22. Machinery and Equipment

22.1 General

		Check-box
a.	Technical documentation, which is described under this article, and any other documentation necessary to assure efficient use and maintenance of the goods delivered, shall be supplied to Raufoss Technology in 2 copies at no extra cost. The Raufoss Technology project manager shall approve the proposed documentation before issuing the final version. The documentation shall be written in the locally used language where the machine is intended to be used to the extent required by the prevailing provisions. Data-sheets may be written in English.	
b.	Documentation and control system programs shall be delivered electronically in a suitable storage media in 1 copy in original format and pdf. Documentation in electronic format must be named and systematized so that it is easy to find documents.	
c.	Documentation shall be produced in accordance with EN/IEC standards. Components shall have the same identification number on electrical, hydraulic and pneumatic diagrams.	
d.	Machinery/equipment shall be built with electrical and mechanical components protected according to requirements adopted for the environment in which they will be installed.	
e.	Marking plates shall be in the locally used language where the machine is intended to be used. Quality of the markings must be such as to ensure proper use in the machinery/equipment's usual environment and cleaning with typical cleaning chemicals. An environment with oil/chemicals and particles that wear away printed labeling over time must be taken into account.	
f.	If the delivery involves use of materials/substances which can be of a health, environmental and/or fire hazard, the supplier is required to state this fact in the offer, mark the equipment accordingly, and provide the required safety data-sheets. These data sheets shall be written in the locally used language of the machine's intended place of use.	
g.	Machinery/equipment shall be painted in color(s) according to the agreement with Raufoss Technology.	
h.	The noise level (decibel) of the machinery/equipment shall be stated in the offer, and meet the requirements of the official authorities.	
i.	Weight of the machinery/equipment shall be marked on the identification plate, or alternatively on a separate plate fastened to the machinery/equipment.	
j.	Machinery shall be delivered with counter for strokes, operations, working hours and electrical energy. Meter for electric energy shall show the instant value, the cumulative consumption since last reset, and total consumption.	
k.	Documentation shall be in format A4, edited in a systematic manner and issued in stiff covers. Documentation to be sent to the Raufoss Technology project manager according to instructions in the purchase order.	
l.	The delivery of the machinery/equipment is not considered complete until Raufoss Technology Project Manager has received and approved all documentation.	
m.	For delivery of machines / equipment subject to the rules for explosive areas shall be agreed upon performance in each individual case. The delivery shall comply with the prevailing laws and regulations in relation to this.	
n.	Machinery/equipment shall be of such design that transport, installation, use and maintenance can take place without any hazard to life or health of personnel. Good ergonomic solutions for operation, maintenance and repair must be emphasized	
o.	Machinery/equipment shall be designed to be energy efficient and shall be delivered with energy saving possibilities, evaluation of the effect of the components/equipment, isolating of parts which is heated, There shall be a function to put the equipment in energy saving mode, i.e. electrical energy to motors, valves, lights, heating, etc. are broken and that the main valve for compressed air, cooling water, etc. is shut off. Equipment that has ramp down time, such as ovens, washing machines, etc. must have functions for automatic / timed stop and start and the "setback".	
p.	The machine / equipment shall be designed and built according to the metric measurement system. All data should be reported in metric dimensions	
q.	Expected repetition accuracy that is relevant for the equipment shall be stated in the offer	

22.2 Documentation prior to delivery

The following documentation shall be delivered as agreed upon prior to delivery of hardware

	Check-box
a. Production Progress Plan, which as a minimum contains design, safety review, fabricate and preliminary completion testing, training, assembly and final completion testing at Raufoss Technology, time of delivery of components/equipment from Raufoss Technology.	
b. Lay-out showing arrangement, access for operators, ergonomic, area requirement of the delivery and supply points for servicing the machinery with information on consumption data for electricity, compressed air, water, etc. as well as detailed description of the physical interface to Raufoss Technology and preferred sizes and types of pipes, cables, etc. Metric dimensions.	
c. Weight and volume for all items of the delivery, including sketches showing crane hoops and lifting points.	
d. Foundation drawings with all specifications including dynamic and static loads, if special foundation is required.	

22.3 Documentation to be delivered with the machinery/ equipment

	Check-box
a. The CE mark, Declaration of Conformity and other required documentation to meet the Machinery Directive	
b. User manual (in the locally used language of the machine's intended place of use) including	
- Safety lay out that shows operator area, main HMI's, safety devices and lock out/shut down points	
- Safety instructions for operations and maintenance	
- Detailed functional description of the machinery/equipment and how to operate the machine.	
- Trouble shooting instructions.	
c. Maintenance manual including	
- Instructions for maintenance carried out by the operators	
- Instructions for routine checks and preventive maintenance	
- Lubrication instruction including oil/grease type, quantity and filter for each lubrication point. Purity requirements for hydraulic fluids shall be considered according to the design.	
d. Mechanical drawings, in Original format and pdf (2D drawings also in Autocad compatible format):	
- Document and drawing list	
- Layout of positioning of cabinets, boxes, tableaux, valve devices and similar	
- Complete assembly drawings and parts lists.	
- Detail drawings for wear parts	
- Detailed drawings with accurate dimensions (production drawings) of all non-commercial components. The drawings of all non-commercial components will become Raufoss Technology AS property.	
- Sequence or functional diagrams	
e. Full constructive/functional 3D model of the equipment in original format, step format and pdf.	
f. Electrical diagrams:	
- Document and drawing list	
- Line diagram showing details for all circuits: main current circuits, control circuits, motor circuits, grounding, fieldbus	
- Terminal diagram with an external connection diagram and cable lists	
g. Complete Source Code for PLC, HMI, robots and other programmable equipment for use with development software. The programs shall be with explanation/comments in Norwegian or English language.	
h. IP-address overview	
i. Circuit diagrams for Pneumatics including parts list, listing type of component, pressure and peak consumption	
j. Circuit diagrams for Hydraulics including parts list, listing type of component, pressure and installed power.	
k. Complete list of all components covering the whole delivery including hydraulic, pneumatic and electrical equipment. For each component the following information must be specified:	
- Manufacturer, type, dimension, reference numbers used in the forms/drawings. Wear parts must be marked	
l. Recommendation of which spare parts to be held in stock by Raufoss Technology, assessed on the basis of the expected consumption of wearing parts and delivery time	
m. Necessary manuals/technical data sheets for setting, operation and maintenance of the equipment.	
n. Overview of all programmable and adjustable machine data after commissioning	
o. Calibration and mastering process of all control and monitoring functions for both operators and calibration personnel.	

22.3 Documentation to be delivered with the machinery/ equipment	Check-box
p. A report of performed FMEA analysis shall be delivered by the supplier.	
q. A report of performed repeat accuracy shall be provided on request.	
r. FE analysis of main structures, e.g. press bodies, hydraulics and main cylinder.	
s. A copy of the Risk Assessment must be provided with the documentation.	

22.4 Technical requirements for hydraulic and pneumatic equipment	Check-box
a. Oil containers must have an easy available hatch to allow cleaning/draining. Several hatches required for larger multiple section containers. Hatches to be opened without disassembling other equipment.	
b. The sump of the oil container shall be inclined towards a draining basin with a tap.	
c. The pump/motor or valve on a tank lid must enable assembly/disassembly of heating element and thermostat without emptying the tank.	
d. Critical valves shall be interlocked with a pump motor.	
e. Hydraulic designs:	
- All equipment shall have oil and breathing filters of good quality and large capacity. Oil filters shall normally filter the oil in the return pipe or by a separate filter circuit and have a protection valve for overpressure. Filters shall have a warning for blocked filters. The necessity of automatic stop at blocked filters must be evaluated in each case.	
- Guiding water for cooling hydraulic aggregates shall be agreed upon in each case. The need for heating of oil shall be agreed in each case.	
- Hydraulic aggregates shall be fitted with visual level readings as well as electrically controlled level and temperature surveillance to enable shut down of the pump and provide an alarm when the level is too low or at excessive temperatures.	
- Hydraulic general working pressure 250 bar, max pressure 300 bar	
- Avoid use of couplings. Use complete pipes, flanges or equal. Elbows with Cutting rings shall not be used for permanent pipe systems (pipes shall have bends).	
- Pipes must be fastened in such a way that they will not be weakened/inflict stress damages. When needed, it must be used flexible adapters between moving parts.	
- Pipes/hoses shall be protected in order to eliminate personnel injuries from splashes or strokes due to a collapse of pipes/hoses. Hoses in areas where people is operating while the system is under pressure must have safety devices against moving of the hose when breakage, such as secured by wire.	
- Hoses in areas where a leakage can lead to oil on hot surfaces shall be protected by a double barrier e.g. “hose in hose” system, protection/cover to lead the leakage away from the hot surfaces or similar	
- The total hydraulic systems in hot tools shall have a double barrier protection against oil splash on hot surfaces.	
- Hydraulic units shall have checkpoints for testing various pressure levels, functions and sampling of oil tests.	
- Rapid coupling type TEMA 5000 ½” for external filtering circuit with inlet/outlet beneath the oil level.	
f. Pneumatic designs:	
- Components for power transmission shall be dimensioned for a pressure of 5 bars and be tested at minimum 10 bar.	
- Pneumatic direction valves and hose rupture valves on cylinder shall be considered based upon operational requirements and requirements for safety shall be taken into account.	
- Systems shall be fitted with an air-conditioning unit, normally with a lockable shut-off tap, integrated electric powered exhaust air valve and soft start.	
- Pressure switches must have readings of real pressure	
- All equipment shall be in metric dimensions	
- For vacuum circuits components and fitting designed for vacuum shall be used. Vacuum pumps shall be evaluated against ejectors with respect to energy consumption	
g. For hydraulic/pneumatic components the following manufacturing types are preferred:	

Equipment hydraulic:	**Manufacturer/type:**	
Aggregates, pumps	Rexroth, Dennison, Parker	
Valves, Cylinders	Vickers, Rexroth, Parker	
Filters	Standardized filter	

Equipment pneumatic:	**Manufacturer/type:**	
General pneumatic equipment	Festo, SMC, Bosch	

22.4 Technical requirements for hydraulic and pneumatic equipment

		Check-box
Grippers	Schunk, Festo	
Ejectors / Suction cups	Piab, Smaltz	
Rapid gripper change	Schunk, RSP. Type to be agreed upon in each case	

Equipment not stated above must be approved by Raufoss Technology prior to use. Technical data-sheets/manuals shall be attached to the documentation	

22.5 Technical requirements for electrical equipment

	Check-box
a. Machinery/equipment shall be CE-marked, and satisfy prevailing local law provisions. The machinery/equipment shall meet the potential loads.	
b. Electrical power supply shall be EN/IEC adopted for a 3-phase distribution system, TN-S, 400 V +/-10%, 50Hz. A national Norwegian requirement is disconnection of the Neutral conductor in switches/circuit breakers and the requirement for fuses in the Neutral conductor.	
c. Control circuit current shall be transformed from 400 to 230 VAC and 24 VDC. Voltage supply 24 VDC shall be stabilized and short-circuit proof.	
Solenoid valves shall have solenoids for 24 VDC with transient protection and light emitting diodes.	
d. Motors must meet the EN/IEC standards and be as energy efficient as possible	
e. Cabinets must satisfy the following requirements:	
- The installation inside the cabinet must be touch-proof (IP2x).	
- External lockable main switch.	
- If special conditions does not imply that the door shall be interlocked towards main switch, it must be possible to open the cabinet without shutting off the main switch.	
- An inside light. The light shall work when the main switch is off	
- An outlet for equipment used for programming	
- Cabinet must have an option of a 25% expansion.	
- Internal cables to be placed in slotted panel trunkings with cover plates.	
- Warning of fuse failure	
- Emergency stop switch, safety circuit, and 2-hand start switch shall satisfy the requirements in relevant safety category after risk assessment according to the Machinery Directive.	
- Cooling unit with filter or fan with filter and thermostat.	
- Components in cabinet to be marked in accordance with electrical diagram.	
- Operating switches to be marked with engraved letters on plates, black letters on white background. All marking shall be written in the locally used language of the machine's intended use.	
- Components on machinery to be marked in accordance with the electrical diagram by marking the supply cable of the component.	
- Multi-leads and supply cables marked according to electrical diagram.	
- All cables marked in both ends using durable marking equipment that will survive external exposure in the environment it is meant for.	
f. Safety instructions for securing machinery/equipment shall be presented to Raufoss Technology.	
g. Input and output signals shall normally be 24V DC. All machinery/equipment movements shall have a positioning sensor. The control system shall monitor positioning signal also when unactivated. Operations that are cycle-related shall not be designed as function of time.	
h. Signal lamps shall be LED and have lamp-test function.	
i. Sensors shall have indication by LED.	
j. Components on the machine shall be marked according electric diagrams by marking of the supply cable at the component. Multi conductors and supply cables shall be marked according to electric diagram. All cables shall be marked in both ends with permanent marking that withstands intended operational environment. An environment with oil/chemicals and particles that wear away printed labeling over time must be taken into account.	
k. Cables and components that may be exposed to mechanical damage shall be properly protected. Special attention must be made to equipment installed at a lower level than 0,8m above floor/walking area and in areas where personnel might step on machinery parts during cleaning, maintenance and repair.	

22.5 Technical requirements for electrical equipment

	Check-box
l. Cables must be placed and mounted permanently and directly on the base, in pipes, in channels or on cable rails/bridges. Use of self-adhesive mounting without using screws or tie-wraps directly on the safety fence is not acceptable. Open mesh trays ("trådbruer") shall be avoided.	
m. Thermocouple Type K. For temperatures below 100 degr C PT100 sensors can be used. All sensors for temperature in equipment with CQI9 process requirement must be calibrated.	
n. For electrical components the following manufacturing types shall be used:	

Component:	Manufacturer/type:	Check-box
PLC's	Siemens S7 1200/1500 series	
HMI-panel	Siemens	
Distributed I/O (pure I/O modules)	Siemens, Festo, Murrelektronik, Beckhoff. To be agreed upon with Raufoss Technology	
Bus-systems	Profinet	
Electric servo systems	Siemens, Festo, Bosch Rexroth To be agreed upon with Raufoss Technology	
Frequency Converter	Siemens	
Robots	ABB	
Control cabinet	Rittal	
DC supply unit	Siemens, Murrelektronik	
Main swithch (with fuse function)	Siemens, Schneider	
Automatic fuses	Siemens, Schneider	
Motor protection switch	Siemens, Schneider	
Contactor breaker	Siemens, Schneider	
Auxiliary relay	Siemens	
Interface relay ("Rekkeklemmerele")	Murrelektronik, Omron	
Safety relay	Schmersal, Pilz. Main part of the safety should be integrated in the PLC	
Safety switch (gate switch)	Schmersal, Siemens	
Protective light curtain	Sick	
Operating switch/signal lamps	Schneider, Siemens, ø22mm, 24V DC LED	
Photocell	Sick	
Fibre-optic	Sick, Omron	
Proximity limit switch (mec. Limit switch)	Schneider	
Ultrasonic initiators	To be agreed upon in each case	
Initiators	To be agreed upon in each case	
Bar code / DMC reader	To be agreed upon in each case	
Contact material	Harting	
Temperature regulator	To be agreed upon in each case	
Thyristor / Solid State Relays	To be agreed upon in each case	
Heating elements	Supplier: MRC Global (400V)	
Load cell	HBM	
Pressure transmitter	Danfoss, Turck, 4-20mA or Profinet	
Vision sensors	Cognex	
Vision systems	To be agreed upon in each case	
Encoders	To be agreed upon in each case	
LVDT	To be agreed upon in each case	

22.6 Electrical heating systems

	Check-box
- Regulation shall be controlled by thyristor units, not contactors	

22.7 Programmable control/data equipment	Check-box
Type of control systems, HMI panels, PC equipment, etc. for machinery/ equipment must be approved by Raufoss Technology. Following data to be presented and requirements to be met, and delivery to be agreed upon with Raufoss Technology:	
a. Control system	
- Brand, series/types and data.	
- Brand, of motor drive system, series/types and data for each axes.	
- Brand, type and data for positioning transducer system.	
b. Data equipment/communication/printers	
- Control system must communicate with Raufoss Technology's data collection system via Ethernet. Data, interface and protocol must be agreed in each case.	
- All special software used in the machinery/equipment shall be delivered with manuals and licenses, where licenses are registered on Raufoss Technology.	
- IP addresses to be agreed upon. Raufoss Technology has a global IP address range	
c. Power supply	
- To be controlled according to EMC regulation with protection against variations in current, excessive current, and take care of noise immunity. The need for uninterruptable power supply must be assessed (ref. article 22.5c).	
d. Programming	
- Programming equipment, software, system program memory, program for use and processing data to be clarified with Raufoss Technology. Standard computer software is Windows. All software necessary shall be described, Raufoss Technology's use, troubleshooting and programming taken into account. Complete documentation and source code on electronic storage media must be included.	

23. Additional requirements for machinery / equipment for use in explosive areas

23.1 See paragraph 22.1 m

24. Additional Warranty

24.1 The supplier warrants that the delivery in all respect, including design, performance and function, is in accordance with the purchase order and meet Raufoss Technology's expectations. Machinery/ equipment must be of such design that risk of accidents, unexpected loadings and damage to life and health will not occur. Safety precautions shall be reviewed with Raufoss Technology. The supplier further warrants that only first class material have been used, and that the workmanship is of highest professional standard. Stability, repeat accuracy, capacity and technical accuracy shall meet the specifications and expected requirements (availability and efficiency rate, or similar. The above mentioned information needs to be documented by an inspection report to be agreed upon by Raufoss Technology.

24.2 The conditions contained in the General Conditions of Purchase article 14 – Warranty, are applicable to article 24.1

24.3 The Additional Warranty herein stated is in addition to General Conditions of Purchase, and shall not in any way limit warranties and indemnification in accordance with article 14 and 18 in the General Conditions of Purchase.

25. Secrecy/utilization of drawings, specifications etc.

25.1 Drawings, specifications and other data that the supplier receives from Raufoss Technology shall not be shown to any third party or in any other way benefit others than Raufoss Technology without the prior written consent from Raufoss Technology.

25.2 If Raufoss Technology has participated in developing the machinery/equipment in form of ideas, know-how, construction work, testing etc, the supplier is obliged to keep the construction and operational details of the machinery/equipment confidential. Raufoss' contribution should also be kept confidential for a period of 3 – three – years from delivery. Nor can the supplier use any of this information for his own benefit, which, according to the above, shall be kept confidential without prior written consent by Raufoss Technology

25.3 If machinery/equipment is made in accordance with drawings, specifications etc. prepared by Raufoss Technology, the supplier shall independently evaluate the material received, and immediately notify Raufoss Technology of any circumstances which based on his professional experience and insight will make the machinery/equipment unfit or less suitable for the intended purpose.

26 General Conditions of Purchase

The Additions to General Conditions of Purchase, articles 22 to 26, shall not in any way limit the validity of the General Conditions of Purchase.