Technical purchasing conditions for machines, installations and devices

Preliminary remark:

The technical purchase conditions are an integral part of the invitation to tender and the placing of the order. Deviations from the technical purchase conditions are only permitted in agreement with MANN+HUMMEL.

The device selection list (Appendix 1) is an integral part of the technical purchase conditions and the order placment.

1 General guidelines

1.1 Standards and regulations

The applicable regulations and generally acknowledged rules of technology as well as the occupational health & safety and accident prevention regulations of the professional indemnity associations and all applicable environmental protection legislation must be complied with, such as:

- ⇨ EC Machinery Directive
- ⇨ DIN standards
- ⇨ EN standards
- ⇨ IEC standards
- ⇨ Association for Electrical, Electronic and Information Technologies (VDE) regulations
- ⇨ UKAPE – United Kingdon Association of Proffessional Engineers
- ⇨ Regulations issued by institutions for statutory accident insurance and prevention
- ⇨ U.K Law on Design and Supply of Products (Health & Safety Executive)
- ⇨ Association of British Insurers (Indemnity Insurers)
- ⇨ EMC Act
- ⇨ Health & Safety Exective (U.K regulatory body on Industrial Health and Safety)
- ⇨ United Kingdom Accreditation Service (UKAS) or equivalent.

The health and safety requirements stipulated in the individual regulations must be adhered to. The conformity / CE mark must be attached permanently to the technical work equipment in a clearly visible location.

An EC declaration of conformity including a risk assessment and AWF file are to be delivered as part of the documentation (to be observed also if placing on the market and reconstructing used machines that have undergone "considerable alterations"!).

In case several installations (machines) from different suppliers belong together, the general contractor must supply the overall conformity of the entire installation/machine.

Components on the device selection lists must be used - any deviations must be approved in written form by MANN+HUMMEL.

Components on the lubricants list and lubricant overview list must be used - any deviations must be approved in written form by MANN+HUMMEL.

1.2 Colour scheme for machines and installations

If nothing else is specified, the following shall apply:

1.2.1 When purchasing new machines and installations

Machine:

Body of the machine:	Grey-white	RAL 9002
.....	Light grey	RAL 7035
Orifices, bases etc.:	Basalt grey	RAL 7012
Electrical panels, switch and control cabinets, terminal boxes;	Gentian blue	RAL 5010
Tempering and preheating units, marking units	Pure white	RAL 9010

Safety:

Hand rails, impact protection, trolleys:	Traffic yellow	RAL 1023
Protective grate	Anthracite grey	RAL 7016
Protective grate frame	Traffic yellow	RAL 1023
Conveyor belts:	Light blue	RAL 5012
Podium, stages	Pigeon blue	RAL 5014

1.2.2 For machines and installations in the inventory

Machine:

Body of the machine:	Light green	RAL 6027
Electrical panels, switch and control cabinets,	Gentian blue	RAL 5010
Terminal boxes:		
Tempering and preheating units:, marking units	Pure white	RAL 9010

Safety:

Hand rails, impact protection, trolleys:	Rape yellow	RAL 1021
Protective grate	Anthracite grey	RAL 7016
Protective grate frame	Rape yellow	RAL 1021
Conveyor belts:	Light blue	RAL 5012
Furnaces:	Grey-white	RAL 9002
Slide assembly:	Green blue	RAL 5001

1.2.3 Pipes

The paint must be labelled according to flow medium and direction in accordance with BS1710:2014 and the E.U standards EC/172/2008. Insulated pipes must be marked with printed labels.

1.3 Documents for approval

Before the start of production of the machines, the following documents must be presented for checking: 1 copy

- ⇨ Schematic diagrams, part lists, layout of mounting plates, location plan of the substation, terminal boxes and operating devices for electrics, hydraulics and pneumatics.
- ⇨ Floor and foundation plans (areas to be left clear for maintenance have to be indicated)
- ⇨ Connection and consumption values.
- ⇨ The necessary lubricants should be agreed with from the M+H at quotation stage.
- ⇨ Lubricant requirement values.
- ⇨ A complete set of drawings, including the work piece-dependent clamping devices, jigs, tools and other equipment designed by the supplier.
- ⇨ You may only proceed with the production of the machine once the approval has been given in signature form.
- ⇨ At least 2 weeks will be required for the documents to be approved.
- ⇨ A quote regarding any necessary replacement parts that are to be stored on MANN+HUMMEL's premises must be provided in advance of machine delivery.
- ⇨ Critical spares, prices and the lead time needs to be accompanied with the proposal. See 1.4 for additional information.

The test does not include a functional or security/safety test!
The approval does **not** relieve the contractor of his or her responsibility to carry out the work correctly and appropriately. The test and release are the responsibility of the appropriate authorised department.

1.4 Documentation

The following documents have to be provided in **English**:
All electronic documentation must be provided in an unprotected format. The drawings have to be in ".dwg" file format. All other documents must be in a Microsoft software compatible format otherwise in ".pdf".

	1 copy (paper format)	2 copies (paper format)	CD or USB drive
The following information must appear on each individual documentation sheet: ⇨ M+H machine description ⇨ M+H machine no. (5-digit or 6-digit) This information is disclosed by M+H.		X	
Manuals with functional description and functional diagram of the whole installation.		X	X
Declaration of (EC) conformity and risk assessment (with hazard identification and analysis of hazardous situations).		X	
(Machine) Layout with location plan of all terminal and switch boxes as well as interfaces for power connections.		X	X
Foundation plan and installation layout, as a ".dwg" file or, in exceptional cases as "dxf" file. The file must also contain, on one layer, a simplified diagram of the installation.	X		X
Transportation and assembly instructions: (mark transportation device on the machine). Transfer of these documents no later than 1 week before machine delivery.	X		
If an installation is integrated into a production line, the connection of the machines must be included in the documentation by the manufacturer.		X	X
Maintenance and lubrication instructions: general layout drawing(s) which link to the individual maintenance points have to be included. Necessary information: ⇨ Location of lubrication points ⇨ Amount of lubrication points ⇨ Quantity of lubricant per lubrication point ⇨ Lubricant classification number acc. to M+H standard ⇨ Lubricating interval		X	X
Calibration list, (calibration carried out by, frequency, duration) Original calibration certificates required.	X		X
Inspection lists subdivided into mechanics, hydraulics, pneumatics, electrics and electronics with work content related to ⇨ the tasks to be carried out ⇨ Intervall of these tasks; the guidelines and specifications indicated in 1.1 must be observed.		X	X

Inspection lists: If physical values (pressure, temperature, stroke etc.) are measured in machines/installations then check possibilities (calibration or functional tests) must be specified, provided they are important for the process. This includes the further processing of output signals (e.g. software) right up to displaying the values. The check includes the sensor, the processing system that is connected downstream right up to the display instrument, even if it's electronically. For screw connections that require special attention, the tightening torques must always be provided on the maintenance and inspection lists.		X	X
Prioritised (critical) spares / consumables list. With part name, manufacturer part number, manufacturer, price, est. lead time, recommended stock. All parts must be purchasable in the UK. The serial has to be noted for transmission motors, rotary tables and linear axes.		X	X
Machinery data sheet (AWF machine card) in file format.		X	X
Type approval or ownership declaration for collecting trays in accordance with U.K Water Resource Management including identification on the object and with a certificate of manufacturer capability.		X	X
Diagrams: Mechanics: ⇨ Mechanical drawings (Assembly and single parts) ⇨ Parts list ⇨ (Critical) spares list Electrics: ⇨ Layout must be page and current path oriented ⇨ Continuous function chart (logic diagram?) ⇨ Circuit diagram with details of the total connected load, pre-fuses, parts lists, configuration plan and terminal plan ⇨ Layout of drawings: Page number, identifying letters, path number or input-output number. e.g.: Proximity switch indicated in circuit diagram on Sheet 10 and message sent to input 31.5 → Designation: 10B315 Pneumatics: ⇨ Continuous function chart ⇨ Piping plan with details of the hourly air consumption rate		X	X

and the connection cross-section ⇨ Parts lists Hydraulics: ⇨ Continuous function chart ⇨ Piping plan ⇨ Parts lists Part lists has to be arranged alphanumerically according to the device description; all devices must be listed individually with clear manufacturer information such as original description and manufacturer order number.			
Complete overview plan of sensors and actuators (for failure indication)		X	X
When using compact devices for control and regulation tasks, internal wiring connection diagrams, manuals and device manuals including parameter lists must be in the delivery scope.		X	
The parameter list of individual components such as frequency converters and servo drives must be provided as a project file. (If possible integrated into the S7 project).			X
The PLC control software with symbolism has to be supplied on a USB stick or CD.			X
Test certificates must be provided for safety devices. The acceptance records must be included. A list of the electrical and mechanical safety-equipment has to be provided.		X	X
Safety test record in accordance with BS EN 60204-1:2006 + A1:2009		X	X
Certificate that the switch cabinet has been constructed in accordance with BS EN 61439:2014.		X	
Licences for operating systems, displays and other software	X		
A program flowchart or a functional diagram for the installation acc. to ISO 5807 has to be provided. Pseudocode, block diagram, status diagram or structured flowchart as Nassi–Shneiderman diagram.		X	X
For hoists or similar a static stress analysis (incl. test reports) must be provided.		X	X
A set of installation guidelines and a bootable CD for every PC.			X

- ⇨ The connected loads for all types of energy have to be provided when the order is placed.
- ⇨ Depending on the delivery time to MHUK one set of critical spares has to be held at the machine manufacturer's or MHUK's premises. If the delivery time from the spare supplier to MHUK exceeds 24h it has to be stored at the machine manufacturer otherwise at MHUK.

When leaving the installation, a valid set of documentation and software has to be left on the installation, this also applies for alteration or repair works. If unnecessary downtime occurs due to a lack of documentation, M+H is authorised to refer this to the system manufacturer.

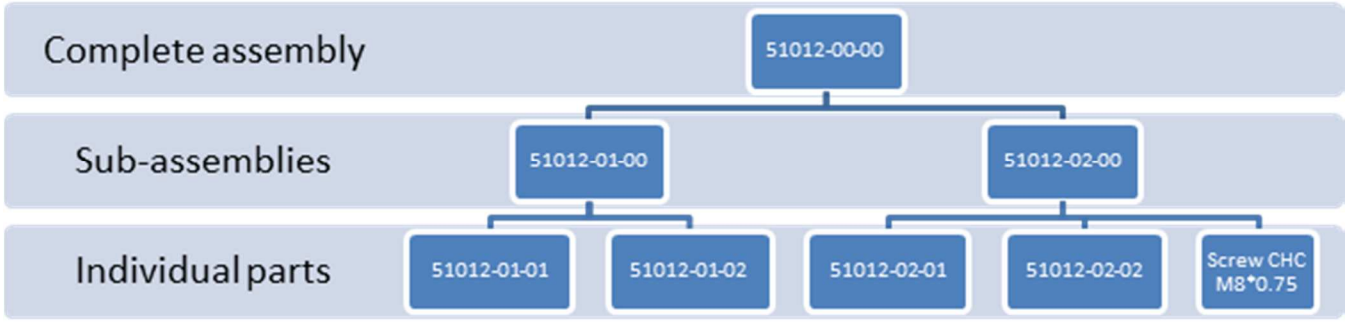
The numerically ordered documentation is part of the scope of delivery. An incomplete delivery with regard to the contractual agreement means M+H is entitled, without influencing the conditions, to make an appropriate reduction to the agreed purchase price.

1.5 3D modell

The 3D model of the asset must be supplied in SolidWorks format or in .stp volumes format. All 2D drawings must be supplied in SolidWorks format or in .dwg format. The complete machine assembly must be clearly labelled with the asset number provided by MHUK.
E.g.: “51012 - Insertion machine”.

Every part of the assembly has to be clearly named. Standardised components such as screws, cylinders, actuators etc. have to be named as the resp. norm directs or after their manufacturer and reference.
E.g: “Hexagon head screw ISO 8765 - M8x1x70 - 8.8” or “FESTO DSNU-12-20-P-A”

The construction of the 3D model follows the following structure:



Each sub-assembly has to regroup all the elements allowing one function of the machine (e.g. feeding system, insertion system, etc…)
All threaded holes have to be marked as such (3/4 of a circle) on the 3D model and on the detail drawing.

1.6 Implementation rules for electrical, pneumatic and hydraulic control systems

The electrical control equipment has to be labelled with a legible, durable machine identification plate.

The following information is required:

- ⇨ CE mark
- ⇨ Manufacturer/supplier
- ⇨ Classification
- ⇨ Factory no. /serial no.
- ⇨ Weight
- ⇨ Circuit diagram no.
- ⇨ Rated voltage of main circuits
- ⇨ Rated voltage of control circuits
- ⇨ Type of current (number of phases - frequency)
- ⇨ Full load current
- ⇨ Short circuit disconnect threshold, over-current safeguard (min.)
- ⇨ Test mark: e.g. BS EN 61439:2014, BS EN 60204-1:2006

No hydraulic or pneumatic components may be installed in electrical device installation spaces. (better: “electric cabinets”?)

Switch cabinet doors (mechanical and electrical) should have a maximum width of 800 mm and a maximum height of 2 m. Aperture angle of doors has to be min. 180°, upright and adjacent cabinet doors should be able to overlap. These pieces of equipment should be installed 400 mm off the ground.

The space to be left free depends on the size of the mounting plates:

Up to 0.3 m²	**≥**	**40%**
0.3 to 1.0 m²	**≥**	**30%**
Greater than 1.0 m²	**≥**	**20%**

One large switch cabinet is preferable to several small stacked cabinets.

Cables must not be fed into the switch cabinet from above.

The switch cabinet, terminal boxes, devices and installation have to have at least a ISO 60529 rating of IP 54. When installing control devices and terminal boxes to the machine, you have to ensure good accessibility for service/maintenance or repair work.

Terminal boxes must be labelled on the outside.

The switch cabinet, main switch, operating elements and light curtains must not protrude the machine frame otherwise you will need to fit a skirting protection.

All speed controllers must be installed in the switch cabinet.

In order to determine the maximum switch cabinet temperature, you have to observe the temperature limits according manufacturer specifications for electrical equipment. In general the temperature should not exceed 40 °C. If the switch cabinet needs to be cooled, a fan, air conditioning system or heat exchanger can be used. The air supply from the fan, heat exchanger and air conditioning system has to be equipped with a filter.

A service socket outlet has to be built into the switch cabinet **before** the main switch. Install the necessary equipment directly next to the feed-in.

A light has to be built into the switch cabinet **before** the main switch. The light must be switched off as the cabinet doors are closed. Further a light test function must be installed. All operational and signal lamps need to be turned off once the machine is disconnected.

Upright cabinets need to be equipped with a folding table for the programming device.

An appropriately sized pocket has to be fitted for the circuit diagram.

A signal lamp pillar, with red, yellow and green must be installed.

Each machine or installation must be equipped with a “Siemens” PLC and control panel (HMI). The choice of device needs to be agreed with M+H before project planning and construction of the installation.

PLC control systems must be expandable and have a reserve of min. 20%.

According to M+H's specifications, a clock timer, elapsed time indicator and the necessary piece counter must be integrated into the PLC.

Host system interfaces must be clarified on a case-by-case basis.

The signal exchange of linked installations must be clarified with MANN+HUMMEL. Preferably signals should be exchanged via Profibus, Profinet or MPI bus. The emergency stop link-up should be implemented in accordance with MANN+HUMMEL.
All faults must be displayed and saved until they are acknowledged. The faults have to be encoded down to the input/output level. The identification of the equipment and the operation variables must be displayed in the fault description text.

If an installation experiences faults following power cuts, a UPS needs to be used.

For all drives that are operated using a frequency converter, the temperature of the motor has to be monitored. Power and monitoring cables need to be shielded and must be connected with separated cables.

For moving cables, dragline-compatible cables must be used. The bending radii has to be observed. Use highly flexible, trailing cables in the cable carrier to remove possibility of cable fatigue.

Use “Robotron” cables for rotating applications (e.g. swivels).

In general for moving servo circuit’s changeable wear pieces have to be used.

The safety circuits must meet at least category 3 in accordance with EN 13849-1.

In collecting trays for tanks or similar, a floating switch or Liquiphant (fill level measuring device) or capacitive sensor for notifying the central control and communication system needs to be installed.

All electrical, hydraulic and pneumatic equipment outside of the switch cabinet must be permanently labelled with the medium description (identical to the schematic diagram). Oil-resistant labels must be used. Labelling in the pneumatic/hydraulic/electrical drawings must be identical. These labels have to be attached close to the cable bush and on the cable connection. Ensure that the labels are arranged correctly in relation to the components (left to right or top to bottom).
The equipment and its place of installation must be indicated in the switch cabinet.

Cable ties need to be cut flush to the surface (use unbevelled wire cutter).

2 Electrical equipment

2.1 Hardware

The machine must be provided with electrical leads and connectors to fit MHUK main electric. Power cable has to be 5 m in length, 16 Amp, 5 pin, 3 phase red plug.

The following standards must be adhered to or considered dependent upon installation type:

- All distribution circuits and any other electrical installation must be designed and built/installed according to the rules and regulations of BS 7671:2008 (Amendment No 1:2011) [17th Edition Wiring Regulations].

- All equipment must be designed and built to comply with BS EN 60204 [Safety of Machinery – Electrical Equipment of Machines]

Compliance to these standards has to be included on the Declaration of Conformity documents.

The machine must operate on UK energy supply, which means 230/400VAC 50Hz.

A facility is to be included to allow the monitoring of all supplied energies.
All electrical panels to be maintained at an ambient temperature of +5°C - +40°C by means of assisted ventilation or enclosure climate control.

All control panels must have 20% free space to allow for future expansion.

Terminal boxes, bus receivers (where existing) and mounting spaces must be marked with a lightning arrow (as per images below), where the voltage exceeding ELV is present.

All electrical instruments, cables, plugs, valves, initiators, sensors etc. must be marked with addresses – as per wiring diagrams. These markings must be durable, legible, and affixed in such a manner that they are well visible when the equipment is completely installed. The instrument markings must be repeated on housings and covers. Terminal boxes must be marked on the outside with characteristics plates on which the numbers of the terminal blocks are indicated. All cable markings must be present at every connection as per electrical drawings. This means all wires/cables/lanes have to be labelled at both ends. The font size has to be minimum 14 pt and in black colour.

Whenever any item of equipment or panel section carries, after insulation, higher voltages than SELV or PELV, such items or sections must bear engraved warning labels of

yellow/black/yellow laminated materials. Further all live parts shall be adequately shrouded to a minimum of IP2X and to the satisfaction of the manufacturing personnel.
Where stored electrical energies exist by means of capacitors or otherwise and are above 50 VAC. Warning notices must be displayed on the outer door to the enclosure advising the discharge time of such devices.
Panels are to contain lighting which remains energized after the panel/enclosure is isolated. The exposed conductive parts must be protected to IP2X as a minimum and be labelled as live after isolation. As below:

If standing water is to be used within a 2m radius of the luminaire, then the luminaire must be protected to a minimum of IPX3
If pressurised water exists with a 4m radius of the luminaire, then the luminaire must be protected to a minimum of IPX4
If the luminaire is to be submerged in water then it must be protected to a minimum of IPX7.
Where enclosures incorporate an interlocking type isolator (can't open door without isolating enclosure) the isolator must include an override which can only be activated by means of a tool. Where panel mounted isolators are used then the panel or enclosure must only be opened my means of a tool or key.

A British Specification 240V 2 P + E socket (BS 1363) is to be positioned on the operator panel door and be protected to 13A.
An extra socket for the purposes of programming must be provided inside the panel or enclosure. This needs to be a British specification 240V 2 P + E socket (BS 1363). This need only be protected to 2A and marked up as such.

Where sensitive electronic equipment is to be utilized, provision against temporary over-voltage shall be provided. This should be by means of a surge protection device and be as near as it's practicable to the supply source. Where equipment is particularly sensitive, local SPD's may be used.
All sockets must be protected by an RCD's, the rating of which must not exceed 30mA.
Every installation shall include an electrical drawing. The drawing must be in English and be clearly legible. The drawing must be delivered with the machine as a hard copy and also electronically (.pdf and .dwg) no later than two weeks following delivery.
The initial setting of any over current device has to be marked on the device itself where practicable and also in the drawing as text.
MCB's are to be used in preference to fuses where practicable.
Cam switches, temperature regulation, position determination, analogue processing and other special applications need to be integrated into the PLC control system.

The MPI address 0 is reserved for the programming device.

If the switch cabinet is installed on a stage or a distance away from the installation, then a service socket and a MPI socket outlet has to be installed in the control cabinet before the main switch.

Sockets on the machine that can be used with the switch cabinet door closed have to be protected with a 30mA residual-current device.

All programs need to be stored in non-volatile memory space in the CPU. The MMC memory card must be large enough for the complete project to be saved. After a general reset and once the memory has been inserted, the control system must boot automatically.

Heating has to be controlled with semi-conductor relays (solid-state relays), use a semi-conductor fuse if necessary.

Use a "Dold" controller for hot die stamps which are not controlled by the central control unit.

Temperature sensors cables have to be up to the connection point in the same colour.

Use “Phoenix” semi-conductor reversing contactors for motor control.

Lay the cable channels in a way they cannot be stepped on or used as climbing aids. The cable channel cover must not point downwards. Cable bushings should be slotted. Provide edge protection for the cable channel edges. Leave spare space in the cable channel.

Use standard components (bus modules, PLC cards, valve clusters, frequency converters etc.) in order to minimise the number of spare parts and ensure that these can be easily exchanged. Even if this leads to oversizing.

2.2 Software

The programming should preferably be carried out in logic diagram LD, programming in statement list STL is only permitted in exceptional cases. If, due to technical reasons, programming has to be carried out in STL, then only the relevant part of the program should be produced in STL (e.g. regulation, file transfer etc.).

Programming must only be carried out using Siemens software.
The M+H installation number has to be used for the S7 project name (provided by M+H). Linked installations need be grouped in one project.

If visualisation is included, it must contain a suitable fault memory.

The PLC program has to be saved on the machine (central computer, USB stick, MMC card). Indicate the revision status by appending the version number and date.
The saved modules must be the same as on the CPU. The modules must only derivate in the content. It must be possible to modify the modules and all inputs, outputs and markers must be commented.

The program must be designed in a way that makes it possible to connect the programming device to the MPI and Profibus interface for test purposes while the machine is running.
The interface for the programming device (S5) must not be used for other functions.

In case of complex installations, basic positions and fault notifications need to be displayed in clear, logical groups.

The commented program must be provided on a CD, without software protection and in archived format (using the Siemens standard archiving program).

The program may only be created in high level language or in other programming languages following written agreement and approval by M+H.

In installations with Profibus, the Profibus diagnostics have to be planned and installed.
The Profibus diagnostics must be integrated into the OP or visualisation.

Programming tools must be named at the time the order is placed and, if necessary, is part of the order.

Network size:	Maximum screen size
Network headings:	Function of the network
Component headings:	Function of the respective module
Symbolism:	Function of the operands (For I/O's the equipment-specific ID must be provided)

Label network cables and bus cables with their destinations.

2.3 Power supply

Supply voltage: 230/400 V, 50 Hz
Electrical grid configuration: TN-C-S

For assembly machines, the power supply should usually lead from the top of the machine to the subsequent connection.
For a CEE connection cable use a rubber-sheathed cable, H07RN-F with at least 2.5mm².

2.4 Connection to the supply voltage

Connection to the supply voltage realised via terminal blocks or directly to the manually-operated main switch. Covers should be fixed to the main connection terminals and load switch terminals to prevent them being touched accidentally. Plastic-sheathed cable must be used for the section of cable from the feed-in terminals to the main switch.

2.5 Control circuits

Control voltage:	**230 V AC**	**Colour - red**
Control voltage:	**24 V DC**	**Colour - dark blue**
External voltage:	**max. 24 V DC**	**Colour - orange**

Maximum permissible external voltage: 50 V AC.

Control transformers must have one the primary side a main voltage adjustment of ± 5%.

Control transformers must primarly operated with 400 V and must be protected by circuit breakers or motor protection switches.

The secondary protection of control transformers or power supply units is being carried out using a single pole.

Short-circuit protection in compliance with ISO 60204-1:2006: must be ensured (certificate required). Pay attention to the length and cross-section of the control cable loop.

Control circuits must be earthed when operated (connection of one control voltage pole to the protective earthing system).
If, due to technical reasons (e.g. electronic circuits), this is not possible an isolation monitoring device with notification or switch-off has to be provided.

Control voltage must be earthed through terminals next to each other using green-yellow jumpers. Even when using PELV and FELV low voltages the **bodies of all electrical equipment** must be electrically connected to the protective earthing conductor system, if they do not correspond to protection class II.

Run control circuits via control transformers in compliance with ISO 61558.
In direct voltage circuits, "plus" should be protected.

All protection and relay inductors must be equipped with an appropriate protective circuit.

Solenoid valves must be provided with a valve switching unit (with LED). If necessary, valves have to be protected individually.

2.6 Main circuit

Use at least 1.5 mm² single core cables for main circuit wiring.

Do not use cable end sleeves with tension spring connectors, if the manufacturer does not allows it.

Motors must be connected in a switchable way and have to be protected against overload and short circuit. If necessary, coarse and/or group pre-fuses should be used.

If possible and as long as the power transmission allows it motors should be plugable.

NH-fuses must normally be used. Semi-conductor switch elements need to be protected using a ring characteristic (quick-acting). Screw fuses (only “Neozed”) is permitted for nominal currents up to 25 A. For screw fuses use fuse switch disconnectors.
If heavy starting is not possible, motors up to 5.5 kW can be directly started.
For drive motors with only one rotation direction a directional arrow has to be permanently fixed to the motor or machine.

2.6.1 Cable colours

Cable colour code to be as per the chart as below:

Function.	Colour.
L1	Brown
L2	Black
L3	Grey
N	Blue
PE, CPC, PC	Green / yellow
Control voltage 230V AC	Red (re)
Control voltage 0V AC	Red (re)
Control voltage 24V DC	Blue (bu)
Control voltage 0V AC	Blue (bu)
Control voltage 24V AC	Red (re)
Control voltage 0V AC	Red (re)
Input PLC	White (wh)
Output PLC	Purple (pu)
Foreign voltage	Orange (or)
Emergency stop	Grey (gr)

2.6.2 Wiring Diagram

The wiring diagram must be written in English, clearly legible and comply with the requirements as per ISO 81346-1:2015. Sockets in the diagram segments must be marked with the device name and diagram segment number of the drive (e.g. contactor spool) (re-denomination). Contact occupation, including connection denomination of contacts must be represented under the switch sign of the spool, in case of multi- polar switches, next to the switching element first mentioned and include the following:

- Voltage, frequency and phase number of incoming feed
- Line or destination denominations
- Connection denominations
- Diagram segment numbers
- Sequence of selector switches
- Setup values of releases, pressure switches, time relays etc
- Nominal values of current and power of all individual drives.

2.7 Light and socket circuits

Light and socket circuits must be protected by a circuit protection switch.

If circuits are diverted before the main switch, the part of the cable from the diversion right up to the fuse must be short circuit-proof. After the fuse, the cables have to be in separate and appropriately labelled plastic sheaths.

The terminals and equipment must be protected by a touch-proof cover and must be labelled with the warning **“Caution, still live when main switch is turned off”**.

2.8 Device arrangement

The devices have to be fixed to a removable mounting plate, which is attached to the rear panel. Safeguards, relays, circuit protection switches and motor protection switches etc. need to be mounted on bearing rails in the switch cabinet in accordance with BS 5584, EN 50022.

2.9 Wiring

All wiring must be in wiring channels using flexible wire “H07V-K”. For all flexible connections in- and outside of the switch cabinet, isolated core cable ends must be used with plastic flanges.

2.9.1 Description of terminals

The terminals and potential terminals must be numbered consecutively. PE and earth terminals need to be numbered as well. Connections and counter connections need to be labelled identically. Reserve wires have to lead to terminals.

2.9.2 Installation

All cables outside of the switch cabinet, which are routed in parallel, must be stored in metal channels with a removable lid. Fine flexible PU cables have to be used for moving circuits. Depending on the housing material you should use cap screws with a PVC or metal cable relief. In either case metal counter nuts must be used. Only one cable must be fed in per cable screw, otherwise you have to use multi-conductor seals.

2.9.3 Connection of the switch cabinet – installation

Cables must not be fed into the switch cabinet from above.

If the switch cabinet and machine are not fixed to each other, the connections to the installation must be contamination-protected using Harting terminal block connectors or similar (e.g. Han E AV). The individual plugs must be encoded and a plug cabinet should be constructed. Ensure that the EMC directive is adhered to.

3 Mechanical equipment

3.1 General requirements

3.1.1 Purchased parts

All purchased parts (such as couplings, brakes etc.) must not be altered before use and must correspond to the applicable EC machinery directives.

3.1.2 Drives/overload protection

Drives must be provided with an overload safety device with a fixed locking point.

3.1.3 Ergonomic configuration

As part of design, consideration has to be given to the expertise of industrial science (ISO 6385:2004, ISO 6385, ISO 14738:2002 etc.),

3.1.4 Transport

You have to take note of the fact that, when delivered, the machine can only be offloaded with a fork-lift truck (max. 2t capacity and max. fork length of 800 mm). Any alternative load devices these must be provided by the supplier.

3.2 Machine components and building specifications

Standard and standardised components must generally be used for these components.
Bespoke parts need written approval from MANN+HUMMEL.

3.2.1 Belts and chains

Re-tightening options must be given.

3.2.2 Guide tracks

Guide track ways have to be provided with a commercially available wiper.

3.2.3 Screws

Metric threads must be used.

3.2.4 Straight pins

Generally, cylindric straight bolts with a pull-off screw thread must be used.

3.2.5 Lubrication (central lubrication)

Lubrication plans have to be produced for lubricants in accordance with ISO 8659 and a full list of used lubricants has to be supplied.

3.2.5.1 Central lubrication

Only use devices mentioned in the appendix 1.

3.2.5.2 Automated lubrication

If the mechanics of the machine make a lubricant feeding device necessary, the preferred solution is a fully automatic system incorporating electrical monitoring of lubricant distribution. The individual devices must be permanently labelled in compliance with the lubrication plan.

3.2.5.3 Labelling lubrication points

All lubrication points must be labelled on the machine. Labels have to include the type of lubricant and the M+H material number. The adhesive labels are provided by M+H on request.

3.2.5.4 Lubricating nipple

If single lubrication nipples cannot to be avoided flat lubrication points such as M4 (M6 x 1) or M1 (M8 x 1.25) can be used.

3.2.6 Pumps

Only (immersion) pumps from the companies mentioned in appendix 1 have to be used.

3.2.7 Cooling units

Cooling devices in accordance with DIN 8975 (CFC-free).

3.2.8 Pipes for cooling or tempering devices

The pipes of cooling / tempering devices must be isolated.

3.2.9 Closure of maintenance doors

Closure of maintenance doors should be carried out either using a rotary handle or using a 7 mm square socket (panel) key. Use safety end switches in hazardous areas.

3.2.10 Three-phase motors

Only 3-phase motors with a thermal contact or thermistor must be used.

3.2.11 Ventilation and exhaust systems

For ventilation and exhaust systems standardised nominal diameters have to be used.

4 Pneumatic equipment

4.1 Components and specifications

All pneumatic and electro-pneumatic components must comply with the EC machinery directive.

For **pressure switches** and electrically-operated valves, the switching status needs to be displayed visually (by an LED).

4.1.1 Mains power supply

For assembly machines, the power supply should usually lead from the top of the machine via pipes to the subsequent connections.
The connection to the main air system must have a stopcock with ventilation function. If necessary, a sequence valve must be used for soft start.
For air treatment a filter system with regulator must be connected downstream.
The maximum operating pressure is 6 bar. If higher pressures are required, consultation and written approval is necessary.
The pneumatic installation must be driven with dry air. This means no oiler has to be used.
In purely pneumatic control systems, control and main circuits are controlled separately and must be adjustable.

4.1.2 Piping and fittings

The piping has to be suitably designed for the pressure/environmental conditions and external mechanical loads.

4.1.3 Choice of device

You must always use “lubricated-for-life” **ISO valves** and **normed cylinders**. If technically possible, double-action cylinders should be used. Measurement device scales must be gauged using statutory units in accordance to ISO 80000-1.

4.1.4 Safety devices

For pneumatic presses or similar devices (compactor) the following has to be provided:

a) **Safety control**
b) **Safety drop guard**
c) **Option for overshoot measuring**

5 Hydraulic equipment

5.1 Components and specifications

All hydraulic components must correspond to the EC machinery directives.

5.1.1 Hydraulic unit

The oil tank must be dimensioned to ensure that the oil temperature does not exceed 60 °C. If necessary integrate coolers, heating or tanks. Oil systems need to be fitted with appropriate filters. Oil temperature has to be monitored. Provide a suitable oil collecting tank - manufactured and approved in compliance with the Water Industries Act & Water Resources Act

5.1.2 Piping and fittings

Piping has to be designed according to pressure, environmental conditions and external mechanical loads (high pressure pipes, tubes). All connections must be disconnectable. The piping has to be fitted vibration-proof. All work units need to be provided with an easily accessible measurement connection.

5.1.3 Choice of device

You must always use **ISO valves** and **standard cylinders**.
Measurement device scales must be using using statutory units in accordance to EN ISO 80000-1.
If lockable switch organs are provided, they must be equipped with a BKS lock, “S-6929 H 2 A” type, and an “H 2” key.
MANN+HUMMEL oil filters have to be used if available.
Pressurised tanks must be designed with a safety shut-off block with drainage.
Electrical valve connections have to use a plug according to EN 175301-803, ISO 4400, and have an electrical status indication.

5.1.4 Safety

A certified pressure limitation valve must be incorporated to prevent the whole installation from exceeding the maximum permissible pressure. The hydraulic system must have unpressurised circulation.
Ensure compliance with safety regulations for hydraulic pipes, BGR237.

6 Energy media

Compressed air:	6.0 bars	PN 16 fittings
Returned coolant:	2.5 bar	PN fittings 10/16, max. temperature 25 °C Max. pressure drop in machine: 1 bar.

7 Safety equipment

7.1 Health and safety

7.1.1 Regulations regarding technical work equipment

For the ordered machine all applicable technical and safety regulations must be obeyed in full. E.g. Health & Safety and accident prevention regulations, the Supply of Machinery Safety Reglations 2011 and with other appropriate regulations, the British Automation & Robotic Association for Flexible and Reconfigurable Manufacturing Systems..
ISO 13857:2008 and EN 294 or EN 349 + A1:2008 must be observed for safety margins.

7.1.2 Noise protection

It must be ensured that all machines, installations and devices operate as quiet as possible.

7.1.2.1 Permissible overall noise pressure level

The noise pressure level of a machine, device or installation, which is operated in an enclosed space (production hall), may not exceed 80 dB(A) at nominal load or when operating 1 m away from the edge of the machine and at 1 – 1.5 m above the operating floor. No pulsed sounds must occur. If these are unavoidable, the basic noise level must not erxceed 75 dB(A). The requirements of guideline 2003/10/EC have to be taken into account.

7.1.2.2 Measuring the noise pressure level

The noise emission must, according to ISO 3744:2010, be determined in accordance with accuracy class 2 and has to be presented in a measurement report pursuant to Section 9 of the abovementioned regulation. This measurement report is part of the delivery scope.
For installations that are erected outside of a factory building, the noise pressure level must be provided at quotation stage.

7.1.3 Pressure devices, pressure tanks, pressure pipes, gas high-pressure pipes

Named devices, installations or units must be designed in accordance with the requirements of the Health & Safety Executive guidance on Industrial Safety and Health and related regulations, e.g. the Pressure Equipment Regulations (as amended). All necessary documents such as the confirmation of a pressure test, acceptance report before commissioning and certification of type approval are part of the delivery. For installations requiring supervision, a safety-engineering assessment with a recommendation regarding the test intervals for the overall installation and for individual parts has to be provided for the reocurring tests in accordance with Health & Safety Executive guidance on Industrial Safety and Health.

8 Environmental protection / Thresholds

8.1 Environmental protection

Rubbish, waste water and energy consumption should be kept to a minimum.

All machines, installations and devices must comply with the current respective requirements of all environmental laws and local regulations.

Machines, installations and devices which, in accordance with their intended use, are covered by the scope of the The Waste Management (England and Wales) Regulations 2011 and the EA Waste Management Technical Guidance WM3 - Waste Classification, the scope of the Clean Air Act 1993 (as amended), and of the Water Act 2014 (as amended) must comply with the current respective requirements of this legislation.

8.2 Directive regarding hazardous materials (REACH Regulations)

The use of hazardous materials is only permitted in cases in which a lowest risk test is carried out and hazardous materials are substituted within the scope of the Hazardous Waste. Statutory bans on the use of a material (e.g. Candidate List of Substance of very high concern) must be observed.

Labelling/packaging must comply with the European Regulation EC No: 1272/2008 or the Carriage of Dangerous goods and the use of Transportable Pressure Equipment Regulations 2009 Ref: SI 2009 No: 1348

Technical work equipment must be constructed in such a way that there are no health hazards for the people and the permissible occupational exposure limit values are not exceeded.

The products provided to us must not contain any carcinogenic, mutagenic or teratogenic substances in accordance with EA Waste Management Technical Guidance WM3. Further there must not be toxic substances in terms of the list of hazardous substances and preparations in accordance with The Waste Management (England and Wales) Regulations 2011.

For all delivered products (substances), an up-to-date EC material safety data sheet must be included in the delivery. In case of amendments and/or updates, an appropriate data sheet must be supplied.

8.3 Installations that are subject to licensing and/or registration

For installations that are subject to licensing or registration, as soon as the planning phase has been completed all documents that have to be presented to the authorities must be provided to the department of environmental protection.

9 Acceptance

The acceptance is split into a pre-acceptance at the supplier's premises and a final-acceptance at the MANN+HUMMEL production plant.

9.1 Pre-Acceptance at Supplier

- The performance of the equipment will be tested at the supplier's plant. The equipment will be deemed ready for acceptance when a full 4 hours of fault free operation has been witnessed and the check list for acceptance has been signed off. This document (WOL-EN-F-0003) can be requested upfront by the supplier. The date for the pre-acceptance will be scheduled between MHUK and the supplier.
- The machine capability C_{mk} has to be tested **by** MHUK with at least 50 parts and a result >1.67 has to be achieved.
- **The hourly output specified in the machine specificaton has to be met.**

9.2 Final acceptance at MANN+HUMMEL

- The acceptance date will be agreed by common agreement between MHUK and the supplier. The supplier will propose appropriate dates. The document (WOL-EN-F-0003) will be used.
- Start-up concludes the proof of equipment capability (where applicable), verified by a Quality Engineer of MHUK and conclusion of MHUK personnel training. Signed training matrices are required for record purposes.
- If damage to the equipment is caused by MHUK operating personnel after completion of their training, it will be the supplier's responsibility to prove that MHUK operating personnel have acted against their training and operating instructions. The supplier will bear any repair costs that cannot be proven to be the cause of MHUK personnel.
- Risk transfer to MHUK, acceptance or the beginning of warranty time is not connected to the start of the trial run or any events during the trial run.
- Successful start-up can be followed by a trial run.
- Final Acceptance will be concluded as soon as stable operating conditions exist, but at the latest six months after start up.

- **O**verall **E**quipment **E**fficiency is defined as: $OEE = FTQ * P * MA$
- The **F**irst **T**ime **Q**uality is calculated using: $FTQ = \frac{\sum first\ pass\ OK\ parts}{\sum actual\ produced\ parts\ (OK+NOK)}$

- **P**erformance gets calculated: $P = \frac{Bottleneck\ cycle\ time\ \left[\frac{s}{pc}\right] * actual\ produced\ parts\ (OK+NOK)\ [pc]}{3600\ \left[\frac{s}{h}\right] * Total\ \ time\ available\ for\ production\ [h]}$

- **M**achine **A**vailability is: $MA = \frac{Total\ \ time\ available\ for\ production\ [h]}{Amount\ of\ shifts * shift\ duration\ [h]}$

- Acceptance will be considered successful when all requirements of this specification, the sign off document is fully signed and met and any points on snag lists are closed out. A supplier's representative needs to be on site during acceptance. In case of absence the by MHUK collected data is the final one.

- Supplier and customer will each bear their respective personnel costs for acceptance.

9.3 Acceptance with Reservations

- If defects are detected which do not affect the function of the equipment, acceptance may be performed by raising a timed action plan [snag list] with a resolution period of no longer than one month to eliminate the defects. An adequate amount (10 %) of the remaining payments will be withheld until the defects have been eliminated and the payment forfeited should the defects not be eliminated following lapse of the timed action plan.

9.4 Failure

- In case of failure of the pre-acceptance, a new date at the earliest convenience will be agreed upon. The costs, such as additional travel expenses for MHUK employees, will be charged to the supplier.

- If the acceptance test shows that the delivered equipment has not been built according to contract, the supplier must request a repetition of the acceptance date within three months. All costs caused by this repetition will be charged to the supplier.

- If a repetition trial of acceptance is required and the contractual agreements are not fulfilled again because the guaranteed performance data are not achieved, the contract will be deemed unfulfilled. The supplier will be required to remove all equipment installed and make any affected area of MHUK plant good at their cost.

10 Training

A briefing and training of the operating and maintenance personnel has to be carried out by the supplier. Time and place should be clarified during negotiations.

The briefing has to be documented, a copy of which is to be delivered to the client.

11 Level of Availability

- The equipment is deemed to be available so long as it is ready for production without any restriction – no faults or damage occur which could adversely affect or prevent operation.
- The equipment is also deemed to be available if its operation is adversely affected for reasons outside the supplier's responsibility (failure of connected aggregates, tools, staff, material, electricity).
- The machine availability is guaranteed at 95% for each individual machine, per calendar month. Availability (technical usability, times for maintenance and inspection have not been included) shall be substantiated every 3 months from date of final acceptance until the warranty period expires. If this availability is not attained, the manufacturer shall be under an obligation to take all necessary technical action to ensure the contractually agreed level.

If this action proves unsuccessful, the guarantee period shall be extended by 3 months, for each 0.5-percentage points of shortfall, with a maximum of 12 months.

12 Warranty and Service

12.1 Warranty

- Duration of warranty is 5000h operating hours, however a maximum of 24 months and begins from the date the final acceptance form (WOL-EN-F-0003) has been fully signed and declared as satisfactorily completed.

- Final Acceptance will be concluded as soon as stable operating conditions exist i.e. there are no limitations, which would adversely affect production - including parts (without consumables) and labour, but at the latest six months after start up. Necessary travel time and travel costs are covered by the supplier.

- Warranty duration for spare parts is one year after delivery. Warranty times for supply parts which cannot remain in operation during revision and / or repair of defects will be extended by the period of interruption of operations.

- Risk transfer to MHUK, acceptance or the beginning of warranty time is not connected to the start of the trial run or any events during the trial run. The warranty period for repaired or newly delivered parts begins a new period at their delivery / repair – even if beyond the legal limitation.

- If damage to the equipment is caused by MHUK operating personnel after completion of their training, it will be the supplier's responsibility to prove that MHUK operating personnel have acted against their training and operating instructions. The supplier will bear any repair costs that cannot be proven to be the cause of MHUK personnel.

12.2 Service

Full service support from the supplier is required from the pre-production stage to introduction. The machine manufacturer grants the following service:

- Telephone support will be available immediately during normal (9-to-5) office hours.

- Commitment to support at 8 am next working day in normal circumstances, with every effort to support for urgent issues.

- Out of hours contact details will be made available in the machine manual for emergency contact.

- For the event that the service engineer is on holiday or off sick a private mobile number shall be made available to MHUK. Contact will be made with the project team within normal office hours and an engineer will be made available on the next working day.

Within the first two years from installation acceptance, a comprehensive service must be carried out according to the manufacturer's recommendation. This service is to be carried out alongside MHUK engineering personnel for the purposes of training. A service plan for the future is to be submitted upon completion

13 Appendices

13.1 Appendix 1 - Device selection list

If devices not included in the device selection list are used, written approval must be obtained from MANN+HUMMEL.

Device	Mandatory brand	Special requirement
Barcode hand scanner	Honeywell	
Batch counter	Hengstler	
Burner (gas,oil)	Weishaupt	
Bus systems	Siemens profibus	Agree choice of device with M+H
Cable channel	Hellerman / Betaduct / Schneider	
Camera	Sensopart / Balluff / Keyence	
Central lubrication	Vögele / Wörner / Vogel / Delimon	
Chain tensioning devices	Murtfeldt	
Circuit auxiliary contactor	Siemens / Schneider / Moeller	
Circuit breakers	Siemens / Schneider / Moeller	Casing design N. The auxiliary contact must also switch during manual operation
Circuit breakers for control circuits	Siemens / Schneider / Moeller	The auxiliary contact must also switch during manual operation
Code reader	Sick / Datalogic / Cognex	
Conveyor belts (assembly devices)	Interroll / MTF	
Conveyer belts (injection moulding machine)	UPM conveyors	
Command element signal lamps	Schneider / Siemens / Moeller	O22, if lockable: Siemens Zeiss Ikon 3600 12K1; Only use LED display lights
Cylinder (hydraulic)	Rexroth / Vickers	
Cylinder (pneumatic)	Festo / SMC	
Cylindrical position switcher	Festo / SMC	

Electro-sensitive protection systems (light curtains / light grid)	Sick / Sensopart / Balluff	
Elapsed time indicator		7 digits, non-resettable
Energy chain	Igus	
Electric power relay	Murr / Siemens / Schneider	
Electronic solenoid valve	Festo / SMC	with LED
End position switch, stop switch	Schmersall / Telemechanique / Moeller / Balluff	Standard casing, switch cotact
Gear motor	SEW / Bauer / Flender / Stoeber Demag / Getriebebau Nord ABUS / Heynau / Dietz / Danfoss	
Grnulate conveyor, dust filter	M+H Protec (any one but protec support is poor we have to pay upfront)	
HMI	Siemens	Full colour touch screen, min 6"
Indicator lamp stacks	Schneider / Siemens	Ø 70mm in LED technology, same order as traffic lights
Industrial PC	hp	Agree with MHUK, IT
Industrial relays	Schneider / Siemens / Moeller	
Initiators	Sensopart / Balluff / ifm	24 V DC PNP shutter, 220 V AC 2-wire design with LED display
Key, key switch	Shneider / Siemens / Moeller	
Laser (marker)	Technifor / Rofin / Keyence	
Leak testing device	Furness FC0750	
Light barrier	Sick / Sensopart / Balluff	
Linear conveyor	Weber	
Locks for electrical part	Rital	
Machine lighting	-	No striplights, non flickering lights, LED technology
Main switches	Eaton / Schneider	

Melting plugs	up to 25 A neozed D 01/D 02 from 35 A low voltage power fuses	only for special puropse, agree with M+H
Motor protection switch	Siemens / Schneider / Moeller	with bimetal and short circuit quick exchanger
Motors	Abb / AEG / Siemens deritend will supply motors if required	
Pumps, immersion pumps	KSB / Allweiler	
PLC, programmabe logic controller	Siemens	S7 (300 or 1200), screw connection
Residual current device / miniature circuit breaker	Siemens / Schneider / Moeller	5SU1354-6KK16
Robotics	Wittman	
Remote maintenance access	-	Confidential agreement, VPN access
Safety control	Pilz / Pnoz / Gaurdmaster	
Safety control for presses	Herion / Festo	
Safety end switches	Schmersal / Schneider / Siemens	
Safety end switches with personal protection function	Schmersal / Schneider / Siemens	
Safety rail	Schmersal / Schneider / Siemens	
Safety switching devices	Schmersal / Schneider / Siemens	
Safety terminals	Phoenix contact / Wago / Siemens	
Screw drivers	Desouter / Stoeger / Kolver	
Series terminals	Phoenix contact / Entralec / Weidmuller	min. Ø 6mm screw terminals
Servo motors	Bosch Rexroth	
Switch cabinet cooling/heating	-	Filter free fans supplied from RS components
Time relays	Siemens / Schneider / Pilz	electronic in the standard casing, no double-wire relay
Two-hand relay	Siemens / Schneider / Pilz	
Valves (electrical)	Parker / Rexroth	

Valves (hydraulic	Parker / Rexroth	
Valves (pneumatic)	Festo / SMC	