

ST 12 MM0006 Technical Specification for Hydraulics, Central Oil Lubrication, and Pneumatics

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1 General

1.1 Field of application

This specification is relevant for hydraulic, central oil lubrication and pneumatic systems within machine or unit deliveries or as specific deliveries or modifications.

This technical specification sets the minimum requirements for the systems.

1.2 Laws and regulations

All design and manufacturing shall be based on the ISO, IEC, EN and DIN standards and to essential safety requirements of European directives. Local laws, safety codes and instructions of the local authorities and the Purchaser shall be followed.

Machinery and equipment deliveries shall include EC Declaration of conformity for machinery document signed by the manufacturer. Machinery and equipment shall be CE marked.

The Supplier shall be responsible for the complete machinery delivered.

1.3 Deviations and alternatives

Any deviations to this specification shall be approved by Purchaser.

2 Reference standards

ST 04 MG0001	General Mill Standards
ST 04 MG0002	Units to be used
ST 13 MM0001	Technical Specification for Piping
ST 13 MM0002	Piping Standards
ST 50 MM0003	Technical Specification for Pressure Equipment
ST 16 MM0004	Technical Specification for Surface Treatment and Painting-Metallic Surfaces
ST 14 MM0005	Technical Specification for Thermal Insulation
ST 20 MEIA0001	Electrical, Automation, and Instrumentation Instructions for Machine Deliveries
2006/42/EC	Machinery Directive (MD)
2014/68/EU	Pressure Equipment Directive (PED)
2014/29/EU	Simple pressure vessel directive
2014/34/EU	Equipment for Potentially Explosive Atmospheres Directive (ATEX)
2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	Electromagnetic Compatibility Directive (EMC)
ISO 3448	Industrial liquid lubricants — ISO viscosity classification
ISO 4406	Hydraulic fluid power -- Fluids -- Method for coding the level of contamination by solid particles
ISO 6020-1	Hydraulic fluid power. Single rod cylinders. Mounting dimensions. 160 bar series. Part 1: Medium series
ISO 6020-2	Hydraulic fluid power — Mounting dimensions for single rod cylinders, 16 MPa (160 bar) series — Part 2: Compact series
ISO 6022	Hydraulic fluid power. Single rod cylinders. Mounting dimensions. 250 bar series.
EN 853	Rubber hoses and hose assemblies. Wire braid reinforced hydraulic type.
EN 856	Rubber hoses and hose assemblies. Rubber-covered spiral wire reinforced hydraulic type.
EN 857	Rubber hoses and hose assemblies - Wire braid reinforced compact type for hydraulic applications
ISO 12151-1	Connections for hydraulic fluid power and general use — Hose fittings — Part 1: Hose fittings with ISO 8434-3 O-ring face seal ends
ISO 12151-2	Connections for hydraulic fluid power and general use — Hose fittings — Part 2: Hose fittings with ISO 8434-1 and ISO 8434-4 24 degree cone connector ends with O-rings

ISO 12151-3	Connections for hydraulic fluid power and general use — Hose fittings — Part 3: Hose fittings with ISO 6162-1 or ISO 6162-2 flange ends
EN 10216	Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
EN 10305-4	Steel tubes for precision applications. Technical delivery conditions. Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems
ISO 8434-1	Metallic tube connections for fluid power and general use — Part 1: 24° cone connectors
ISO 6162-1	Hydraulic fluid power -- Flange connections with split or one-piece flange clamps and metric or inch screws -- Part 1: Flange connectors, ports and mounting surfaces for use at pressures of 3,5 MPa (35 bar) to 35 MPa (350 bar), DN 13 to DN 127
DIN 2353	Non-soldering compression fittings with cutting ring - Complete fittings and survey
EN 1012-1	Compressor and vacuum pumps. Safety requirements. Part 1: Air compressors
ISO 1217	Displacement compressors — Acceptance tests
ISO 8673-1	Compressed air — Part 1: Contaminants and purity classes

3 Basic design

The entire system shall be designed leak-free.

3.1 Operation and life cycle criteria

3.2 Design and layout for operation and maintenance

All equipment shall be designed for easy maintenance and inspection. The required maintenance space shall be stated and delivered in documentation, e.g. in general arrangement drawings, taking into account lifting and repairs that may be required. Minimum 800 mm around main equipment units, which require service and operation shall be reserved. Main equipment maintenance shall be possible without disassembly of other equipment.

The Supplier shall define all required maintenance activities and intervals to assure the equipment's reliability and availability.

Maintenance and repairs shall preferably be able to be executed without special tools. If special tools are required, it shall be stated and quoted or included in the delivery.

Inspections and maintenance to be done during the operation/running of the equipment shall be made possible, e.g. visual instruments and oil fill and drain connections shall be easily accessible and identified, without compromising the equipment operation.

Special fire protection instructions for equipment design and layouts shall be followed if applicable. See MG0001 Appendix II – Mondi Fire Protection Code.

3.3 Safety

Emergency shut-down push buttons shall drive actuators and the system to safe position.

In case of power failure the actuators shall stay put (load holding) or move to safe position.

Pipe and hose break shall be taken into account in the design of the system and safety equipment. Measures to prevent injuries shall be applied accordingly.

Pressure equipment and systems shall be equipped with pressure relief valves or similar safety devices.

It shall be possible to isolate systems and/or part of the system safely from the rest of the process for maintenance purpose.

In case above listed safety requirements are in contradiction with Suppliers safety design, the Supplier shall inform Mondi in advance and ask for an approval of different requirements.

3.4 Units

Units to be used are specified in "MG0002 Units to be used"

3.5 Piping

According to MM0001 Technical Specification for Piping, MM0002 Piping Standards or this specification, where applicable.

3.6 Electrical, instrumentation and automation

According to MEIA0001 Electrical, Automation, and Instrumentation Instructions for Machine Deliveries

3.7 Surface treatment

Surface treatment according to MM0004 Technical Specification for Surface Treatment and Painting-Metallic Surfaces.

Series-produced products (such as electric motors, electric cabinets, valves, actuators etc) shall be delivered painted in accordance with the manufacturers painting system unless specified in the enquiry documents.

3.8 Equipment nameplates

Minimum according to 2006/42/EC Machinery Directive (MD), but also mill standards shall be taken into account.

3.9 Documentation

According to the mill standard.

4 Hydraulic systems

4.1 General

Parallel operation of the heating and the cooling must be prevented in systems.

4.1.1 Hydraulic oil

Supplier shall inform the hydraulic oil and oil properties to be used, taking into account the application and specified conditions and components used.

Mineral, synthetic, and/or environmental acceptable hydraulic oil shall be defined. Viscosity class ISO 3448 shall be defined taking the low temperature start-up and all other conditions into account.

The Supplier shall ensure that all components are suitable for the selected oil.

4.2 Filtration and Cleanliness

System filtration must be designed so, that cleanliness level determined by the component suppliers and the end-user are fulfilled.

Minimum cleanliness level according to ISO 4406 shall be:

- Servo systems: 18/13/10
- Proportional systems: 20/15/12
- Other systems: 22/15/16

Depending on the cleanliness requirements and the construction of the system, following filtration methods can be chosen to be used or part of these:

- work filtration (tank circulation filters, off-line filters and return filters)
- protection filtration (pressure filters)
- air breather filtration

Hydraulic system shall preferably be equipped with filtration in both the pressure line and return line: pressure and return filters.

the filters shall be duplex-type, to ensure filter cartridge change during operation. The filter shall be equipped with pressure differential gauge.

Oil tanks shall be equipped with breather cap or separate air breather filters, according to needed max. flow rate.

4.3 Power units

Power units shall be connected to the piping via shut-off valves and flexible hose connections.

A quick connector for pressure measurement shall be provided in the vicinity of each pressure limiting valve or pressure switch, pressure regulator, flow control valve and pump.

Power units shall be equipped with:

- two-compartment arrangement in bigger units
- filling connection
- desiccant breather
- basin for catching fluid leakage, the bottom of which is at least 200 mm above the floor
- level indicator and transmitter
- pressure indicator and transmitter for relevant pressures

- temperature indicator and transmitter
- heating or cooling, if necessary, with a suitable controller

Hydraulic units located in the field shall be of enclosed design and, if necessary, also sound insulated. Power units located in the hydraulic rooms shall be of open construction type.

Hydraulic power units shall always be provided with a sufficiently large spill containment pan to prevent oil from spreading into the environment. The min. capacity of the pan shall be 1.3 x system oil capacity. The pan shall be equipped with drain valve. All the components shall be located inside the pan.

The material of the spill containment pan shall be stainless steel. Also, painted carbon steel and concrete lined with stainless steel can be used for special cases, if agreed.

Hydraulic power units shall be located as close to the application in question as possible.

4.4 Hydraulic rooms

Hydraulic systems may be placed in hydraulic rooms. Preferred for large systems, volume over 500 liters.

Adequate layout for operation and maintenance shall be taken into account.

Hydraulic rooms must be equipped with an exhaust fan.

4.5 Hydraulic system components

All components of hydraulic system have attached tags (equipment numbering) according to hydraulic diagram.

4.5.1 Oil tanks

The oil tank shall be equipped with at least:

- a cleaning hatch
- drain valve at lowest point
- air breather filtration (desiccant breather)
- connections nozzles for off-line (by-pass) filtration unit.
- level indicator and transmitter
- temperature indicator and transmitter
- oil sampling connection

Oil tank volume shall be adequate to allow the free air in the return flow to release. The external oil volume must be taken into consideration: the tank must have capacity for the oil located in actuators, pipe lines, accumulators valves and other hydraulic components.

4.5.2 Pumps

Pump type shall be chosen by taking into consideration technical requirements and operating conditions.

4.5.3 Hydraulic motors

The motor type shall be chosen by taking into consideration technical requirements and operating conditions.

4.5.4 Cylinders

Standard cylinders shall be preferred according to ISO 6020-1/2 and/or ISO 6022, if not otherwise agreed.

4.5.5 Valves and valve assemblies

Valve assemblies shall be made by using assembly plates and/or manifolds. Valves to be installed shall be grouped according to functions. Pipe outlets of the valve groups are mainly led straight from the manifold or multi-station manifold through the shutoff valve to the piping.

Valve assemblies shall be equipped with drip pan below.

Control valve shall be used if possible. Thermostatic valves are not preferred.

Drain valves shall be equipped with end plug. Minimum 300 mm of space shall be reserved below the drain valve so the tank or equipment can be emptied through the drain valve.

4.5.6 Filters

Filters shall be preferably be provided for both return and pressure lines.

Filters shall be equipped with pressure difference indicator and transmitter.

Duplex filter arrangement shall be used and/or bypass, for filter switch-over and service during operation.

4.5.7 Coolers

If cooler is needed in the system, it shall be equipped with isolation valves, filter for impurities in oil and by-pass to ensure maintenance during operation.

Water coolers shall be plate heat exchangers or straight tube heat exchangers.

Control valve is preferred over thermostatic valve for coolers.

4.5.8 Heaters

Surface power of electrical heaters shall not degrade or damage the oil quality (as guideline: surface power not to exceed 1,0 W/cm²).

4.5.9 Accumulators

Pressure accumulators have to be equipped with safety devices required by PED and local regulation.

Accumulators shall be installed vertically.

System shall be equipped with warning signs for the pressure accumulator.

4.6 Hoses

Standard hoses shall be used and the amount of sizes and lengths shall be minimized whenever possible. Hoses shall be according to SAE 100 R, EN 853, EN 856, and/or EN 857

Hose fittings shall be according to ISO 12151-1/3.

For detailed specification check Appendix II.

4.7 Pipes

Symmetric piping and hose assemblies shall be used in systems where simultaneous operation is required.

Hydraulic piping below DN35 shall be manufactured of CrNi stainless steel (EN 1.4307) and CrNiMo stainless steel (EN 1.4404) according to EN 10216-5. Above DN35 EN 10305-4 carbon steel pipes shall be used, painted outside if otherwise not agreed.

For detailed specification check Appendix II.

4.8 Pipe Fittings

Pipe fittings shall be progressive ring fittings according to EN ISO 8434 series S up to pipe size 38 mm, when the pressure is ≤ 160 bar, and series L up to pipe size 42 mm.

Pipe fittings shall be flange fittings according to ISO 6162, when the pipe size > 25 mm and pressure > 160 bar. Also applicable when the pipe size is > 42 mm.

Compression ring fittings to DIN 2353, heavy-duty series. Material of fittings shall match the pipe material.

4.9 Inspection and testing

Supplier shall deliver an inspection and test plan (ITP) for Purchaser's approval.

Power units, devices and valve stations shall be tested by the Supplier and report shall be delivered.

It shall be jointly agreed how and by whom the system shall be site inspected, flushed and filtered for cleanliness.

Leak freeness of the system shall be verified in start-up and acceptance test at reception after reaching the normal operation of the system.

5 Central Oil Lubrication

5.1 General

Redundancy shall be implemented in the system design for critical lubrication applications.

The requirements set by the lubricated equipment shall be followed in the system design,

The lubrication system shall be presented in lubrication diagram. All components of the system have attached tags (equipment numbering) according to the diagram.

All lubrication points shall be specified with the requirements: lubrication type, quality, amount and lubrication interval.

Lubrication function (for each lube point), oil quality and system integrity shall be monitored with adequate instrumentation.

5.2 Oil quality

Supplier shall inform the lubrication oil to be used taking into account the application and specified conditions and components used.

Mineral, synthetic, and/or environmental acceptable lubrication oil shall be defined. Viscosity class ISO 3448 shall be defined taking the low temperature start-up and all other conditions into account.

The Supplier shall ensure that all components are suitable for the selected oil.

Specification for pre-filtering of the oil shall be given by the supplier.

Minimum cleanliness level according to ISO 4406 shall be stated.

5.3 Lubrication unit

5.3.1 Oil reservoir

The oil reservoir filling interval shall be specified. Preferably re-filling shall be longer than 1 week.

The reservoir, if not standard oil barrel, shall be equipped:

- a cleaning hatch
- drain valve at lowest point
- air breather filtration (desiccant breather)
- level indicator and transmitter
- temperature indicator and transmitter
- oil sampling connection
- heater, if needed.
- Connection for filtration unit – bypass
- Water separation unit with dewatering function
- Tank has to be installed above floor for water separation unit installation

5.3.2 Pumps

Pump type shall be chosen by taking into consideration technical requirements and operating conditions.

For critical application a spare pump shall be installed.

5.3.3 Filters

Filters shall be preferably be provided for both return and pressure lines.

Filters shall be equipped with pressure difference indicator and transmitter.

Duplex filter arrangement shall be used and/or bypass, for filter switch-over and service during operation.

5.4 Piping

Symmetric piping and hose assemblies shall be used in systems where simultaneous operation is required.

Piping below DN35 shall be manufactured of CrNi stainless steel (EN 1.4307) and CrNiMo stainless steel (EN 1.4404) according to EN 10216-5. Above DN35 EN 10305-4 carbon steel pipes shall be used, painted outside if otherwise not agreed.

The piping (common lubrication line) shall be equipped with pressure measurement and transmitter for monitoring the system.

For detailed specification check Appendix II.

5.5 Valves and distributors

All lubrication points shall be equipped with a distributor and indication that the lubrication is working properly. Monitoring or fault detect shall be possible for each equipment and lubrication point.

5.6 Inspection and testing

Supplier shall deliver an inspection and test plan (ITP) for Purchaser's approval.

System functional test shall be performed at site, if not otherwise agreed.

Flushing and filtering for cleanliness of the systems shall be jointly agreed how and by whom it will be done.

6 Pneumatic systems

6.1 General

Supplier shall deliver a pneumatic diagram of the complete system. All components of the system have attached tags (equipment numbering).

Adequate layout for operation and maintenance shall be taken into account in the system design.

6.2 Compressed air purity class

Supplier shall state air purity class according to ISO 8673-1 for particulates, water and oil, which shall be determined based on environmental conditions and the requirement from the pneumatic system components.

6.3 Air compression units

Preferably air compression system shall be supplied as a complete package, including compressors, separators, filters and dryers, as well as the control and monitoring of the complete unit.

6.3.1 Compressors

Air compressors shall be delivered as complete units, with all necessary auxiliary equipment and components. Compressor type shall be selected according to specified operation conditions.

Dry or oil lubricated compressors may be used depending on the application.

Compressors shall preferably be controlled based on actual air demand and pressure.

All safety features shall be included.

Air compressors shall comply with EN 1012-1 safety requirements. The capacity tested according to ISO 1217 for displacement compressors.

If applicable, the compressors shall be delivered with in sound proof cabinets.

6.3.2 Water and oil separators

Water and oil separators shall be integrated in the compressor or as stand-alone equipment.

6.3.3 Dust and oil filters

Filters shall be selected to meet the requirements of specified air purity.

6.3.4 Dryers

Dryers shall be stand-alone equipment and according to PED (if applicable).

6.4 Air tanks

Air tanks shall be equipped with at least

- inspection hatch
- drain (automatic de-watering if required)
- pressure gauge
- safety valve

Tanks shall be galvanized or stainless steel.

6.5 Compressor room

Compressor room shall be design taking necessary operation and maintenance space requirements into account.

Compressor room ventilation and heating shall be done in co-operation with the compressor supplier e.g. integrated compressor heat recovery systems.

6.6 Pneumatic components

Standard pneumatic components shall be used. In the selection of components specified design and environment data and the life cycle shall be taken into account.

For detailed specification check Appendix I.

6.7 Piping

Stainless steel piping or tubing shall preferably be used for pneumatic systems.

For detailed specification check Appendix II.

6.8 Hoses

Standard pneumatic hoses shall be used and the amount of sizes and lengths shall be minimized whenever possible.

For detailed specification check Appendix II.

6.9 Inspection and testing

Supplier shall deliver an inspection and test plan (ITP) for Purchaser's approval.

Compressors shall be factory tested: pressure test, manufacturer standard performance and mechanical test.

Pressure vessels shall be tested and inspected according to relevant mill standards (MM0003), if not otherwise agreed.

Appendix I. Recommended suppliers

Suppliers of hydraulic components

Type of component	Make (preferred)	Make (alternative)	Remarks
Regulated pumps: - Axial piston pumps - Fan cell pumps	Bosch Rexroth	Parker, Vickers/Eaton	including double and multiple pumps
Constant flow pumps: - Gear pumps - Screw spindle pumps	Kral, Allweiler, Settima, Kracht		used for COL and HY-units for shoe press
Shut-off valves	Bosch Rexroth	Hydac, Parker	
Flow control valves	Bosch Rexroth	Parker	
Pressure-reducing valves	Bosch Rexroth	Parker	
Pressure-limiting valves	Bosch Rexroth	Parker	
Servo and proportional valves	Bosch Rexroth	Moog, Parker	
Multiple-way valves	Bosch Rexroth	Parker, COAX	
Oil filters	Hydac	Parker, Pall	
Oil cooler oil / air	Parker		Standard
Oil cooler oil / water	Parker (Olaer) welded Alfa-Laval (screwed)	GEM	Special applications (e.g.: for shoe press) Material: AISI316
Pressure meters	Wika	Parker	
Pressure transmitters	Hydac	Bosch Rexroth	
Pressure accumulator	Bosch Rexroth	Hydac	
Level switches	Bosch Rexroth	Parker	
Temperature switch	Bosch Rexroth	Parker	
Flow control cooling water	Danfoss		
Oil heater	Loval	Backer	
Cylinders	Rexroth	Bosch Parker	
Flow control bearings	AS-Drive (System FlexoFlow)	SKF	for COL
Measuring connections	Parker	ISO 15171-2	coupling thread M16x2
Water warning unit (COL)	Bühler	Hydac	

Suppliers of pneumatic components

Type of component	Make (preferred)	Make (alternative)	Remarks
Solenoid valves	Aventics	Festo, Norgren	
Manual multiple- way valves	Aventics	Festo, Norgren	
Pressure control valves	Aventics	Festo, Norgren	
Proportional pressure valves	Aventics	Festo, Norgren	
Boosters	Fairchild		
Converters I/P	Samson	Emerson	
Pressure meters	Wika	Parker, Aventics	
Pressure switches	Aventics	Festo, Norgren	
Air filters	Aventics	Festo, Norgren Hörbiger	
Maintenance units	Aventics	Festo, Norgren	

Appendix II. Material specification

MATERIAL SPECIFICATIONS

Specifications of materials according to the machine sections in the following tables:

Remark: The mentioned material is the **minimum standard**; the use of better material is allowed.

Environment	Preperation, Refiner	Press part	Wire part	Pre-drying drying	Clupak, Coater, SizePress	Calender	Reeler POPE, Chopper, Rewinder
Water content %	100	100	100	60-40	100	0	0
Temperature °C	20-30	70	120	150	120	200	20-30
Chemistry	0	5% NaOH	5% NaOH	0	0	0	0
Vibration	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[illegible]

Hose material	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement
Hose fittings (Hose ends secured)	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti
Piping material	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti
Environment	Preperation, Refiner	Press part	Wire part	Pre-drying drying	Clupak, Coater, SizePress	Calender	Reeler POPE, Chopper, Rewinder
HYDRAULIC & PNEUMATIC BOXES / PANELS							
Boxes/Panels on machine framing or inside hood	AISI 304	AISI 316	AISI 316	Steel varnished (RAL 7035)	AISI 304	Steel varnished (RAL 7035)	Steel varnished (RAL 7035)
Boxes/Panels outside machine framing or on HY-units	AISI 304	Preferably chemical-resisting plastic if technical possible or AISI 304	Preferably chemical-resisting plastic if technical possible or AISI 304	Preferably chemical-resisting plastic if technical possible or Steel varnished (RAL 7035)	AISI 304	Preferably chemical-resisting plastic if technical possible or Steel varnished (RAL 7035)	Preferably chemical-resisting plastic if technical possible or Steel varnished (RAL 7035)
Pipe connection <=42 mm Parker Ermeto (alternative Swagelok) or Walterscheid Walform	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Pipe connection >=42 mm DIN flange or SAE flange	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel varnished	AISI 316Ti	Steel varnished	Steel varnished
Hose material for hydraulic	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement
Hose fittings (Hose ends secured)	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Piping material <=42 mm	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Piping material >=42 mm	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel varnished	AISI 316Ti	Steel varnished	Steel varnished
Plastic tube for pneumatic box	PP	PP	PP	PP	PP	PP	PA

installed in field outside machine							
Plastic tube for pneumatic box installed on the machine	PP	PTFE	PTFE	PTFE	PTFE	PTFE	PA
Plastic tube connections system	Push-In nickel-plated brass	Push-In nickel-plated brass	Push-In nickel-plated brass	Push-In nickel-plated brass	Push-In nickel-plated brass	Push-In nickel-plated brass	Push-In plastic
Environment	Preperation, Refiner	Press part	Wire part	Pre-drying drying	Clupak, Coater, SizePress	Calender	Reeler POPE, Chopper, Rewinder
PIPING FOR MACHINE AND FIELD							
Pipe connection <=42 mm Cutting ring bolted connection Parker Ermeto (alternative Swagelok)	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Pipe connection >=42 mm Welded or if requirement DIN flange or SAE flange	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti
Hose material	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement	as per requirement
Hose fittings (Hose ends secured)	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Piping material <=42 mm	AISI 316Ti	AISI 316Ti	AISI 316Ti	Steel with CF-zinc-chrome coated	AISI 316Ti	Steel with CF-zinc-chrome coated	Steel with CF-zinc-chrome coated
Piping material >=42 mm	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti	AISI 316Ti
Gaskets	Viton	Viton	Viton	Viton	Viton	Viton	NBR
Clamps	RAP (80°C)	RAP (80°C)	Al	RAN (120°C)	RAN (120°C)	Al	RAP (80°C)
installation material (screws, butterfly nuts, runners, supports, C-rail)	AISI 316Ti Screws secured against loosening	AISI 316Ti Screws secured against loosening	AISI 316Ti Screws secured against loosening	CF-zinc-chrome coated Screws secured against loosening	AISI 316Ti Screws secured against loosening	CF-zinc-chrome coated Screws secured against loosening	CF-zinc-chrome coated Screws secured against loosening

ACTUATORS / FIELD DEVICES							
drives, cylinders motors	Stainless steel finish, heat- resistant plastics	Stainless steel finish, heat and chemical- resistant plastics	Stainless steel finish, heat and chemical- resistant plastics	Stainless steel finish, heat and chemical- resistant plastics	Stainless steel finish, heat- resistant plastics	Standard finish, heat- resistant Standard design plastics	Standard design
Units for air treatment	Chemical- resisting plastics	Chemical- resisting plastics	Chemical- resisting plastics	Heat- resistant plastics	Heat- resistant plastics	Heat- resistant plastics	Standard design
Measuring (Manometers) and control elements	Stainless steel, chemical- resisting plastics	Stainless steel, chemical- resisting plastics	Stainless steel, chemical- resisting plastics	Metal, heat- resisting plastics	Stainless steel, heat- resisting plastics	Metal, heat- resisting plastics	Metal, heat- resisting plastics