 60 Hz +/- 10%), which must be clarified in advance.

2.2. Mains connection

Terminal blocks must be provided for the main connection up to 240 mm². Watch out for clockwise field of rotation. An equipotential bonding strip must be provided and connected with the PE on the mains side.
Principally, a 5-conductor connection (TN-S network) is to be provided. A connection between N and PE in the machine/mechanical system is not permitted. The terminals must be labelled with L1, L2, L3, N and PE. External conductor terminals and N conductor terminals must be labelled as live (cover, voltage warning message).

2.3. Connection interfaces

The interface between a peripheral device and the machine/machinery must first be clarified with the client.

2.4. Fuse

The expected operating currents and the output of the machine are to be made known to Hirschmann Automotive no later than 3 weeks before delivery.

2.5. Main switch

Every machine/mechanical system must be equipped with a mechanically-actuated, 3-part lockable main switch.
Door couplings are not permitted, or the switch lever must be firmly connected to the switch element. The main switch must be lockable in the "OFF position".
The switch must be red with a yellow background when it takes on an emergency stop function.
The control cabinet must be able to be opened at any position of the main switch (OFF/ON).

2.6. Supply voltage

An automatic start-up of the controller must take place after failure and restoration of the supply voltage, so that all configuration parameters are restored automatically without operator intervention, without initiating a start of the machine/mechanical system (processing/movement). A failure of the supply voltage may not lead to data loss. If a rechargeable battery or a battery is used for data retention, its voltage is to be monitored and visualised.

2.7. Faults

After voltage interruptions and failures as well as after system faults, the program must be able to continue correctly. The means of production must be able to continue a cycle further in home position with the command device.

2.8. Power supply connector

Power supply units are not permitted to be connected to the ground machine.

2.9. Active power meter

From a connected load > 70 kW, an active power meter with pulse output is to be built into the control cabinet to display the energy consumed. It must be implemented on terminals (potential-free contact, wiring colour ORANGE). The pulse must be adjusted so that recording of the number of pulses per kWh is possible with a PLC standard inlet 24V DC in the building control technology.

3. Control cabinet and switching devices

3.1. Equipment

Within a machine/machinery the same equipment is always to be implemented, i.e. no assemblies or components of the same function from different manufacturers can be implemented.
Only assemblies, components, devices and process materials according to the client's approved list can be used. They may only be installed in their original state and without any changes. Impermissible, for example, is the drilling out attachment holes, removal of housing parts, changing shaft ends and modification of circuits.
The construction and installation regulations of the device and system manufacturer must be kept. Assemblies, components and devices which require inspection must be made known to the client and listed in System Overview List. Testing deadlines must be discussed with the client (e.g. the testing of pressure vessels, power sensors, etc.). All equipment is to be selected by the contractor and designed so that it can be connected to the given local networks without special precautions - despite voltage fluctuations and interference pulses occurring - and be fully functional.

3.2. Size, arrangement and implementation of control cabinet

The size and arrangement of the control cabinet must be coordinated with Hirschmann Automotive during design engineering.
The control cabinet has to be in the colour light grey (RAL 7035). If this is not possible, the control cabinet should be painted in the machine colour.
IP 54 is required as the minimum protection type.
For door seals, oil-resistant sealing material must be used.
The closure system "Doppelbart 5" is required.
To store the circuit diagram, a suitably dimensioned and screwed or riveted metallic circuit diagram folder is to be provided.
With free-standing control cabinets, the electrical connection between control cabinet and machine must be implemented as pluggable.

3.3. Space reserve

The control cabinets are to be dimensioned so that for the devices of the individual function groups (equipment, terminal strips, cable ducts, I/O level, etc.) at least a 20% space reserve is available.
Control cabinet doors generally are only considered a space reserve when an attachment for equipment is also provided.

3.4. Space distribution

The control cabinet may only contain electrical equipment. They are to be stored clearly arranged and in conjunction with their function, appropriately and in agreement with the layout plan. Swivel frames are only permitted if the opening angle is greater than 110° and tipping over of the non-attached control cabinet is ensured with the frame swivelled out.
Access to the components behind the swivel frame must be ensured.

3.5. Touch-proof equipment

Only touch-proof equipment may be used. If despite this
covers should be necessary, transparent materials (e.g. Makrolon) are to be used.

3.6. Operator equipment accessibility

Equipment which is placed in the control cabinet but requires configuration by the operator must be adjustable without opening the control cabinet.

3.7. Mounting plate

Only solid mounting plates with wiring channels (slotted channels) are permissible as wiring systems.

3.8. Control cabinet/machine lighting and service sockets

Inside the control cabinet, a Schuko socket with Fi 230V 16A must be available as well as lighting and be connected before the main switch. Location-specific exceptions must be agreed with the client.

Energy-saving LED machine room lighting is to be installed/in-built and must be pluggable and able to be switched on/off.
The energy-saving LED control cabinet lighting must be switched per control cabinet field via its own door contact switch.

3.9. Control cabinet cooling

The temperature in the control cabinet over the control and drive components and operating fields may not exceed 40 °C. The regular ambient temperature in the hall must be clarified with the client; possible temperature peaks and location-specific conditions (elevation, solar radiation, etc.) are to be considered.
When opening the control cabinet doors, the control cabinet cooling must be interrupted by a door switch.
The temperature in the control cabinet and the operating fields must be monitored, and if the permitted temperature (40 °C) is exceeded it must be displayed as a fault message. It may never exceed the maximum value of 45 °C.
Faults on cooling devices must be monitored and reported to the central control system. Air conditioners are to be equipped with a pre-filter.

3.10. Roof installation of cooling devices

Cooling devices as rooftop structures are not permitted.

3.11. Type plate

A type plate with the required electrotechnical data is to be attached to the control cabinet.

4. Installation

4.1. Potential equalisation / shielding

The potential equalisation must be carried out at a central point and executed in accordance with EMC guidelines.
Shielding of signal lines must take place close to devices and may not be used as potential equalisation. A topology plan is to also be delivered for the potential equalisation. All separate machine and system parts are permitted for the purpose of potential equalisation and ESD protection and are to be permanently conductively connected together.
Control cabinet doors, apertures, mounting plates and mounting frames are to be included in the protective measures.

4.2. Protective earthing and protective equipotential bonding

All installations and switching systems are to be designed, according to their construction, against indirect contact with live parts by protective measures "protective earthing and protective potential equalisation" using the TN-S system.

4.3. Safeguarding connector systems

A circuit breaker is to be used for connector systems over 32A.
For a connector system under 32A, protection against direct contact with live parts, a circuit breaker with residual current protection
(FI-Ls, 30 mA, according to the equipment installed, min. Type A at least) is to be used.

4.4. Three-phase current connector systems

Only three-phase connectors of type CEE (16A/32A, 5-pin, 6h) are to be installed.

4.5. Control voltage

The control voltage for PLC, initiators, light barriers, valves, magnets etc. must be 24V DC.
The control voltage for measuring devices is to be supplied via separate power supplies. Safety extra-low voltage (SELV) or protective extra-low voltage systems (PELV) are to be installed.

4.6. Control circuit earthing

The control circuit earthing may only be undertaken with an earthing separation terminal.

4.7. Valves

All hydraulic and pneumatic valves are to be provided with valve protection circuit and LEDs and may be operated at max. 24V DC.

4.8. Metal screw connections

Metal screw connections are not permitted in plastic housings.

4.9. Safety equipment

Safety equipment must be designed so that it cannot easily be bypassed. Doors or the like which enclose the internal safety circuit are to be fitted with safety switches. If the inner safety area can be entered and it is possible to close the safety circuit behind a person, this area must additionally be queried by pressure sensitive mats, laser scanners, etc..

4.9.a. Protective locks / protective doors

Protective doors to moving equipment (e.g. robots, portals, etc.) are to be provided with a control switch with an interlock. Principally, contact-less door safety switches (locking devices) are to be used. Manual unlocking must be possible in case of an emergency. Moving protective doors as access points for maintenance are to be secured in closed state by a safety switch.
Protective doors which are opened and closed during each working cycle, are to be secured by safety switches.

4.9.b. Emergency stop / in case of failure

The emergency stop control device must be red. If a background is present behind the control device and if it feasible, it must be yellow (also applies for fixed wired or pluggable hand operating devices).
The use of emergency control devices with collars is to be agreed with the responsible occupational safety dept. of the client.
The "Emergency stop" command for PLC control is reported and displayed in detail.

5. Operational equipment

5.1. General equipment

5.1.a. Overload and short-circuit protection

To protect against overload and short-circuits, a circuit breaker is to be provided (fuseless) from a current strength of 32A.
With general three-phase circuits, three-pole circuit breakers are to be used.
For motor/engine circuits up to 100A, a motor protection switch is to be used.
From a current strength of 35A, an NH fuse switch disconnector is to be provided.

5.1.b. Types and designs

In general, standard types and standard designs of the equipment are preferable for use.
If special types of equipment (e.g. sensors, actuators, etc.) are used, these must be agreed with Hirschmann Automotive. An offer must be provided for corresponding spare parts.

5.1.c. Accessibility

The equipment arrangement must be clear and appropriate. All equipment must be easily accessible in consideration of maintenance.

5.1.d. Labelling

All equipment in the control cabinet and on the machine or system must be labelled via badges in printed form, identical with the equipment labels in the circuit diagram. The labelling is to be carried out twice (one the equipment and on the cable or on the mounting plate) and must be legible without removing covers. In the case of plug connections, labelling must be provided on both sides. Devices on which several wires have to be disconnected to replace the device, must be provided with a permanent single wire label. Exceptions can be agreed with the client. The identification plates may not be attached to interchangeable components, assemblies or devices. When marking the components installed in the machine/machinery, the following information must be observed:
The device identifications have to be repeated on the corresponding panels and covers.

Rotation arrows must be attached to all pumps and motors.
Labelling signs must principally

- be engraved or etched on aluminium/plastic
- have good legibility
- be permanently attached to a well visible point (permanently)
- be attached next to the components, assembles and devices
- for covered installed devices be attached next to the installation space.

5.1.e. Labelling outside the control cabinet

The equipment labelling outside the control cabinet must be attached via engraved/stamped or etched badges permanently, undetachable, without gaps and well visible next to the component and on the cable. This also applies for plugs, switch boxes, command boxes and operating elements.
All electrical installation spaces must be marked with a warning sign (electrical voltage warning).

5.1.f. Equipment labelling

The equipment labelling inside the control cabinet must be provided on the mounting plate and on the component so as to be clearly visible.
The naming and symbols are to be adapted according to the standard.
A consistency/similarity of the labelling which makes sense must be ensured between sensor/actuator levels and PLC controller.
Safety-relevant components are to be labelled with +SF and a yellow sign.
Component identification or location markings must be location- and sheet-specific.

5.1.g. Rotary table drive

Rotary table drives may only be controlled by frequency converters. Three-phase motors with an output of 7.5 kW or above must preferably be designed with an electronic soft start. For an output of up to 4 kW, the connection must take place via a plug connector. The start-up conditions are to be agreed with the responsible specialist department of the client.

5.1.h. Three-phase motors operation

Three-phase motors should principally be operated with frequency converters.
Direct switching on of loads over 3 kW with switch or safeguard is not permitted. A star-delta start-up is only permitted up to maximum of 10 kW.

5.1.i. Safeguards and relays

Safeguards and relays which switch in every machine cycle must be designed in semi-conductor technology.

5.1.j. Fuse

The power supply must be divided into 3 groups, each of which must be fused separately:

- CPU, HMI, PC systems, network components
- Sensors, bus electronics, measurement amplifiers
- Actuators

5.2. Control systems

5.2.a. I/O level

For the inlet and outlet levels, only short-circuit proof equipment in semi-conductor technology with potential isolation (optocoupler) may be used.

5.2.b. Buffer battery

A voltage failure with empty buffer battery may not cause any program loss. Lowering of the buffer battery voltage is signalled via a message text in the display.

5.2.c. Control systems

Siemens and Beckhoff controllers are preferably to be used.
If another manufacturer is used, this is to be reported to Hirschmann Automotive.

5.2.d. Machine program

The program must be provided completely (inc. symbols, comments, etc.) and without know-how protection on the data carrier. This also applies for programs which were created in a higher programming language (user program, soft PLC, etc.).

5.2.e. Standstill

Undefined standstills without corresponding operating of fault messages may not occur at any time during operation. In the event of a loss of power, it must be ensured that there is no risk of collision when the system is put back into operation. After a fault, the machine/mechanical system must come to a standstill in a defined state (if technically safe to do so).

5.2.f. Operational equipment error messages

Equipment with error messaging contacts must be wired to all contacts of the higher-level control unit and visualised.

5.2.g. Set-up mode

Movement processes which could lead to collisions or dangerous situations are to be prevented in set-up mode by corresponding technical program locks.

The set-up mode must allow the option to type in the sequence steps from individual stations and the whole machine. While doing so, it is to be ensured, that also for longer actuation only one cycle per actuation is executed (edge evaluation). Returning to automatic mode may only be possible when a starting position is available.

Another option of the set-up mode must be the movement of single actuators (e.g. cylinder) via buttons and the associated lights (e.g. working position/ starting position) and the movement of axes (POS, JOG, REF, etc.) on the operator panel. Returning to the automatic operating mode may only be possible with restored starting position, or it must be ensured that no collision occurs by processing the positions on the modules.

Furthermore, it must also be possible to carry out a controlled home position movement.

5.2.h. Data backup

Data backups and parameter lists are to be supplied for all devices which are configurable via software (e.g. controllers, frequency converter, temperature controller, etc.).
If a PC is used as a machine controller, a complete backup (status: final acceptance) of the hard disk is to be supplied. Acronis is preferred.

5.2.i. Data interface

The interface must be compatible with MES systems.
The precise structure of the interface must be obtained beforehand from the client's Process & Project Management Department.

5.2.j. Languages

HMI-texts and –messages, such as machine lettering have to be made in English. Additionally it has to be provided in national language of the machines destination country. If multilingual execution is demanded, there has to be the opportunity of switching the languages in the machine program by a soft-key switch.

5.3. Command and reporting devices

5.3.a. General

Command and reporting devices must be easily reachable without danger from the operator's position. If reporting devices can not be reached, they must be visible. Command devices for starting the system must be instructed and arranged so that they cannot be accidentally actuated.
Status displays (e.g.: illuminated buttons) are to be placed in the visual field of the operating personnel, they should give information about the insertion readiness and OK/nOK parts.
The machine may not at any time go into standstill without a message; there must be a corresponding message for each situation. Error/fault messages must always be output in clear text, error codes are not permitted.
Sensor lists with report texts must be handed over to Hirschmann Automotive at the latest 2 weeks before the first planned preliminary acceptance.

5.3.b. Status and error indicators

In the case of machines/machinery, production cells, interlinked systems, assembly systems, etc., the operating state must be indicated by means of a clearly visible signal light:

- Red (flashing light): fault indicators (e. g. machine standstill due to an electrical or mechanical fault, "emergency stop" actuation)
- Yellow (continuous light): machine standstill due to missing start requirements (e.g. set-up mode, maintenance, missing workpieces, tool change)
- Yellow (flashing light): warning, machine standstill impending due to e.g. missing workpieces in flow, minimum stock level reached
- Green (continuous light): machine running in automatic mode, normal mode
- Green (flashing light): machine/mechanical system is in automatic mode, whereby the start conditions are available.

The attachment of the signal lights is to be agreed with the client. The sequence of the colours from top to bottom is red – yellow – green.

5.3.c. Differentiation

A clear differentiation must be made between fault and operating messages.

5.3.d. Operating elements

The number of operating elements (button for hand functions) must be low, but known operating elements which are to be pressed often are to be designed as hardware buttons.

5.3.e. Lamp test

All optical and acoustic displays must be able to be tested for function during operation via a lamp test.

5.3.f. Light displays

Only LED inserts are to be used for light displays.

5.4. Sensors

5.4.a. General

All sensors must be pluggable and must be checked for switch changes during every machine cycle.
Sensors for measuring devices must be designed in a way that the measuring results can`t be failed. (e.g. vibrations, motions,..).
Distributor boxes, terminal boxes and sensor distributors are to be collected in groups and arranged in accordance with the single stations or assemblies of the system. All sensors must be checked for switch change during each cycle. If this is not possible (e.g. with sensors for set-up check), two switches are to be implemented which mutually monitor each other. In case of a missing signal change, a fault message must occur with the corresponding sensor identification. This function is tested during the preliminary acceptance of each sensor.

5.4.b. Switch state

An LED for the switching state of the sensor must be present on the sensor and on the connection socket (for example, sensor-actuator distributor).

5.4.c. Switching accuracy

For switching accuracies > 0.3 mm, inductive proximity switches or magnetic field sensors are to be implemented.
For switching accuracies < 0.3 mm and for measuring tasks, measuring systems (inductive, incremental or laser technology) are implemented.

5.4.d. Moving cables

It is to be ensured that moving cables must be fundamentally pluggable on both sides and designed to be highly flexible. Distributor boxes may only be attached to non-moving components. Exceptions are sensor modules with a highly flexible supply cable.

5.4.e. Light conductor amplifier

Only Keyence light conductor amplifiers are to be used.
Optical sensors must not interfere with one another.

5.4.f. Reed contacts

Reed contacts are not permitted for magnetic field sensors.

5.4.g. Limit switch

The limit switch of an actuator (e.g. cylinder) must be monitored.
The movements of the actuators are to be designed as time-monitored (timeout).
All limit switches must be checked for switch changes during each machine cycle. If this is not possible (e.g. with sensors for set-up check), two sensors are to be deployed which mutually monitor each other.

If the sensors for start position and work position are actuated at the same time, a fault message must be displayed. Due to the mechanical construction of the actuator, it is possible that both limit switches are briefly actuated during switchover. In this case, a delayed initiation of the fault is to be programmed.
All limit switches must be checked for the status change in the corresponding sequence steps. This function is tested during the preliminary acceptance of each sensor.

5.4.h. Cylinders

Preferably use cylinders with a C, T or trapezoidal groove.

5.4.i. Analogue sensors

All sensors which convert a non-electrical analogue signal into an electric signal must be equipped with a digital measurement indicator (PE-converter, vacuum switch, etc.).

5.4.j. Camera systems

Camera systems may only be deployed after consulting Hirschmann Automotive.

5.4.k. PC use

If PCs are used, they must be industrial PCs. The PC may not be exposed to any vibrations and it is to be provided with a uninterruptible power supply (UPS system).

5.4.l. Fill status detection

Pendulum switches must be used for the filling level detection in bulk material.

5.4.m. Material manufacturer

The materials approved and proposed by the client must be available from the material manufacturer for at least 10 years from the date of commissioning/ordering. It is forbidden to use equipment which has been discontinued where alternatives are available. The equipment shall be tested by the contractor before installation.
Material manufacturers who are not on this list may only be used in consultation with the client after written approval.

Control cabinets:	Rittal (standard colour RAL7035)
Main switch:	EATON, Kraus-Naimer
Command and reporting devices:	EATON RMQ-Titan (IP65 / 22.5mm),
Key switch:	EATON RMQ-Titan (Code MS1)
Programmable controllers:	Siemens, Beckhoff
Displays:	Siemens , Beckhoff
Main and auxiliary contacts:	EATON, Siemens
Terminals:	Weidmüller, Phoenix, Siemens, Wago
Drive systems:	Danfoss, SEW, Siemens, Berger Lahr, Kollmorgen SERVOSTAR, Bosch Rexroth, SEW
Valve islands:	Festo, SMC
Magnetic field sensors:	Balluff , Baumer, Festo, Schunk
Proximity sensors:	Balluff, Baumer, Bernstein
Light sensors:	Keyence, Wenglor, Baumer, Sick
Camera systems:	Cognex, Keyence,
Safety components:	Pilz, Schmersal, Sick
Plug connectors:	Harting, Mennekes,
Rotary tables:	Fa. Weiss
Markinglaser:	Panasonic (LP-Z130-LS1-C)
Codereader:	Keyence

Frequency control devices:	REOVIB (MFS168 6A) Pfuderer (WaCo B.7/65.2-V1)

6. Wiring and cabling

6.1. General

Each device is to be connected from the control cabinet or a terminal box with a separate, flexible line or cable. No wiring (or cables) may be passed through from device to device.

Neutral and protective conductor outlets must be clearly assigned to each cable.
Reserve inlets and outlets are to be lead to terminals.
Conduits in and on the ground are to be avoided.

The EMC guidelines must be heeded for the conduits.
Inductive and capacitive interference of disturbances (e.g. from power converter, contactor coils, controlled drives, transformer and its lines, etc.) may not cause any impairment of the PLC or sensors.
It is to be considered that control cabinets can be set up near on-site cable lines which are external to the machines.
For analogue signals, interfaces and bus cable shielded lines are to be used in accordance with the manufacturer's specifications.
The installation guidelines of the controller manufacturer are to be kept.
Good accessibility is to be ensured to the devices. Changing of assemblies and components as well as the removal of covers must be possible without dismantling other components.
For special machines, 20% space reserve must be available in the control cabinet at the time of ordering.

6.2. Alignment of the lines

Data, bus and measuring lines must be laid separate from the usual power lines or shielded accordingly.

6.3. T-distributor and Y-distributor

Multiple assignments of connectors to terminals of control cabinet assemblies or signal distributor assemblies (e.g. bus module, passive signal distributor, contactors) are not permitted. Distribution of the signals with T and Y-distributor sections or similar is also not permitted due to the clear signal assignment.

6.4. Networking

Networking of internal and external equipment such as sensors, actuators, servo-controllers, etc. is to be done via bus systems such as Industrial Ethernet, PROFIBUS or ASI-Bus with conventional wiring.

6.5. Terminals

Only spring-loaded technology products are to be used for terminals and terminal strips. They are to be labelled permanently, easily recognisably and in accordance with the circuit diagram.
With the use of screw terminals for other equipment, cable ends must be provided with insulated wires end sleeves or insulated cable lugs.
For all cables from control cabinet to system, a clamping unit is to be provided per cable wire (two wires in one clamping unit is not permitted).

6.6. Wiring inside housings

Cables to devices on swivel frames or door inset must be laid with a protective hose.

The wiring of the control cabinets must be designed in channel wiring.
When using wire end sleeves, a design with plastic protective shrouds must be used.

6.7. Wiring outside housings

6.7.a. Cable entries

With a cable entry, it must be ensured that no moisture or damage to the cable can occur due to it. Multiple M-screw connections are not permitted, cable bushing systems are permitted. Ready-made cables must be able to be replaced without dismantling the plug.

6.7.b. Plug connectors

Initiators and other peripheral devices are to be designed as pluggable. The switching state must be displayed with LEDs. Replacement of connected cables must be easy to carry out (e.g. in cable drag).
The line length of sensors/actuators with fixed connection lines may not exceed a max. cable length of 1.5 m for good accessibility.
In the event of high stress on the connector cable, irradiated cables, e.g. those with a higher temperature range, must be used.
If several connector devices are used next to one another, accidental switching must be prevented by suitable measures (e.g. connector coding, certain fixed line lengths, etc.).
Up to a rated current of 36A, all connecting cables for the system parts, which have to be electrically separated to transport the machine/mechanical system, must be provided with one-sided connector devices.
The design of the section of the energy supply chain is to be documented and the energy supply chain must be plugged in / replaceable as an assembly within a unit of time agreed with the client. Pluggable devices for additional devices (e.g. pumps, filters, measuring controllers, etc.) must be connected behind the main switch.

6.8. Flexible cables

Only flexible cables may be used for the wiring and cabling.
Cable types are to be used in accordance with the ambient conditions (resistance to oil, water, coolant, lubricant, solvent, etc.).

6.9. Moving cables

For cables which have to be moveable (e.g. energy chain, etc.), special suitable, highly flexible cables with fine wired strands have to be used and their bending radii are to be complied with.

Energy chains must be able to be opened and have a barrier strip between electrics and pneumatics. Also, a reserve of 20% is to be kept in energy chains. The cables may not be bundled together.

6.10. Cable designation

Labelling signs with corresponding cable numbers are to be attached to the cable ends.

6.11. Cable colours

Permissible cable colours according to EN 60204-1

Cable colours:
Protective conductor: GREEN-YELLOW
Neutral conductor: BLUE
Main power circuits alternating or direct current: BLACK
Control circuits, alternating current: RED
Control circuits, alternating current (earthed line): RED with WHITE
Control circuits, direct current: DARK BLUE
Control circuits, direct current (earthed line): DARK BLUE with WHITE
Locking circuits, which are supplied from an external power source (potential-free contacts): ORANGE
Circuits before the main switch: YELLOW / ORANGE

7. Other

7.1. ESD

As long as the system is planned for use in an ESD area, it must have a defined ESD connection point.

7.2. Order log

It must be possible to print and save an order log where all data is available (for example, job data, quantity OK/nOK, run times ...).

7.3. Total piece counter

The system must have a non-resettable total piece counter.

7.4. Good and reject part counter

The system must have a separately resettable good and reject part piece counter.

7.5. Workpiece or operating hours counter

The machine/machinery must contain a non-resettable piece counter for the number of workpieces processed (total, OK/nOK parts). Preferably, this is implemented by means of software and must correspond to the parts of the product and the bad parts in the crates; no deviations from the protocol may occur.
A non-resettable operating hours counter is to be provided via hardware and software.
A non-resettable system workpiece counter is preferably to be provided via software.
If cycle-dependent maintenance cycles are necessary, the machine/machinery must contain count functions and signals for this.

7.6. Remote maintenance

The manufacturer is obliged to use Hirschmann Automotive's own VP tunnel for remote maintenance. A link, user name and password will be provided by Hirschmann Automotive.
The controller must have a readily available network connection.

7.7. Error analysis

The machine must have an error history. This means a list of bad parts per module/station and the precise error description. If a part is recognised as nOK, it cannot be processed further in the following stations. The part must be ejected as a nOK part.

The machine must have an error log/history that includes fault messages, process messages, warnings and change histories.

7.8. Passwords

Hirschmann Automotive must be given authorisation to be able to change passwords themselves. Passwords and user levels (e.g. admin, technician, user, etc.) are to be clarified with the client.