22. Machinery and Equipment

22.1 General

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. Computerised documentation and guiding system programs shall be delivered electronically in a suitable storage media in 2 copies.

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 and defect warnings 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.

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 colour(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.

o. Machinery/equipment 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, ie 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 and 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

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 form 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 specifications if special foundation is required.

22.3 Documentation to be delivered with the machinery/ equipment

a. The CE mark, Declaration of Conformity and other required documentation to meet the Machine 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 MMI's, safety devices and lock- and shut down points
- Description of the machinery/equipment and a manual for operating the machine.
- Operational instructions and defect-search list.
c. Maintenance instructions for the operator(s) and preventive maintenance instructions.
d. For mechanical operations:
- Layout of positioning of cabinets, boxes, tableaux, valve devices and similar
- Complete assembly drawings and parts lists.
- Detail drawing for wear parts
- Detailed drawings with accurate dimensions (production drawings) for all manufactured components
- Forms and bills of material for pneumatic and / or hydraulic systems
- Sequence or functional diagrams
e. For electrical operations:
- Line diagram that shows all the circuits detailed, control circuit for the main current the control current motor circuits, grounding, fieldbus
- Cable terminal diagram with an external connection diagram and/or cable lists
- Computer programs with comments according to agreement in each case.
- Complete source code with all comments for development tool for PLC programs, MMI panels, robots and other programmable equipment in a suitable electronic storage media.

22.3 Description of programme design

a. Lubrication instruction including oil/grease type, quantity and filter for each lubrication point to be specified on Raufoss Technology's standard lubricant form. Purity requirements for hydraulic fluids shall be considered according to the design.
b. Complete list of all components covering the whole delivery including hydraulic, pneumatic and electrical equipment. For each component the following information must be given:
- Manufacturer, type, dimension, reference numbers used in the forms/drawings. Wear parts must be marked
c. 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
d. Necessary manuals/technical data sheets for setting, operation and maintenance for the equipment..
e. Overview of all programs and data used for operating the machine after start-up.
f. Calibration and mastering process of all control and surveillance functions for both operators and calibration personnel.
g. A report of performed FMEA analysis shall be delivered by the supplier.
h. A report of performed repeat accuracy shall be provided on request.

22.4 Technical requirements for hydraulic and pneumatic equipment

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.
- Equal elbows 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.
- 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.
- Hydraulic direction valves shall normally be of a 3-position type with shut-off in the middle position.
- Hydraulic clamp functions shall have a hydraulic lock and a 3-position valve with open A-B-T in mid position.
- 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.

g. All hydraulic and pneumatic valves that are electrically controlled shall be fitted with transient protection and light diode indication.

h. Pipes/hoses shall be protected in order to eliminate personnel injuries from splashes or strokes due to a collapse of pipes/hoses. Avoid use of couplings. Use complete pipes, flanges or equal.

i. For hydraulic/pneumatic components the following manufacturing types are preferred:

Equipment hydraulic:	**Manufacturer/type:**
Aggregates, pumps	Rexroth, Dennison, Inline
Valves, Cylinders	Vickers, Rexroth, Parker
Pressure switches	Must have readings of real pressure
Filters	Pall, Hydac, Mahle, Lekang

Equipment pneumatic:	**Manufacturer/type:**
Pressure switches	Festo, SMC
Valves, cylinders etc	Festo, Rexroth SMC
Vacuum valves	Festo, SMC
Fittings/hoses	SMC, Festo
Holders	Schunk, Festo
Air equipment	Festo
Ejectors	Piab, Smaltz
Suction cups	Piab, Smaltz

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

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.

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.

On guiding systems/units with battery back-up at power failure the battery's mark and type as well as data for capacity and replacement intervals shall be stated. Descriptions for change of battery shall also be stated.

d. Motors must meet the EN/IEC standards

e. Cabinets must satisfy the following requirements:

- The installation 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 dismantle the voltage.
- An inside light when agreed upon.
- An outlet for equipment used for programming
- Cabinet must have an option of a 25% expansion.
- Internal cables to be placed in circuit channels 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 "maskindirektivet" (machine directory).
- Fan with filter and thermostat, possibly cooling unit if necessary.
- 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.
- If necessary, place a fan with thermostat inside the cabinet.
- 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. Input and output components to be marked with numbers according to the marking of the control system's signal number. All machinery/equipment movements shall have a printout from a positioning sensor. The control system shall monitor positioning signal also when unmanned. Operations that are cycle-related shall not be designed as function of time. Lamps shall have lamp-test function.

h. Signalers/sensors shall have indication by LED.

i. 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.

j. 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.

k. 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 strips directly on the safety fence is not acceptable. Open "trådbruer" shall be avoided.

I. For electrical components the following manufacturing types shall be used:

Component	Manufacturer/type
PLS-controls	Siemens S7 300/400 series
OP-panel	Siemens, Pro Face
Distr.I/O (pure I/O modules)	Siemens
Bus-systems	Profibus, Profinet, ASi
Electric servo systems	Bosch Rexroth, Siemens
Frequency Converter	Danfoss, Siemens
Robots	ABB, Kuka
Control cabinet	Rittal
DC supply unit	Siemens, Murrelektronik
Main swithch(with fuse function)	Moeller, Telemecanique, Siemens
Automatic fuses	Siemens, MG
Motor protection swithch	Siemens, Telemecanique, MG
Contactor breaker	Siemens, Telemecanique
Secondary relay	Siemens, Telemecanique
Safety gate relay block	Murrelektronik, Omron
Safety relay	Jokab, Schmersal, Pilz
Safety switch (gate switch)	Telemecanique, Schmersal
Protective light curtain	Sick
Operating switch/signal lamps	Telemecanique, ø22mm, LED
Photocell	Sick
Fibre-optic	Sick, Omron
Proximity limit switch (mec. Limit switch)	Telemecanique
Ultrasonic initiators	Pepperl+Fuchs
Initiators	Standard design (PNP, preferably with connector)
Stress code reader	Sick
Contact material	Harting, HTS
Temperature regulator	Eurotherm
Thyristor	Eurotherm
Heating elements	Suppliers: Backer, Teck, ProxII
Temperature sensor	Teck, Danfoss, Type K, PT100
Load cell	HBM
Pressure transmitter	Danfoss, Turck, 4-20mA

22.6 Electrical ovens and heat exchangers

Regulation of output shall be controlled by thyristor units when using regulators with great adjustment intervals. Safety or excessive heat control shall disrupt output by means of a separate contact switch. Regulating device must communicate with higher level systems. Protocol must be agreed with Raufoss Technology in each case

22.7 Programmable control/data equipment

Type of control systems, MMI 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 IT-department:

a. Control system

- Mark, series/types and data.
- Mark, of motor drive system, series/types and data for each axes.
- Mark, type and data for positioning transducer system.
- Control system that is about to be taking out or being replaced by new equipment must not be used without special approval from Raufoss Technology.

b. Data equipment/communication/data prints

- Control system must communicate with Raufoss Technology's data collection system, preferably 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 licences are registered on Raufoss Technology.

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 programme memory, programme 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 on electronic storage media must be included. Possibilities for defect tracing must be described as well.

e. Training

- Service possibilities by agent or producer.
- Warranty for service, know-how, components, spare parts, and how to store spare parts at Raufoss Technology shall be stated.
- Training of operators and maintenance personnel in use of data system shall be stated.

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

23.1 See para. 22.1 m

24. Additional Warranty

23.2 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.

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

23.4 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.

GENERAL CONDITIONS OF PURCHASE

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.