FRAME AGREEMENT FOR EQUIPMENT PURCHASE

Appendix 3b Electrical and Component Standard

Issue 1.4

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CONTENT

1 PURPOSE AND SCOPE

The purpose of this Electrical and Component Standard is:

- to create consistent conditions and requirements for the electrical plants at HKSCAN.
- to set out the minimum requirements on electrical and control equipment for installation at all production sites.
- to strengthen further the electrical safety in the electrical plant, since the provisions of the current National Electrical board´s Regulations are not considered to be sufficiently strict in view of the extreme operating conditions prevailing in production premises with the associated areas for slaughtering, butchering and processing operations.
- to maintain electrical safety at as high a level as practically possibly.
- to be able to maintain, in the long term and with relatively modest means, the high quality that this type of electrical plant demands.
- to achieve a plant that is reliable and serviceable, which will ensure high availability and low maintenance costs.

This Electrical and Component Standard shall principally serve as a basis for project design, tendering, purchasing and installation in new procurement and modification of production equipment, although also as a basis for maintaining a high standard of electrical safety at the existing parts of the electrical plant.

This Electrical and Component Standard shall apply to electrical plant and relates to nominal voltages of up to 1000 V AC or 1500 V DC.

2 RESPONSIBILITY

Local Maintenance Manager or appointed representative at HKSCAN site is responsible for this Electrical and Component Standard being available.

3 IMPLEMENTATIONS OF THE STANDARD

3.1 Availability

The Electrical and Component Standard is included in the project documentation.

3.2 General principles

Electrical switching and control equipment manufactured and installed for HKSCAN shall be designed in accordance with *European Standards and Regulations.*

Only electrical contractors with authorization issued by the National Electrical Safety Board (i.e. in Finland Tukes and in Sweden Elsäkerhetsverket), may be entrusted with electrical plant work at HKSCAN. Moreover, the electrical contractor shall be responsible for only approved electrical equipment being used and installed.
An electrical installation contractor retained for the electrical installation work shall become acquainted in advance with the HKSCAN regulations and the Electrical and Component Standard. The electrical installation contractor shall also be approved by HKSCAN for gaining access to the HKSCAN production site for carrying out electrical work.
If the electrical contractor retains subcontractors, these shall also be approved by HKSCAN for gaining access for carrying out electrical work.

If a foreign electrical installation company carries out the electrical installation, this company shall be able to produce a copy of a relative EU country National Electrical work Approval authorities that is valid within the EU.
A copy of the permit shall be handed in to the person responsible for electrical safety at HKSCAN, i.e. local Maintenance Manager or specified Electrical Manager in charge.

Electrical equipment included in machinery ordered by us shall be produced in conformance with the HKSCAN Electrical and Component Standard.
The HKSCAN Electrical and Component Standard has general priority over the National Board´s Regulations, since the latter are minimum requirements and are considered to be insufficiently high in these cases, in view of the extreme operating conditions prevailing in this type of food production and processing environment.
If the HKSCAN Electrical and Component Standard is in conflict with the relevant the National Board´s Regulations, the National Board´s Regulations shall apply.

If the HKSCAN Electrical and Component Standard is in conflict with other codes or standards, the HKSCAN Electrical and Component Standard shall apply. However, it shall be noted that the provisions of the relevant laws and regulations must be satisfied.

This Electrical and Component Standard shall apply at the time when the order is placed. The Supplier shall check which revision of the Standard is valid at that time from the Project Manager or the local Maintenance Manager.

Departures from this Electrical and Component Standard are not permissible unless the person responsible for electrical safety or the person appointed by him at HKSCAN has approved the departure in writing before any production or delivery may start.

Electrical, switching and control equipment manufactured and installed for HKSCAN shall be accompanied on delivery by a “Declaration of conformity” (manufacturer declaration) and shall be provided with CE marking. Technical documentation shall be available as a basis for the manufacturer declaration, and this shall be stored and kept available in accordance with the relevant law.

When handed over to the Purchaser, electrical, switching and control equipment intended for installation at any of the HKSCAN production sites shall conform to the references listed in Section 3.3, in addition to conforming to this Standard.

When handed over to the Purchaser, electrical, switching and control equipment intended for installation at any of the HKSCAN production sites shall conform to the relevant requirements on electromagnetic compatibility (EMC).

If the required design involves departures from the Supplier’s standard or if the required design in any technical or economic respect is otherwise unsuited for the Supplier and if the Supplier therefore requires quoting a different design, this shall be specified and justified in the Tender.

A Tender without reservations will be considered to a Tender in accordance with the required design and shall thus include all costs in the Tender for conforming to this Electrical and Component Standard. This also applies to subcontractors retained by the Supplier.

All concerning the number of control systems, sensors, motors, indicating lamps, etc. shall be regarded only as information from the Tenderer. The Supplier is responsible for delivering enough quantities for conforming to the functional requirements made, regardless of the Tender.

The equipment shall be designed so that a minimum amount of energy and utilities will be consumed. Motors energy efficiency classification shall be according to The current Regulation on ecodesign for electric motors (EC) No 640/2009 which covers single speed, three-phase 50Hz or 50/60Hz, induction motors with the following characteristics:

- 2 to 6 poles
- rated output between 0.75kW and 375kW

- rated voltage up to 1000V
- rated based on continuous duty operation

The energy efficiency of an electric motor is calculated as the ratio of the mechanical output power to the electrical input power. The energy efficiency level is expressed in International Energy efficiency classes (IE), IE1 being the lower class and IE4 the highest. Under the current regulation, motors must reach the **IE3** efficiency level, or meet the IE2 and be equipped with a variable speed drive, an electric device that adjusts the speed of the motor.

New ecodesign requirements from **July 2021**

From July 2021, the current regulation will be repealed and replaced by Regulation on electric motors and variable speed drivers (EU) 2019/1781 (europa.eu) Under the new rules, several induction motors that were previously not covered will be regulated, including

- smaller motors between 120W and 750W
- larger motors between 375kW and 1000kW
- 60Hz motors, 8 poles motors and single-phase motors (the latter only as of July 2023)

The level of requirement will moreover increase as three-phase motors with a rated output between 0.75kW and equal to or below 1000kW must reach the **IE3** level by July 2021. Motors between 75kW and 200kW must meet the **IE4** level as of July 2023.

As in the previous regulation, some motors designed for specific conditions are excluded or benefit from more favorable conditions. Worm gear transmissions are not accepted.

Losses under idling conditions shall be avoided, and consideration shall be given to automatic shutdown, if this cannot be expected to cause operating disturbances.

HKSCAN reserves the right to carry out delivery inspection of the electrical equipment ordered.

3.3 Environmental and hygienic requirements

In the project design and execution of electrical installations at HK Scan, the following typical circumstances shall be considered:

- Low ambient temperatures
- Occurrence of water
- Chemicals
- Organic materials
- Blood and other organic liquids that may occur
- Occurrence of ice
- Occurrence of steam
- Who will be serving the electrical installation or any part thereof (electricians and/or electrical mechanics, and also production personnel)?
- Occurrence of cutting and sawing machines
- Effect of water at high pressure
- Effect of cleaning agents

Electrical equipment and cable installations shall be arranged, designed and installed so that they will be easy to clean and, to the greatest extent possible, shall be in areas outside the production premises.

Automatic control cubicles shall be equipped with fans provided with filters.
Electrical, switching and automatic control cubicles located in wet areas shall be provided with internal fans with thermostatically controlled heater elements.

Electrical equipment located inside production premises shall have surfaces that are as smooth and non-absorbent as possible. Electrical equipment must not be located directly above production equipment, in view of dirt, etc. that may drop down.

If considered appropriate, all electrical equipment shall be self-draining, but without it thereby contaminating the production equipment. In certain relevant cases, it may also be advisable to pressurize enclosures and components, etc. in order to obtain a better environment and thus also achieve a longer useful life.

High-pressure spray guns and chemicals will be used for cleaning the production equipment. In relevant cases, the electrical equipment and cable installations shall also be capable of withstanding such spraying, or else measures shall be taken to protect the electrical equipment against such spraying by means of additional enclosures.

Wall-mounted cubicles shall normally be installed at some distance from the wall to simplify cleaning behind the cubicles.

For hygienic reasons, the use conduit should be avoided except for running individual cables up to components on a machine. Conduit should be made of a suitable material and shall be mounted clear of the surface on which it runs in order to simplify cleaning. Conduit shall be sized so that internal cleaning will be possible. Whether conduit is to be sealed at the ends is dependent on each individual case and shall then be provided with drainage facilities.
Surfaces within the production area must not have open joints, gaps, cracks or indentations. External surfaces that are not in contact with the product must also not have open joints, gaps, cracks or indentations.

3.4 System standards

The nominal voltage is 230/400 V, 50 Hz, and the system is direct-earthed,
type TN-S. Loading of the neutral conductor is not permissible.

AC distribution systems shall be designed as single-phase, two-phase or three-phase systems.

DC distribution systems shall be designed as two-conductor systems.

Information on the installed and simultaneous electric power shall be specified in the Tender. Requirements on the main fuse and the highest motor rating and starting method shall be specified in the Tender.

One machine should have only one supply point. However, exceptions can be allowed for geographically spread-out machines with several separate drives, and the machines should then be regarded as one machine unit.

The total reactive power consumption permissible per feed point is 25–30% of the active power.

Direct in-line starting of motors is permissible for ratings up to 7.5 kW. Motors with higher ratings shall be equipped with smooth starters, frequency converters or star/delta starters. Direct in-line starting may be permissible for larger motors but must then be approved beforehand by the local electrical engineer.

If the electrical, control, switching or data processing equipment supplied requires protection against transient disturbances in the mains, e.g. by means of magnetic stabilizers, filters or the like, these shall be included in the delivery.

If the electrical, control, switching or data processing equipment requires the power supply to be continuous and devoid of fluctuations, suitable equipment, e.g. in the form of uninterruptible power supply (UPS) units or the like, these shall be included in the delivery.
Such equipment shall be capable of maintaining the supply voltage for at least 20 minutes.

Uninterruptible power supply (UPS) units shall be of such design that the unit is self-monitoring as regards disturbances and shall be suitable for connection to existing monitoring systems via TCP/IP.

3.5 Connection to the power supply

The connected electrical equipment shall be supplied by a 5-conductor system of TN-S type. All power distribution shall also be done by 5-conductor systems of TN-S type. Other conditions may prevail locally, and departures shall be approved by the local electrical engineer.

The Supplier shall notify the Purchaser of the necessary power demand, and the Purchaser in cooperation with the local electrical engineer will then notify the Supplier of the design and rating of the incoming power supply.
Purchaser to make the feed connections to Suppliers enclosure with supervision of the Supplier.

The supply cable shall enter the enclosure preferably from below, though the bottom of the cubicle. If the cable must enter from above for practical reasons, a cable flange or seals that are suitable for the environment shall be used.

The connection space for the incoming power supply shall be sized in consultation with the Purchaser.

Connection space shall be provided to enable rational entry of the power supply cable. In addition, space shall be provided for transition from aluminium to copper conductors.

As a general rule, the space for connecting the power supply cable shall be sufficient for installing the cable with the next higher standard area to that necessary. This also applies to the connection of heavier power cables between related machine units and the common equipment cubicle.

3.6 Earthing and shielding

Separate earthing busbars shall be installed in cubicles for protective earthing and shield earthing.

The busbars for shield earthing shall be insulated from the casing and other parts with protective earthing and shall be marked “MEB XX. The markings shall be durable.
Shield earthing busbars from adjacent cubicles shall be interconnected and connected to protective earth at only one point and as close as possible to the earth termination.

Protective earth conductors shall be sized and run in accordance with the relevant National Board´s Regulations.

Load objects shall be provided with protective earthing by separate conductors in the group cables and shall be run in the same conduit or be included in the same cable as the associated live conductors.

The frames of larger frequency-controlled motors shall always be provided with protective earthing, and shielded connection cable shall be employed.

The protective earth conductor shall be insulated in the same manner as the other conductors in the live circuit. The exception regarding protective earth conductor insulation is PV-insulated, PV-covered, where the shield consists of bright copper wire or strip. In these cables, the shield shall be provided with green/yellow plastic sleeves at both ends.

Protective earth conductors shall be protected in a suitable way against damage due to external physical action, chemical attack or electromagnetic forces.

Joints in protective earthing conductors shall be accessible for inspection and must not be located in cable trunking.

All parts of a metal enclosure, such as the cubicle, door, hinged frame, mounting plate, roof plate, bottom plate, flanges and side walls shall be provided with protective earthing, regardless of whether or not components are mounted on them.

An exposed part must not be included as part of the protective earth circuit.

If shielded signal cable is used and the shield is used as shield earth, the shield shall be connected to a separate terminal marked “SK” or to the shield earthing busbar.

Shield conductors shall be provided with transparent plastic hose.

The shield in an individual signal cable shall be connected only to the earth potential in an automatic control cubicle. The shield should be insulated only at the terminal end of the cable.

All neutral or negative sides of DC units and transformers shall normally be connected to a protective extra-low voltage (PELV) circuit.
((PELV Protected extra low voltage. IEC 611 40 defines a PELV-system as “an electrical system in which the voltage cannot exceed ELV under normal conditions, and under single-fault conditions, *except* earth faults in other PELV-systems and earth (ground)).

If shielded cable is used for a nominal voltage >50 V, a protective earth conductor shall be included and shall be used. The shield shall be connected to the SK busbar. The shield conductor shall be provided with transparent plastic hose.
The shield of a shielded control cable shall be provided with transparent plastic hose.
Separate earthing is nor permissible.

3.7 Potential equalization

Main and extra potential equalization systems shall be employed in accordance with the relevant regulations and with the additions specified below.

Potential equalization conductors shall be sized and run in accordance with the relevant National Board´s regulations, EN60204-1 chapter 8.1.

The equipment supplied, such as machines, tracks, frames and other steel structures shall be connected to the potential equalization system for the building. The machine supplier shall thus ensure that potential equalization conductors can be connected to all parts of the machine at a common point and to the PE busbar of the electrical cubicle, or to a connection point provided for this purpose. The connection shall be made to the main earthing terminal that is assumed to be provided in every electrical distribution room in which switching equipment is located.
Protection by earth-free, local potential equalization is not permissible.

3.8 Safety circuits, emergency stop and emergency tripping

A risk analysis shall always be carried out in order to determine the category of the machine to be installed and to decide on suitable safety circuits. Emergency stop and/or emergency tripping systems shall be installed in accordance with the relevant European standards and regulations.

The risk analysis carried out and the assessment of machine category will determine whether the safety circuits should be 1-channel or 2-channel. It can generally be said that 2-channel circuits are preferable, since increased safety is obtained at low additional component and cable cost, if a decision is made right from the start that this circuit solution will be employed.

Safety circuits shall be designed so that the function can be monitored.

Components and cables shall be monitored so that any open circuits, short circuits and component faults can be detected.

The output circuits of the safety relay shall be connected directly to the control circuit so that the machine or the connected object will immediately be stopped. However, a controlled stop shall be carried out in certain cases and shall then be handled by suitable control equipment specifically intended for this function.

Components specially intended for use in safety circuits shall be employed.

The safety circuits and the components connected to them shall also provide information to the control system on the status and operating position of each individual component. Each individual safety component, such as limit switch or emergency stop button, shall thus be indicated by a separate signal contact being employed and being connected to its own PLC input. The control system shall be programmed so that information will be given to the user on which component has been activated. This information can be given on the operator display or by a separate indicating lamp for each individual component.

In cases where no control system is employed, indication shall also be provided for each individual safety component, and this shall be done in a suitable manner, e.g. by a lamp panel located in a place where supervisory personnel are expected to be present.

Resetting of personnel protection shall be carried out only locally, where a good overview is available of the monitored object. If resetting is not done in the place where the indicating panel is located, a local stop indication shall be provided at the object.

No machine may start automatically after resetting, i.e. the operator must apply a new start pulse.

Emergency stop and/or emergency tripping functions shall be provided in accordance with the relevant European standards and regulations at all machines supplied.

When an emergency stop button has been activated, all machines included in that particular emergency stop cell, i.e. all related machines gathered into a group in the same cell, room or area, shall be stopped.

Emergency stop or emergency tripping functions and a suitable number of operating points and resetting places shall be investigated in consultation with the Purchaser.
Push-buttons for emergency stop or emergency tripping shall be provided with a “mushroom head” with trigger action and latch and, if specified, shall be provided with key resetting.

Each individual emergency stop or emergency trip circuit shall be prepared, i.e. ready at terminals, for connection of an external main emergency stop function.

3.9 Main circuits

3.9.1 Isolation of power supply

Main switches shall be installed in all electrical and equipment cubicles. It shall be possible to operate the switch when the door is closed.

Each incoming power supply shall be provided with a main switch.

The incoming supply shall always be connected directly to the main switch, although not if the main switch is located on a movable part, such as a door.

If the main switch is installed in a door or the like, a suitable transition (group of terminal blocks or the like) shall be made in a suitable manner to an extra multi-strand cable. An extra marking is necessary to indicate that the transition is live when the main switch is open.
A main switch with a rated current higher than 63 A must not be mounted directly in a door.

Cubicle doors shall not be interlocked mechanically by the main switch.

Main switches should be of current-limiting mechanical circuit breaker type, since major advantages are then obtained on the sizing of equipment further down in the circuit, and major benefits are also obtained in the event of faults.

A separation plate shall be provided between electrical cubicles that are not tripped by the same main circuit breaker.

3.9.2 Power distribution

Plants that require distribution of incoming power supply shall be equipped with distribution cubicles. Distribution shall take place by means of mechanical circuit breakers and/or miniature circuit breakers. In the smaller systems, distribution may be done directly in electrical and equipment cubicles.

The short-circuit data of the supply network shall be taken into account when selecting and sizing components and cables.
Efforts shall be made to achieve selectivity in order to limit the amount of isolated equipment in the event of a fault.

In project design, efforts shall be made to achieve sectionalizing of the switching equipment in separate cubicles, compartments or modules. The aim is to limit the effect and spread of damage to electrical equipment and injury to personnel in the event of a fault in the electrical plant, such as arcing, etc. If sectionalizing and other sizing have been correctly carried out, some redundancy will thereby be obtained, which will allow for limited continued production.

To allow for future expansion and additions, space shall be provided for additional groups of at least 25% of each type employed. Whether or not these shall be fitted with components will be decided on each procurement occasion. However, at least two spare groups of each type shall always be fitted with components and shall thus be included in the delivery.

Terminals connected to the network shall always be preceded by current-sensing earth fault switches with a maximum rated tripping current of 30 mA.

3.9.3 Starters

Starters often generate disturbances. All components related to this group shall therefore be provided with suitable disturbance protections and filters.

Contactors for forward and reverse shall mutually interlock one another by means of auxiliary contacts.

Contactors for high and low speeds shall mutually interlock one another by means of auxiliary contacts.

Smooth starting equipment, frequency converters or star/delta starters are recommended if direct in-line starting is not suitable. Smooth starters shall always be bypassed by employing bypass contactors.

If approval has been obtained from the Purchaser for the installation of star/delta starters, the contactors for the star and delta positions shall mutually interlock one another by means of auxiliary contacts with special time delays in accordance with the manufacturer’s instructions.

Frequency converters shall be equipped with suitable filters, etc. Frequency converters shall always be installed in accordance with the recommendations of the relevant manufacturer for conformance to the relevant ***EMC Directive.***

3.9.4 Short circuit protection

Fuseless technique shall be employed, which means that mechanical circuit breakers and miniature circuit breakers, etc. shall be employed wherever applicable. Where a special fuse is needed, e.g. at a thyristor unit, this may be employed. If threaded fuse holders for cartridge fuses are used, these shall be provided with a test hole.
Glass tube fuses, terminal block fuses and the like must not be installed as short-circuit protection.

Miniature circuit breakers and motor protection circuit breakers shall be provided with normally open auxiliary contacts to indicate tripping. This shall be indicated either in a PLC program or by means of an indicating lamp.

3.9.5 Overload protection

All motors, including those rated below 0.5 kW, shall be protected by overload protections connected to all loaded phases and shall also have phase failure protection and be interlocked against automatic restarting.

Overload protections for motors with long starting times and/or heavy loads must not be tripped during the starting process, unless the motor is otherwise protected against harmful temperature rise.

A motor shall normally be provided with winding temperature monitoring of thermistor or equivalent type.
A motor with speed control shall be provided with winding temperature monitor of thermistor or equivalent types.

All overload protections, including thermistor relays, shall be provided with auxiliary contacts, one of which shall be connected directly to the actuating circuit of the contactor coil. The other auxiliary contact shall be used for overload indication and can be connected in sections in parallel, if considered advisable, either to the PLC input or directly to an indicating lamp if a PLC system is not used.

3.9.6 Isolating device for preventing unexpected restarting

A start inhibitor is a device intended for preventing inadvertent or improper starting of an electrically driven machine or machines that have been shut down for repair or service.

A start inhibitor shall be produced by using safety isolating switches.

A safety isolating switch shall be fitted in every main circuit for every motor or group of motors in each machine plant or for every motor in a multi-motor plant in which the motors can be taken out of operation individually for service, etc.

Safety isolating switches shall correspond to the requirements of the relevant Swedish standard and shall be located within sight and reach of the loading object. However, consideration shall be given to mechanical and hygienic aspects.
A sign with information on the operation shall be mounted immediately adjacent to the safety isolating switch.

A sign conforming to the regulations, with information on how and when the safety isolating switch may be used, shall be mounted directly on the safety isolating switch.

Safety isolating switches shall be designed with stainless shaft and nylon bushes.

A safety isolating switch connected to a motor shall be equipped with normally open auxiliary contacts that shall be connected directly to the actuating circuit of the contactor coil. The normally open auxiliary contacts shall be used for indication and shall be suitable for connecting in parallel in sections. If a PLC control system is used, interlocking shall also take place in the software.

3.10 Emergency power and emergency lighting

Accumulators and charging rectifiers of the make and type specified in the Component Standard shall be used as the uninterruptible power supply source. The system shall be switched in automatically.

An emergency power source and incandescent lamp fittings of the make and type specified in the Component Standard shall be used for the emergency lighting system. The system shall be switched in automatically.

3.11 Actuating circuits

3.11.1 General

The technical design of actuating circuit is highly dependent on the type and size of the plant. The specifications below should therefore be regarded only as guidelines but shall nevertheless be met and must otherwise be specified in a special functional specification for the intended object.

For each individual object, the Purchaser should be consulted in order to determine the design and the technical level.

Loads such as contactor and relay coils, solenoid valves, etc. shall be connected directly to the neutral or negative conductors, without intermediate contacts.

The actuating circuits shall be protected by means of miniature circuit breakers with suitable characteristics, depending on the object connected.

Miniature circuit breakers in actuating circuits shall be provided with auxiliary blocks, the function of which on tripping shall have one pair of normally open and one pair of normally closed contacts.
In battery systems, the positive and negative sides shall be provided with common two-pole miniature circuit breakers.

Voltage drops and the tripping condition shall be taken into account in the design of the actuating circuits.

The operating voltage for motor groups shall be 230 V AC. If the motor group is controlled from a PLC, the operating voltage from the PLC shall be connected across an interface to the starter.

Every machine group shall have a separate control fuse.

The actuating voltage in the production premises shall be 24 V.

3.11.2 Actuating transformer

A 230/400 V AC or transformer shall be used as the actuating transformer.

The neutral of the secondary winding shall be connected to earth potential.

The transformer shall be designed so that the secondary voltage will be maintained within ±5% of the nominal voltage at nominal primary voltage and all normal loading conditions and starting currents. The transformer shall normally also be designed with 50% power reserve.

3.11.3 Power supply units

The operating voltage for the PLC equipment and the components connected to its input and output shall be 24 V DC, and the power supply unit in accordance with the Component Standard shall be used for this.

The power supply unit shall be equipped with the stabilizing, smoothing and filtering components necessary for the load to which it is to be connected.

The negative side shall be connected to earth potential.
The power supply unit shall be rated so that the secondary voltage will be maintained within ±5% of the nominal voltage at nominal primary voltage under all normal loading conditions and starting currents. It shall also be rated with 50% power reserve.

If a battery is required for DC supply, DC shall be taken from a battery with trickle charging from a constant voltage-controlled rectifier connected to 230 V, 50 Hz. The positive and negative sides shall both be equipped with miniature circuit breakers with normally open auxiliary contacts. The battery shall be of stationary type.

3.11.4 Programmable control system circuits

Every component, such as sensor, limit switch, lamp, etc. shall be connected to a separate input and output in the control system, unless otherwise specified by the Purchaser. Interconnection of sensor signals (series or parallel connection of sensors, limit switches, etc.) is not acceptable.

3.12 Indications

Indications shall always be incorporated to the extent necessary to enable total reading of operating functions and faults.

Indications shall consist of indicating lamps, LED panels, operator displays, monitors or alarm panels.

The extent and type of indication shall be decided in consultation with the Purchaser.

All fault indications shall persist until reset manually.

It shall be possible to check the performance of indicating lamps by means of a common lamp test button. If the indications are connected to a programmable control system, the lamp test shall be carried out via the control system.

3.13 Design of electrical, automatic control and equipment cubicles and other enclosures

3.13.1 General

Applicable parts of the ***relevant European regulations and Directives***, and the HKSCAN Electrical and Component Standard shall apply to the manufacture of electrical and switching equipment for machines and their electrical safety systems.

No power components may be in the same part of the cubicle as the control system and other computer equipment.

Electronic equipment and equipment for power, such as contactors, relays, etc., shall be installed in separate cubicles or, if satisfactory protection against disturbance is achieved, in the same cubicle.

Any outside voltages occurring in electrical, automatic control and equipment cubicles shall be shown on an orange sign stating the group to which they belong and provided with the text “Outside voltage”.

Equipment in cubicles shall be secured by means of 35 mm mounting rails. Machine screws shall be used for securing replaceable bolted components.

The distance between equipment and cable trunking in the cubicle shall be at least 30 mm. Any component that emits heat shall be mounted at a distance of at least 5 mm from an adjacent component. The installation instructions and safety distances specified by the corresponding component manufacturer shall otherwise be followed.

Actuating and signalling devices in control cubicles, etc. shall be grouped so that good overview will be obtained.

Equipment in electrical, automatic control and equipment cubicles shall not be located lower than 400 mm above floor level.

Cable entries in the cubicle base shall be sealed to prevent the ingress of dust and vermin.
If possible, all cable entries shall be made from underneath to avoid the risk of water and other impurities entering. Enclosures located in production premises shall always be designed for cable entry from below.

Cable entry through the floor that supports the cubicle, such as chequer plating, concrete floor or the like, shall be sealed against fire in order to prevent the spread of fire from the floor blow into the cubicle.

All spare conductors shall be connected to spare terminal blocks. Multi-conductor cables for actuation shall have at least 25% spare conductors.

All single conductors shall be run in cable trunking. Every cable trunking in the enclosure shall have at least 25% spare space for additional conductors.
All control box and junction box lids (not push-button boxes with a maximum of 6 units) shall be hinged.

Every electrical cubicle shall be provided with a drawing pocket of suitable size for storing documentation such as drawings, instructions, etc. The drawing pocket shall be durably secured.

If fuses are used in a cubicle, a fuse box with space for a suitable selection of spare fuses shall be provided.

3.13.2 Enclosures

Enclosures of electrical and equipment cubicles in separate equipment rooms shall be designed with degree of protection IP54. Floor-mounted electrical cubicles in equipment rooms shall be provided with bases.

Enclosures of electrical and equipment cubicles in production premises shall be made of stainless steel (SS 2333) or glass fibre reinforced polyester with degree of protection IP65 and shall be adapted to the environment in consultation with the Purchaser. Examples of adaptations that may sometimes be required are splash protection and rain roof. Extraordinary hygienic adaptations may be required in certain cases.

If stainless steel (SS 2333) is used in the enclosure, all cubicle parts, such as hinges, locks, flanges, screws for signs, etc. shall be made of the same material.

Electrical cubicles and other enclosures shall be sized with 25% spare space for every functional group. Cubicles consisting of several cubicle modules shall have 25% spare space in each part. The terminal rail shall also be fitted for the addition of 25% terminal blocks. The spare space shall be available when the Purchaser takes over the plant.

Floor-mounted electrical cubicles placed outside electrical and equipment rooms shall be equipped with bases or legs made of stainless steel (SS 2333).

Wall-mounted cubicles shall generally be located at some distance from the wall to allow for cleaning.

Doors and covers shall have effective equipment that guarantees a tight and vibration-free mounting on the frame and shall be fitted with gaskets. Cubicles for equipment shall be accessed by means of a fixed handle with key lock, and shall be suitable for lock cylinders.

Breakable glass shall not be used in doors provided with transparent front. Other suitable material shall be used (e.g. Plexiglas or laminated glass).

Cubicles with hinged frame shall have a depth of at least 600 mm.
The door and hinged frame shall be equipped with effective and appropriate stop device in order to prevent the equipment on the hinged frame and the inside of the door coming into contact with one another when the door and the hinged frame are open. It shall be possible to open the hinged frame through 180 degrees.
A clear space of 1.25 m shall be provided in front of the automatic control cubicle front.

Flanges (complete with gaskets, screws, washers, nuts) and cable glands shall be included in the delivery of electrical and equipment cubicles or control boxes.

3.13.3 Electrical cubicle lighting and service outlets

All larger electrical and equipment cubicles, such as floor-mounted or the like, shall be provided with lighting and a 230 V AC service power outlet.

The electrical cubicle lighting shall be of disturbance-free type and shall be equipped with a 230 V AC service power outlet.

3.13.4 Electrical cubicle climate control

All necessary climate control products shall be included in the delivery of electrical and equipment cubicles.

The temperature difference between the maximum ambient temperature and the temperature in the interior of the cubicle shall not exceed 10°C, and the interior temperature shall not exceed 45°C.

A forced cooling system shall be installed, if necessary. Filters and fans may be installed in premises with a relatively clean environment, but closed-circuit cooling must otherwise be employed.

Heating may be necessary in order to prevent condensation, etc.
An equipment cubicle thermostat shall be installed for both heating and cooling/ventilation in order to prevent continuous operation that may be unnecessary in certain cases.

3.13.5 Junction boxes and junction cabinets

Junction boxes may be used only for transitions between fixed and flexible cabling.

A junction box shall be made of plastic and shall provide degree of protection of at least IP65 within the production premises. Special junction boxes shall be used in a corrosive environment. This shall be decided in consultation with the Purchaser.

For interconnecting several items of equipment to a common multi-core cable, a junction box with terminal blocks shall be used. Each core of the cable shall be connected to its own terminal block.

Junction cabinets shall be made of stainless steel (SS 2333) or of glass-reinforced plastic. Junction cabinets used in production premises shall have degree of protection of at least IP65.

Junction cabinets, boxes, etc. shall be mounted in such a manner that they are not blocked by production parts or machinery.

3.14 Components

3.14.1 General

External components are often located in an environment that imposes serious external attack. In each individual case, the environment in which the component is to be installed shall be assessed before a suitable component is selected. This work shall be carried out in consultation with the Purchaser.

Unless otherwise indicated by an investigation or other specification, components and motors, etc. shall generally be designed for degree of protection IP65.

Wherever applicable, components such as motors, etc. shall be provided with drain holes or shall be pressurized.

Components located outside electrical and equipment cubicles must not contain glass.

Light fittings shall be enclosed and shall have well-sealed polycarbonate covers.

Efforts shall generally be made to minimize the number of external components. This also applies to the number of buttons, knobs and indicating lamps. If possible, the operator panel shall be installed with a graphic interface to the operator.

The extent and choice of suitable operator interfaces shall be investigated in consultation with the Purchaser.

3.14.2 Terminal blocks

Terminal blocks shall be treated as individual components or as component groups. Each terminal block group shall also be marked with item designation.

Terminal blocks shall not be mounted lower than 400 mm above floor level.

In electrical, automatic control and junction cabinets, the terminal block mounting rails shall be mounted on spacers. The incoming and outgoing cabling shall be secured to a rail specifically intended for this purpose.

Cables belonging to power circuits or control circuits shall be connected to adjacently located connection clamps, with the groups separated by means of plastic spacers of different colours.

The cores of a given cable shall be connected to terminal blocks located next to one another to form a terminal block group.

The type and size of terminal blocks shall be selected to suit the function and the cross-sectional area of the cable.

Terminal blocks for neutral conductors shall be blue.

Special protective earth conductor terminal blocks or protective earth conductor busbars shall be used for earth protective conductors. Protective earth conductor busbars in combination with protective earth conductor clamps shall be approved for this type of use and shall be made of copper or steel.

Stacked terminal blocks should not be used.

Terminal blocks for signal cables shall be of open-circuiting type.
For certain metering circuits, terminal blocks intended specially for this application shall be employed.

Terminal blocks for low voltages shall be located at an appropriate distance from other terminal blocks or shall be mounted on a separate mounting rail.

Two-phase objects shall be connected to terminal block groups consisting of three-phase terminal blocks and, in the case of direct-earthed systems, a neutral terminal block.

Only one external cable core may be connected to one side of a terminal block.

A maximum of two internal connecting conductors may be connected to one side of a terminal block.

Only one cable core may be connected per side of a protective earth terminal block.

Only one cable core may be connected per protective earth conductor clamp for the protective earth conductor busbar.

3.14.3 External position sensors

Non-contacting position sensors shall be used wherever possible. These shall be provided with LED indications and cable connectors.

Safety limit switches shall have forced-opening contacts.

Position sensors shall be arranged so that they will not be damaged by overtravel.

3.14.4 Solenoid valves

The actuating voltage for solenoid valves shall be 24 V DC or AC.

If possible, the coil shall be of low-power type.

Capacitor protection shall always be mounted and located as close as possible to the coil.

Short-circuit protection is recommended for each individual solenoid valve.

If possible, cable connectors with LED indication shall be used for cable connections.

3.14.5 Manually operated control switches

The colour and function markings of push-buttons and knobs shall conform to the relevant European Standards.

3.14.6 Indicating lamps

The colour and function markings of indicating lamps shall conform to the relevant European Standards. In the event of the doubt, specific colours shall be selected in consultation with the Purchaser.

Indicating lamps shall be designed for 24 V DC and LEDs shall be employed. It shall be possible to check the operation of all indicting lamps by means of a lamp test.

If PLC control systems are used, each individual indicating lamp shall be driven by a separate output.

3.15 Cables and cable installation

3.15.1 General

Cable materials shall be harmonized with the relevant European Standards.

Cables and conductors in accordance with the material specification shall be used for all installations. Cables and conductors shall be halogen-free.

Multi-strand conductors shall be provided with end sleeves.

3.15.2 Connection conductors

Extra multi-strand conductors with a minimum cross-sectional area of 0.75 mm^2 shall be run inside the enclosure.
The following conductor colours shall be used for identifying the various conductors.

3.15.3 Cables

Power cables for external installations outside the machine shall be sized in accordance with the relevant ***European Standards***.

Unless otherwise specified, the ambient temperature is 25°C, and cables shall be run in one tight layer.

In concealed cable runs, cables shall be run in conduit.

Different voltage types or voltage levels shall not be mixed in a given cable. Exceptions are allowed, e.g. for certain motors with built-in brake.

Every electric motor shall be supplied with power by a separate cable. Shielded cables shall normally be used for supplying frequency-controlled motors, unless otherwise specified by the manufacturer or others in order to conform to the EMC Directive.

In PLC control systems, conductors for incoming and outgoing circuits must not be included in the same cable if different power supply units are employed.
All cable cores shall be connected to terminal blocks on connection in electrical or equipment cubicles.

Cables with seven or more cores shall be provided with number markings stamped on the conductor insulation. If a protective earth conductor is required, this shall be durably marked with green/yellow colour combination.

Signal cables to and from the control system shall be run at an appropriate distance from power and control cables that could cause interference.
Signal cables shall be shielded and with twisted pairs.
The minimum permissible conductor area is 0.5 mm^2.

3.15.4 Cable installation

Cables and conductors shall always be completely protected, e.g. by cable conduit, against mechanical damage at a distance of up to 1200 mm above the floor.

Cabling must not be run, and electrical components must not be mounted directly on warm surfaces at >40°C. Spacer blocks and heat-dissipating protection shall be used in such cases.

Great importance shall be assigned to achieving a durable and tight connection between cables and electrical components. If necessary, extra cable clamps or special glands shall be used. The glands shall be of food-approved type.

Cabling must not be secured to other equipment, e.g. pneumatic or hydraulic pipes.

Cable clamps shall be secured with stainless steel screws.

Cabling shall be secured with blue cable ties to the cable racks and trays.

Cables should be run on traditional cable racks and trays or racks of wire type. Wire racks shall be used on machine units. Wire racks shall be of stainless steel. In production premises with unpackaged products, cable racks and trays shall be provided with protection against falling materials and shall be fitted with protective cover plates.
Horizontal cable racks may have to be mounted on edge in certain cases.
Individual cables and conductors that are mounted on a machine shall be run in stainless steel conduit.

Power cables and actuating cables (>50 V AC) must not be mixed with signal cables. Cables and conductors for signal and actuating systems shall be run on separate cable racks and trays provided with brown markings every 3 metres. Cable racks and trays intended for power cables shall be provided with yellow markings.
As an alternative, partition walls can be used in the case of individual signal and actuating system cables. Cables with high disturbance fields shall be given special consideration.

3.16 Marking

3.16.1 General

All plant parts, electrical cubicles, items of equipment, cables, etc. shall be marked with identification signs. The signs must not be secured to covers.

All markings shall be of durable and permanent type and the material used for identification signs shall be decided in consultation with the Purchaser. In certain special cases, identification

signs made of stainless steel are necessary in order to withstand both mechanical and chemical attack.

Marking of equipment and cables shall be easily identifiable.

Marking directly on components may be employed as clarifying marking but shall be supplemented with main marking on the mounting plate or marking rail intended specially for this purpose.

Item designations shall follow European Standards.

Lists of identification signs shall be drawn up in consultation with the Purchaser.

3.16.2 Component marking

Marking signs shall be clearly legible and shall preferably be made of laminated (white/black/white) melamine plastic with engraved black text or of aluminium with engraved text filled with durable black paint. **N.B. Note the legibility requirements.**

Marking signs shall be secured at the equipment location and shall be provided with item designations in accordance with the drawing documentation. Marking signs shall be secured so that they are clearly legible. If necessary, extra mounting brackets may have to be arranged. The marking sign shall be mounted so that it will not have to be removed when the component is changed.

Marking signs inside the enclosure shall be secured with screws, rivets or two-component adhesive on a rail mounted on spacers on the mounting plate. As an alternative, marking signs can be mounted directly on the mounting plate if space is available and if the text is not obscured by cables, etc. In addition, items of equipment shall be provided with markings. This may be of simpler design, e.g. marking by the manufacturer of the item of equipment.

Engraved marking signs from corresponding manufacturers shall be employed for push-buttons and indicating lamps. Markings in the local language.

Terminal blocks shall be marked with terminal block group (e.g. – X23) designation and the individual terminal block number.

External components shall be marked with complete item designations in order to allow for unique identification of each individual component.

Identification signs on the outside of the enclosure and identification signs adjacent to each component shall be secured by means of stainless steel screws or pop rivets, unless this is considered unsuitable due to the prevailing enclosure requirements. If considered appropriate, identification signs can be hung from stainless steel chains.

Marking signs secured to cables are not acceptable as the only marking and can be used only as extra marking.

3.16.3 Cable marking

All cables shall be marked with the cable number at both ends. The execution of marking shall be determined in consultation with the Purchaser, who will also provide guidelines for suitable structure and/or serial number series.

3.16.4 Conductor marking

All internal conductors in electrical and equipment cubicles and in junction boxes/cabinets shall be marked with core marking. The only exception are fully visible jumpers on the same connection side within the same item of equipment.

Internal conductors between items of equipment in equipment cubicles shall be marked with the zero series number. The highest zero series number shall be specified in the diagram and at a suitable place in the electrical cubicle.

Internal conductors connected to terminal blocks shall be marked with the terminal block number.

All cores of incoming cables to electrical and equipment cubicles and to junction boxes/cabinets shall be marked with core markings according to European Standards.

3.16.5 Function marking

Eternal components shall be provided with complete item designations and a brief function designation.

For components with safety functions, the value of which is adjustable, the value of the setting shall also be specified on the marking sign.

3.17 Testing and inspection before commissioning

Inspection before commissioning shall be carried out in accordance with the relevant European Standards and Regulations.

In addition to the provisions of the relevant European Standards and Regulations, and before a new plant is taken into operation or after any significant modification, the relevant electrical engineer or an inspector appointed by him shall carry out inspection of the electrical installation or modification to ensure that it has been carried out in accordance with the regulations and conforms to the instructions in this Electrical and Component Standard and the relevant procurement document.

All testing, inspection and adjustments shall be recorded, and the report shall be handed over to the Purchaser in readable condition. The reports on adjustment values and calibration values, etc. shall be clean typed.

Testing should be coordinated and in accordance with testing plans prepared in advance. These testing plans shall be drawn up by the Supplier and shall be approved by the Purchaser before the relevant testing.

Functional inspection of all electrical circuits shall be carried out and documented.
Functional inspection of all programmed functions and sequences, etc. shall be carried out and documented. Commissioning inspection, point verification and Supplier’s self-surrender list.

Insulation measurement and testing of protective earthing, etc. shall be carried out and documented.
In addition to following the HKSCAN Electrical and Component Standard, testing shall follow the relevant European Standards and Regulations.
The manufacturer’s product number sign shall be mounted on/in each individual box/cubicle. The location of the sign shall be decided in consultation with the Purchaser.

3.18 Installation, miscellaneous

3.18.1 General

The electrical installation work shall be carried out in accordance with the relevant European Standards and Regulations and this Electrical and Component Standard and in accordance with the relevant instruction from the manufacturers and/or suppliers.

Electrical installations with the associated machines and equipment shall be carried out in such a manner that service, maintenance and preventive maintenance will be simple to perform without inconvenience and that the electrical safety will be maintained throughout its useful life.

3.19 Control systems and other computerized systems

3.19.1 General

Control systems, computers and other computerized components shall be designed for and adapted to the environment prevailing at the installation place.

Each item of equipment and each system connected shall be capable of withstanding the voltage and frequency variations without stoppage.
The network always contains a certain number of higher harmonics, known as harmonic distortion. Each item of equipment and system connected shall be capable of withstanding the specified harmonic distortion.

Uninterruptible power supply systems shall be installed if disturbances on the network may give rise to problems such as stoppages of production units.

Twisted-pair and shielded-pair cables shall be used for all analogue input and output circuits.

Terminal blocks with open-circuiting links shall be used to simplify service and maintenance.

3.19.2 Hardware

The central unit or units of the control system shall be designed with CPU capacity, memory, etc. for an installed loading of 50% of the actual hardware capacity.

I/O units shall be separate for analogue and digital signals, and their mutual locations shall be flexible.

All inputs and outputs shall be galvanically separated.

Distributed I/O units shall be used if a larger number of signals are grouped in other premises, e.g. switchgear or ventilation rooms.

Auxiliary relays shall be used for digital outputs, although not at indicating lamp outputs.

Disturbance protections, such as transient protections, shall be provided in all analogue input and output circuits.

The signals for different process sections that are independent of one another or supplement one another shall be separated by being connected to different I/O units.

3.19.3 Power supply

The following requirements on the power supply shall be met. This means that the Supplier shall check that the specified particulars of the network are correct and, if not, the Supplier shall supplement his delivery with equipment that will ensure that his delivery perceives the supply network accordingly.

Alternating current:

- Frequency: 50 ± 0.5 Hz
- Maximum permissible RMS harmonic distortion: 5%
- Maximum tolerance/disturbance limit for transients of the system

Direct current:

- Nominal voltage: 24 V
- Permissible variation range including ripple: 20.4 – 30 V
- Ripple ≤10%

If the above requirements cannot be met, filters or other suitable equipment should be installed by the supplier.

The power supply to the system shall be divided into at least the following sections:

- Central processing unit
- I/O units

3.19.4 Spare capacity

Space should be available for expanding the inputs and outputs by about 25% for each signal type. However, for rack-mounted control systems, a minimum of one circuit board shall be provided for each signal type.

Spare installed inputs and outputs on handing over shall be at least 25% for each signal type.

Spare capacity of at least 25% shall be available for program functions of each type, e.g. registers, timers, alarm texts, etc.

3.19.5 System software

System software for programming via a personnel computer and the necessary communication cable, adapters, etc. shall be included in the delivery, unless otherwise agreed.

Software for documentation of PLC programs, commented program versions etc. shall be included in the delivery.

3.19.6 Communication

All control systems and computers, etc. shall be equipped with circuit boards or modules for communication with other computers, operator panels and computer systems. The communication protocol shall be TCP/IP or Profibus DP.

3.19.7 Hardware lock

Licence protection in the form of hardware lock is not acceptable unless otherwise agreed.

3.20 Technical documentation

3.20.1 General

The extent of the technical documentation is specified in 3.21.3–4.

All documentation shall be in **English**, unless otherwise agreed.
However, Safety Instructions and operating instructions, must be provided in the national language.

Final documentation shall be delivered in accordance with the following, unless otherwise agreed:

- One (1) set of diskettes or CD with all documentation stored in electronic form.
- Two (2) sets of printed-out size A4 copies. A size larger than A4 may be used if this is considered to be clearly more advisable, such as for plant layout and the like.

Computer generated documentation shall be stored in the latest program version when delivered.

CAD files shall be delivered in AutoCad-compatible .dwg format and .pdf format, dxf-format is acceptable only in exceptional cases and only if the Purchaser has approved this in advance.

Before manufacture or ordering of electrical equipment is started by the Supplier, the documentation in accordance with the agreement in the order shall be sent to the Purchaser for information.

Object data shall be linked to document items, which provides the user with simple means for finding and starting documents that are linked to a specific object, e.g. a motor circuit.

Object data shall be linked to PLC programs and operator display programs, which provides the user with simple means for finding and starting programs that are linked to a specific object, e.g. a motor circuit.

Documents shall be linked to the functions and details in the plant that they concern.

Documentation of the process/function of the equipment delivered and its installations and equipment shall be carried out in accordance with the relevant European Standards and Regulations and this Electrical and Component Standard.

Drawings shall be provided with drawing numbers and sheet numbers that shall be unique to every sheet.

Other documents shall be provided with document name and sheet number.

If PLC and/or PC-based control systems are used, the components included shall be marked unit-oriented and I/O-oriented.

In the list of spare parts and the component list, the manufacturer and/or the supplier and the type designation shall always be specified.

3.20.2 Symbols and contact positions

Electrical drawings should be drawn with symbols in accordance with the relevant European Standard.

The symbol of every component shall be provided with electrical item designation and connection designations, and reference to the main symbol, if any.

3.20.3 Computer and control system documentation

In addition to the documentation mentioned earlier, computer and control system documentation shall also comprise the following descriptions and lists

- Operating descriptions
- Service and maintenance instructions
- Functional description (detailed)
- List of proposed fault-correction measures when an alarm is initiated
- Back-up of all programs on suitable media, i.e. diskette or CD-ROM

All program documentation shall be made with the latest version number of the system software.
The program printout shall be complete with legible text descriptions (labels) for inputs, outputs, timers and memory cells.

4 TRAINING

Training shall be coordinated and shall conform to the previously drawn up training plan. This training plan shall be drawn up by the Supplier and shall be approved by the Purchaser before training is started.

Training shall be adapted and divided to suit different types of personnel. Users and operators, as well as repair personnel and service personnel shall all be provided with suitable training.

5 COMPONENT STANDARDS

5.1 General

If the required design involves departures from the Supplier´s standards or if the required design in any technical or economic respect is otherwise unsuited for the Supplier and if the Supplier therefore requires to quote a different design, this shall be specified and justified in the Tender or before delivery. Departures shall be approved by HKSCAN project manager and manager of Local Engineering Department or the person appointed by him.

5.2 Content

		Group standard				
Nr.	**Component**	**Recommended manufacture**	**Type**	**Alternative manufacture / type**	**Supplier proposal / Selected**	
5.3	**Enclosures**					
.1	Electrical cubicles	Eldon, Rittal Fibox				
.2	Junction boxes	Eldon, Rittal, Fibox		Rose		
.3	Control panels	Fibox				
.5	Push-button boxes	Fibox				

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	
.6	Electrical cubicle locks	Rittal				
.7	High voltage cabinets	ABB				
.8	Low voltage cabinets	ABB				
5.4	**Equipment cubicle climate Control**					
.1	Cooling unit	Rittal				
.2	Ventilation unit	Rittal				
.3	Heaters	Rittal				
.4	Thermostats	Rittal				
5.5	**Switching devices**					
.1	Main switches	Eaton		Telemecanique, Kraus Naimer, ABB		
.2	Disconnectors	Eaton		ABB		
.3	Safety isolating switches	ABB, Eaton, Kraus Naimer				
.4	Safety isolating switches for Inverter drives	ABB, Eaton, Kraus Naimer			ABB	
5.6	**Fusing and circuit breaking**					
.1	Knife fuses	European Standard				
.2	Diazed fuses	European Standard				
.3	Glass tube fuses	European Standard				
.4	Miniature circuite breakers	Schneider		Merlin Gerin, Siemens		
.5	Mechanical circuit breakers	Schneider		Merlin Gerin		
.6	Motor protection circuit breakers	Schneider		Klöckner Moeller		
.7	Overcurrent relays	Schneider		Klöckner MOeller		
.8	Earth fault isolation switches	Merlin Gerin		Siemens, Hager		
.9	Distribution stations	Garo		ABB		
5.7	**Safety Components**					
.1	Emergency stop module	ABB		Jokab Safety, Automation System, PILZ		
.2	Emergency stop button	Schmersal		Klöckner Moeller, Elan, PILZ		
.3	Cable-operated Emergency stop	Schmersal		Automation System		
.4	Protection stop module	ABB		Jokab Safety Automation System, Tele-mecanique, PILZ		
.5	Safety-PLC	Siemens				
.9	Light curtain	Automation System, ABB		OEM-Automatik		

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	Rev
.11	Light beam unit	ABB		Automation System, OEM-Automatik		
.12	Safety key switch	Schmersal				
5.8	**Components, operator-machine interface**					
.1	Push-button			Kraus Naimer,		
.2	Selector switches			Kraus Naimer,		
.3	Key switches			Kraus Naimer,		
.4	Pilot lamps			Kraus Naimer,		
.5	Light columm units	Auer		ABB		
.11	Energy consupmtion pulse sensors	ABB	DAB 13000			
5.9	**Power supply**					
.1	Transformers, power 10/0,4 kV	ABB	Resibl ock			
.2	Transformers, control 400/230 V					
.3	Transformers, instrument 230-400/24 V					
.4	Transformers, protection					
.5	Power supply units, rectifiers					
.6	Emergency power supply sources (constant V charges)					
.7	Emergency power supply (accumulators)					
5.10	**Signal acquisition, position**					
.1	Limit switches	Schneider				
.2	Inductive sensors	IFM		Automation System,		
.3	Capacitive sensors	Automation System		IFM		
.4	Level switches	Kubler, Carlo Gavazzi, Inreco		IFM, Sick		
.5	Photoelectric cells	IFM		Automation System, IFM, Sick, Omron		
.6	Photoelectric cells ”colour sensing”	Automation System		IFM, Omron		
.7	Linear position sensors	Automation System				
.8	Rotary position sensors	Leine & Linde				
.9	Cylindical sensors	Mecman, SMC, IFM				
.10	Optical angle sensors	Leine & Linde				

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	Rev
5.11	**Signal acquisition, other**					
.1	Pressure switches	Danfoss		Telemecanique		
.2	Flow switches	Jumo		Danfoss, Landis & Gyr		
.3	Temperature switches	Jumo		INOR		
.4	Thermostats	Jumo		Danfoss		
.5	Speed monitors	Leine & Linde				
.6	Load monitors	Emotron				
.7	Temperature control	Jumo				
5.12	**Control & Regulation**					
.1	Auxiliary relays	Releco		Schrack, Telemecanique		
.2	Time delay relays	Crouset, Syrelec		Telemecanique		
.3	Contactor-interface	Schneider				
.4	Contactors	Schneider				
.5	Measured value converters	Automation System				
.6	Disturbance protection	Automation System				
.7	Terminal block relays	Phoenix				
5.13	**Control system**					
.1	PLC-systems, smaller	Mitsubishi Melsec Siemens S7/300	Q			
.2	PLC-systems, larger	Mitsubishi Melsec. Siemens S7/400	Q F15x x			
.3	Operator terminals, display	Beijer Siemens	E 1000			
.4	I/O-modules Profibus DP	Mitsubishi Melsec. Siemens ET200	FnIO			
.5	Communication, at process level	Siemens, Mitsubishi	Profi bus DP	AS-i, Profinet		
.6	Communication, PLC-PLC	Ethernet				
.7	Master computer systems, SCADA type	Citect Siemens Wonderware				
.8	Network switch	Westermo		Siemens		
.9	Robot control units	ABB				
.10	Communication, PLC Master system	TCP/IP, Fibersystem				
.11	Interface converters, General	Westermo				
5.14	**Power control**					
.1	Frequency converters	Mitsubishi SEW, Danfoss				
.3	Smooth starters	ABB		Carlo Gavizzi		
.4	Servo drives	Mitsubishi				
.5	Stepping motor drives	Solectro				

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	Rev
5.15	**Connection devices etc**					
.1	Connection devices for sensors with cable connectors	Automation System				
.2	Connection devices for solenoid valves with cable connectors	Automation System				
.3	Terminal blocks	Phoenix				
.4	Cable glands	Agro Rutab				
.5	Power outlets	ABB, Cewe		GEA		
.6	Multi-pole connectors	Wieland, Harting				
5.16	**Installation components**					
.1	Wall switches	Eljo, Elko		Busch Jaeger		
.2	Wall sockets	Eljo, Elko		Busch Jaeger		
.3	Flourescent light fittings (for wet premises)	Thorn		Glamox, Exactor, IDMAN		
.4	Flourescent light fittings (for other premises)	Thorn		Glamox, Exactor, IDMAN		
.5	Evacuation light fittings	Dahlbergs		Legrand		
.6	Emergency light fittings	Dahlbergs		Legrand, Thorn		
.7	Junction boxes	Eljo		Thorsman		
.8	Flourescent light tubes	Philips, Osram				
.9	Flourescent light starters	Philips, Osram	DEOS			
.10	Incandescent light bulbs	Philips, Osram				
5.17	**Cables etc** ***Free from Halogen***					
.1	Permanently run cable					
.2	Cables that can accomodate frequent movements					
.3	Servo motor cables					
.4	Puls sensor cables					
.5	Tachometer cables					
.6	Motor cables, permanently run					
.7	Motor connection cables			Alcatel		
.8	Cables for analogue signals					
.9	Sensor cables					
.10	Heating cables					
.11	400 V flexible connecting cables					
.12	230V flexible connecting cables					
.13	24 V AC/DC flexible connecting cables					

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	Rev
.14	24 V AC/DC, permanently run signal cables					
.16	Special cables					
5.18	**Trunking**					
.1	Cable racks	Wibe				
.2	Wire racks	MP		Wibe		
.3	Angle section	MP				
.4	Protective hoses	Anaconda				
5.19	**Miscellaneous**					
.1	Regulators	Sauter, Jumo				
.2	Counters					
.3	Batteries (smaller models)	Celltech				
.4	Cable ties	Hellermann Tyton	MCT 50P	Adaptable in departments with unpackage product.		
5.20	**Pneumatic Systems**					
.1	Cylinders	Mecman, Parker, Festo				
.2	Solenoid valves (electro-pneumatic)	Mecman, Parker, Festo				
.3	Solenoid valves (direct acting)	Danfoss, Mecman		Festo		
.4	Snap couplings	CEJN				
.5	Air filters	Mecman, Norgren Martonair, Parker				
.6	Reducing valves	Mecman, Norgren Martonair, Parker				
.7	Preassure gauges	Norgren Martonair, Parker			Graduated in Mpa or Bar	
.8	Mist lubricators	Mecman, Norgren Martonair, Parker				
.9	Permanently run tubes				Rustless steel, Coppar	
.10	Flexible hoses				Plastic type PU	
.11	Cones and compression nuts	Mecman				
.12	Valve manifolds in the Process	Festo	CPV, CPA			

Nr.	Component	Recommended manufacture	Type	Alternative manufacture / type	Supplier proposal / Selected	Rev
5.21	**Hydralic systems**					
.1	Cylinders	Rexroth Mecman				
.2	Valves	Rexroth Mecman		Sperry Vickers		
.3	Pumps	Rexroth Mecman		Sperry Vickers		
.4	Pressure gauges	Rexroth Mecman			Graduated in Mpa or Bar	
.5	Flexible hoses	AEROQUIP Högtrycksslang				
.22	**Mechanical equipment**					
.1	Ball bearings	SKF				
.2	Bearing housings	SKF	Serie SNA			
.3	Chains	Renhold			Standard dimension	
.4	Transmission geerwheels				Hardened	
.5	Taper drive belts	Trelleborg		or related		
.6	Toothed belts	Trelleborg		or related		
.7	Bolted joints for humid premises	Stainless steel A2/A4				
.8	Sheet and steel for humid premises	Acid proof material SS2343		SS2333		
5.23	**Driving equipment**					
.1	Induction motors (for wet premises)	ABB		VEM, Nord, SEW		
.2	Induction motors (for other premises)	ABB		VEM, Nord, SEW		
.3	Servo motors	Mitsubishi, Lenze				
.4	Geared motors	Nord		SEW		
.5	Stepping motors	Solectro		SKF		
.6	Actuators	SKF				
.7	Electrically driven conveyor rollers	Interroll		BDL		
.8	Reversing rollers	Interroll		BDL		
.9	Gears	SEW, Nord, VEM				
.10	Variators	Lenze				
5.24	**Weighing equipment**					
.1	Weighing machines	Flintab. Mettler-Toledo		Scanvaegt		
.2	Printers	Ubi, Intermec				