

Technical specification

CONTINUOUS LINE FOR TUBE PLATING AND PLASTIC COATING

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Revision	Date	Changes
1	19/04/2016	First issue
2	10/05/2016	Complete revision, added annexes

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1. Purpose of the document

The purpose of this document is to provide information necessary for technically sound operation, easy maintenance and operational safety of the device purchased for the purposes of Cooper Standard Automotive.

Unless stated otherwise, compliance with this specification is mandatory. The technical requirements apply to the device itself to full extent; general requirements apply to the device and have to be approved prior to realization.

Fulfilling these specification does not relieve the contractor of the responsibility of creating a safe, high-quality and functional device. The contractor is ultimately exclusively responsible for the integrity of the device.

CSA encourages open and substantive communication with partners. They encourage the contractors to generate ideas and fail-safe measures.

2. Bid Scope

This initial requirements serve as the basis for the project, engineering and production of a single-purpose machine (production line) for the customer - Cooper Standard. The project must include proposal, design, production, assembly, transport, installation of machinery, training of operators and maintenance personnel, and participation during the commissioning at the customer's facility, as required.

3. Contact Persons

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4. General Requirements for the machinery

- These requirements serve as general regulations for machinery design.
- The system shall be designed and manufactured to comply with CE requirements and with the general ergonomic requirements valid in the Czech Republic (see Annex No. 1). Evaluation of the ergonomics of individual workstations will be part of the handover and acceptance documents.
- The current power distribution system features 240 V or 3x400 V. If the supplier requires other media or media parameters, these requirements must be included in the proposal, including any supplemental devices.
- The pneumatic circuits must be designed for the pressure of 6 bar (the hall features a maximum distribution system pressure of 7 bar).
- The machine controls must be comfortably accessible by the operator in line with the worksite ergonomics (start buttons, controls, etc.).
- The electric panels should feature a surface finish (powdery coating) shade agreed with the customer. The line must be equipped with LCD touchscreen or touchscreen monitor offering extra 20 inputs and outputs. All the sensors installed in the machine must be connected through connectors due to their simpler and quicker replacements during operation.
- Each machine must be equipped with (A4) information board for documentation and must be properly illuminated to comply with the applicable hygienic and legislative requirements.

It must be possible to control the light independently of the machine control. The machines must feature manual closing valves at the hall central distribution system connection location. The machine must feature one 230 V socket behind the operator's work area and one 230 V socket in the machine distribution box.
- Line processing parameters: the process parameters setting must be password-protected. Password may be changed only through a two-level encoding.
- If the equipment is fitted with components used for measuring and assessment of for example technological parameters, leaks, speeds etc., applicable calibration sheets for the installed components and devices must be supplied, including specifications of the calibration intervals. In the case of electric value testers, it is possible to replace the calibration protocol with a measuring protocol based on comparable equipment that is ten times more accurate. The machine producer's declaration must be supplied as well.

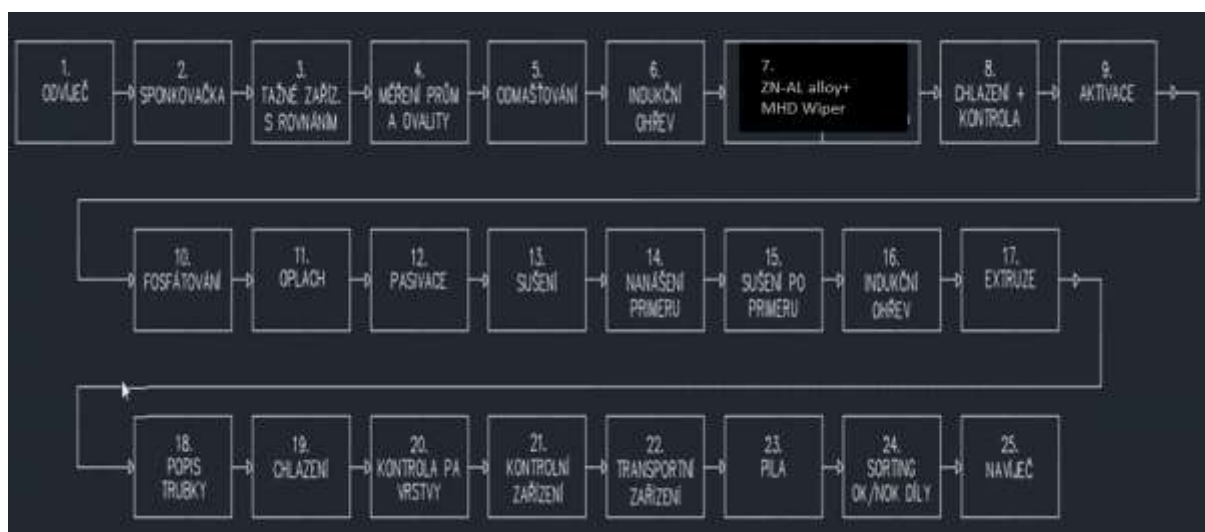
- The insertion of all components must be checked by sensors. If a component is missing, the machine must not complete its operation. It must notify the operator of an error. The tool design must guarantee their proper orientation and position. A mechanical solution (Poka-yoke) is preferred to electrical sensors for proper position and orientation checking.
- If the machine features a PC for data control and storage – consider a monitor-integrated PC with wireless mouse and keyboard. All measured values either processing values (speeds, temperatures etc.), or testing values (leaks, pressures, dimensions etc.) must be stored in the machine PC. This applies also to all inputs in the control and configuration system. The input and the applied change together with the time, date and year of the change shall always be stored.
- The surface finishing of all the tools must meet the requirements for accurate position setting during key operations.
Hardened tools shall be machined and surface treated in order to extend their lifetime.
Exchangeable tools must be marked in line with the applicable installation assemblies and subassemblies – marking shall be done after an agreement with the customer and based on the type of the manufactured part.
- Each machine must be equipped with a signalization light column – signaling manufacturing statuses (G/Y/R).
- Protective elements on the frames and clamps shall be a combination of the following elements:
 - photo cells enabling easy access to the machine from the front - the supplied photo cells must include a test roller to check the photo cell operation. The roller must be directly supplied by the photo cell manufacturer. This check element must be placed on the machine. It must be easily available to the operator, and it must not interfere with the machine operation.
 - Sliding or otherwise closing panels shall be made of section aluminium with windows of clear and transparent polycarbonate in order to prevent any potential injuries of the operator or others. The panels shall be secured against sliding and opening via electronic lock.
 - Protective elements shall feature connections that will allow their service and maintenance.
 - The surface temperature of the mechanical equipment must not exceed 35°C. However, if it is necessary due to processing issues these areas must be visibly marked.
- All machines must be filled up with the necessary operational fluids and machines posing a risk of chemical substance leaks (hydraulic fluid, operational chemicals etc.) – must be equipped with a collector pan to catch possible leaks. The machine shall be filled up with the necessary chemicals after the machine is properly installed and connected to power media in the hall.

- The handover and acceptance documentation must contain a list of used chemicals and safety and material sheet must be attached to each chemical substance – applies only to operational fillings of the machine. Documentation for chemical fillings for own technology shall be supplied by the customer.
- All the air reducing valves must feature lockable covers, or reducing valves with key-based position blocking must be installed. If keys are installed, one master key for the entire line shall be supplied.
- The machine equipment (line) must be equipped with operational hour counter (number of produced parts) and must offer an option to set service interval messages with respect to the operational hours (number of pieces or meters).
- The tool exchange process for various references must comply with SMED requirements. Tool exchange cannot exceed 20 minutes using 2 adjustment technicians. An alignment head may be used for individual tubs, see the picture below:



5. Description and Technical Requirements for Machinery Equipment

The required line has been engineered to use an innovative method to deposit a layer of zinc and aluminium on copper-coated soldered pipes. The line must also be able to apply polyamide layer, apply text description using UV paint, and must be able to cut the pipe to the desired length and automatically sort pipes to OK and NOK parts. The end of the lines must be equipped with a pipe coiler, if the pipe is not cut to the desired length. The process begins with the pipe decoiling from the spool (coil), while the speed and outside diameters necessary for the coat application are continuously checked. See the functional diagram below.



Description of production line inputs:

The production line must be engineered for pipe manufacturing:

Outside diameter

- ❖ double-layer: **4.75 ± 0.05 mm,**
- ❖ single-layer: **8 ± 0.05 mm, 10 ± 0.05 mm, 12 ± 0.05 mm**

Wall thickness

- ❖ double-layer: 0.7 mm copper coated 2.2 - 3.7 µm on both sides
- ❖ single-layer: 0.7 mm

Outside roundness: 0.05 mm

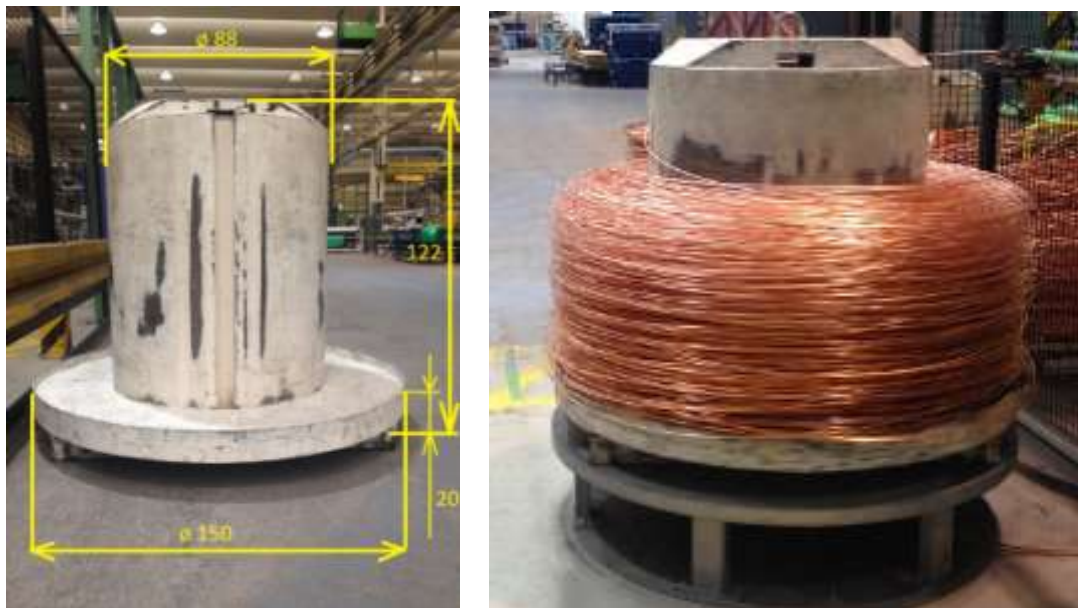
Material: double-layer: DC01/DC03 according to EN10139 – LC quality

single-layer: DC04 according to EN10139 – LC quality

Input material form:

Material shall be fed into the line as a pipe coiled on a metal drum (further referred as basket only). The maximum weight of the basket with the material is 600 kg.

Dimensions sketch: values in the sketch are in "cm".



Description of production line outputs:

Line speed: adjustable up to maximum of 150 m/min

Maximum weight load on floor exerted by the machine:

max. 5 tons per each leg of the machine equipment

Maximum anchoring depth of the machine:

max. 22 cm from the floor level

Floor flatness: Up to 5 mm difference on a 3 m pattern on average on the area

Air duct requirements: The machine shall be equipped with an exhaust duct with a closing flap - other ducts shall be addressed by the customer. All air ducts must be equipped with flow sensors. The sensors must be installed behind the closing flap (in the direction facing away from the machine), and must be connected to the line control system and error messaging system.

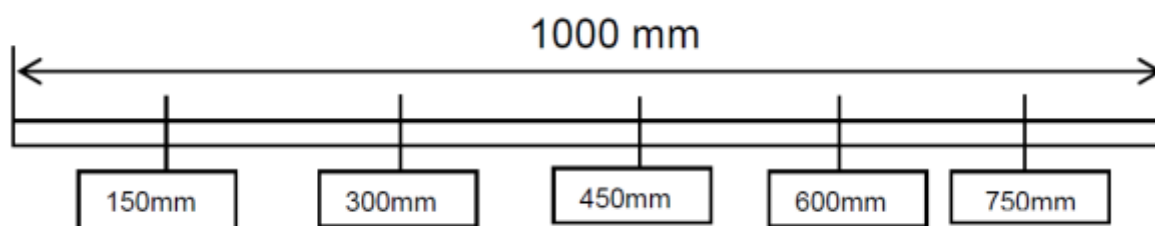
❖ Output material:

The Zinc-Alluminium layer thickness is the average thickness of a length of 1000 mm 15-25 μm .

The absolute minimum thickness by single measurement is 6 μm

Coating thickness measurement:

12x measures per section (each 30 degrees)
 5 sections (every 150 mm) per tube (on 3 tubes)



Outer diameter of tubes with polyamide coating

Base tube nominal O.D. [mm]	Finished tube O.D. [mm]
4,75 mm	5,20 mm – 0,075 mm
6,00 mm	6,45 mm – 0,075 mm
8,00 mm	8,45 mm – 0,075 mm

Minimal thickness of polyamide layer is 13µm.

❖ Output material, option No. 1

The production line is to manufacture pipes according to preset diameter and length specifications

Length specifications: 250 ÷ 7500 mm

Cutting accuracy: see item 13

Cut: Regular cuts free of any chips and cuts/ perpendicular to the pipe longitudinal axis

The material shall be sorted into OK and NOK parts in line with the below specified requirements.

❖ Output material, option No. 2

The production line will be manufacturing pipes according to preset diameter specifications which are to be coiled on baskets in line with the specifications available further down in this document. Certain material defects (marked dents on the pipes "nopens" and joined spots) are allowed for this manufacturing process.

When the material leaves the line it will be coiled on a metal drum (further referred as basket only). The maximum weight of the basket with the material is 750 kg.



In order to control the line, for example when feeding new material into the line or when regulating the speed, the line shall be equipped with wireless 2 remote controllers able to communicate with the main control panel.

All materials must be resistant to chemicals with which they may come in contact.

DESCRIPTION OF MANUFACTURING OPERATIONS

(the numbering system matches positions on the functional diagram at the beginning of the chapter No. 5)

1. Decoiler

Due to processing reasons and to lower scrap, the line must be capable of continuous production without stopping. Therefore it must be equipped with two decoilers powered by electromotors - one is decoiling (feeding) and the other one is backup. Decoiler speed must be electronically controlled and must be adapted to the line feeding needs, to the planned maximum speed of 150 m/min and must have a sufficient reserve in terms of operational life (durability) and wear and tear. Decoilers must be equipped with side doors with electronic locks to allow material supplies - delivered by forklifts. The lock must block the door of the decoiler that is currently used.

Safety fencing must be rated and designed to comply with EN ISO 13857 standard. We prefer floor mount design +/-0,00 of the hall, without the need to modify the floor. The machine must offer an option to manually turn and regulate RPM at the machine inlet in order to allow the operator to set the entry position for the feeding material.

The outlet part on both decoilers must be equipped with positioning equipment able to detect the movement of the pipe. The positioning equipment shall allow adjustment in two axis (x and y), where the y axis is parallel to the axis of the basket. Horizontal position is to be set manually and vertical position automatically - during the manufacturing process depending on the amount of the remaining material. To detect the movement of the pipe a sensor shall be used equipped with a backlight whose surface shall be cleaned from dirt particles produced by the pressure air pulse-blower filtered through a cascade of filters to reduce the dirt size particles down 5µm. Nozzles are to be used for blowing. We prefer both decoilers to be aligned along the axis of the production line, one behind the other.



Fig. 1 Decoiler placement sample

2. Automatic Joiner

As soon as the material on one decoiler is used up, the end of the pipe must be connected to the beginning of the pipe on the backup decoiler. This is done by the operator by placing the beginning of the pipe machined to a conical shape (the shaping machine is to be delivered by CSA) from the backup decoiler at an exactly specified position. As soon as the electronic sensor detects the end of the pipe it will grip it with its jaws and will ram the beginning of the pipe into the end opening of the first pipe. Then the machine will crimp (press) the pipes together using enough force to make sure that the pipes will not get separated during the entire manufacturing process. Then the jaws will release the pipe and will return back to the original position. The lightning column must notify the operator that the decoiler does not have any pipe ready.

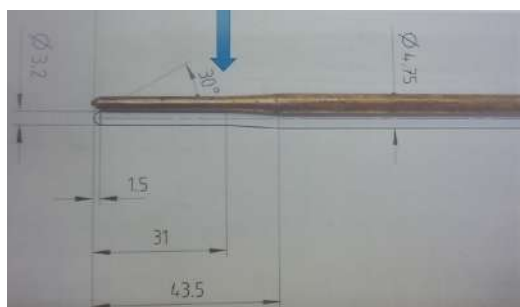


Fig. 2 Shaped pipe



Fig. 3 Attached and crimped joint

A straightening station must be installed before the machine – manual station is fine. The straightening shall be done along two planes – horizontal and vertical plane. The purpose of the straightening station is to make sure that the decoiled pipe is aligned properly to ensure defect-free joints.

3. Pulling Equipment with Straightening Function

In this section pull drives must be installed at the beginning and at the end of the machine in order to provide continuous material feeding. At the same time and based on the decoiling, the pipe must be straightened horizontally (9 rollers) and vertically (9 rollers) to ensure that the pipe goes inside the machine straight and with the required roundness. We prefer to have the same design of the horizontal straightening equipment where the fixed side shall be fitted with 5 straightening rollers and the moving section shall be fitted with 4 straightening rollers. The positioning of the moving rollers shall be insured by an sezor and must allow connection to the line control system and offer option to store positioning data - due to backtracking issues. Rollers adjustment must be done automatically based on the selected recipe/control programme.

The machine must also be equipped with a calibration unit which shall eliminate possible defects in the roundness (ovality) - the top ovality tolerance is 0.05 mm.

Permanent fluid fillings in transmissions and gearboxes shall be delivered with safety sheets describing the given fluid and must offer visual checks - fluid level viewing port marked with the minimum and maximum level line and specifying the type of the fluid. If drives equipped with central cooling systems are used, the inlet and outlet of the machine must be equipped with manual valves showing the direction of the flow of the cooling fluid.



Fig. 4 Straightening and testing device placement sample

4. Online Diameter, Length and Ovality Measurements

After the pipe strengthening and calibration is done the diameter and the ovality of the pipe must be checked using touchless measuring device. These data are continuously stored in the PC of the machine as data from the previous measurements and also serve as input information before the zinc and aluminium alloy layer is applied during the next following operations. Measurements shall be done along 4 axis and with precision of ± 0.001 mm. Also the speed of the pipe must be measured by Eddycheck in order to identify defect spots positions. If the diameter or the ovality is outside of the allowed tolerance the pipe must be cut and separated. This is done in the cutting section using a saw and the pipe goes to the NOK parts. Both monitored parameters must be adjustable by the control software

protected by password only. The measurement results are projected online on the information panel.

5. Degreasing (de-oiling)

Before the pipe is processed any further the oil film on the pipe surface must be removed. We prefer electrolytic degreasing system using SurTec 198 - ART.NR.S04218 mixture with demi water, concentration $15 \pm 5 \%$ at 60°C . The temperature is to be stored in the PC of the production line and displayed on the line control panel.

Then the pipe must be rinsed with demi water at maximum temperature of 25°C .

The last section of the machine is the blower ring. The purpose of the blower ring is to get residual water off the surface of the pipe using pressurized air. The pressure air supply must end with a shutdown valve (on the machine). Also, electrically controlled valve, reduction valve used to set the air pressure, and cascade of filters with outlet filtration particle size up to $5\mu\text{m}$ and pressure sensor providing information to the control system must be installed.

Safety sheet for SurTec 198 - ART.NR.S04218 – see Annex No. 3.

6. Induction Heating System

The pipe passing through the machine must be heated up to a temperature of $500 \pm 50^{\circ}\text{C}$ and must allow manual setting. Except for short-term shutdowns of the line, a constant temperature of 350°C must be maintained. Temperature shall be monitored by a sensor.

This process must take place in the presence of pure nitrogen with minimum leaks.

For this operation we assume that the machine will be connected to a central cooling water distribution system. Due to this reason the machine equipment must be equipped at the inlet and outlet section of the distribution system with manual valves showing the direction of the flow of the cooling fluid and the consumption of the cooling media/fluid.

As far as the distribution and connection to nitrogen is concerned, the same rules as for the connection of cooling water shall apply, with the only difference that each input location must be equipped with a reduction valve and with an electric valve controlled by the production line control system and also with a pressure sensor connected to the line control system.

Technological information about the temperature shall be stored in the PC of the line and displayed on the line control panel. Thermal sensor including the entire evaluation circuitry must be delivered and calibrated after the machine is installed at the facility of the customer.

Entry to the induction chamber must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel, by entering a password. Induction chamber must be designed as sliding and must slide out of the line axis in case the glass pipe around induction coils must be replaced.

7. Hot-dip coating of Zinc-Aluminum Alloy + MHD wiper

A robust metal bath must be capable of containing melted zinc and aluminum (95%Zn-5%Al) at temperature of $440 \pm 10^{\circ}\text{C}$, through which the pipe goes. The bath length is approximately 1.3 m long. The bath must be designed with a suitable opening allowing insertion of the material - 20 kg ingot 20x7x80 cm. The temperature may never fall below 420°C and continuous circulation must be ensured to guarantee a stable process. Level and temperature control.

Immediately behind the bath with Zinc-Aluminum alloy the pipe must go through MHD (Magneto-Hydro-Dynamic) wiper. The power output of the MHD wiper must be adjustable on the control panel and must be protected with a password.

This process must take place in the presence of pure nitrogen with minimum leaks.

For this operation we assume that the machine will be connected to a central cooling water distribution system. Due to this reason the machine equipment must be equipped at the inlet and outlet section of the distribution system with manual shutdown valves showing the direction of the flow of the cooling fluid and the consumption of the cooling media/fluid.

As far as the distribution and connection to nitrogen is concerned, the same rules as for the connection of cooling water shall apply, with the only difference that each input location must be equipped with a reduction valve and with an electric valve controlled by the production line control system and also with a pressure sensor connected to the line control system.

Technological information about the temperature shall be stored in the PC of the line and displayed on the line control panel. Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

8. Cooling + Inspection

The pipe with the applied mag-alloy coating must be cooled down. The continuous pipe goes through a water tank which is filled with cooling water circulating in an enclosed loop. This cooling process takes place in two independent zones. Each zone is connected to its own enclosed cooling circuit. Both sections shall be designed in the same way, and shall be made of the following machine equipment and components:

Cooling circuit No. 1

Cooling medium: demi water – refilled from the main water distribution in the hall

Operating temperature: $70 \pm 2^{\circ}\text{C}$ – the temperature value must be stored in the machine PC

Cooling chamber: stainless steel (bath + lid). The lid must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel - by entering a password. The

manufactured pipe shall travel through the cooling chamber on adjustable rollers. The cooling chamber must be designed in a certain way, so the length of the pipe that it submerged is 1000 mm.

Pumping tub: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath shall be placed on a metal frame. No collection safety pan is required. The volume of the tub is 800 litres.

Pumping tub the equipment:

- 1pc – pump supplying the media to the cooling chamber, and used to empty the tub into the hall distribution system
- 4pcs – heating units
- 1pc – water level sensor in the tub
- 1pc – thermal level sensor in the tub monitoring the temperature of the media
- 1pc – opening lid, see the sketch below
- 1pc – electrically controlled valve used to refill demi water.
- 1pc – manual valve used as a bypass of the electrically controlled valve used for water refills

All piping systems must be properly marked, see the chapter below

The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

Cooling circuit No. 2

Cooling medium: demi water – refilled from the main water distribution in the hall

Operating temperature: $70 \pm 2^{\circ}\text{C}$ – the temperature value must be stored in the machine PC

Cooling chamber: stainless steel (bath + lid). The lid must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel - by entering a password. The manufactured pipe shall travel through the cooling chamber on adjustable rollers. The cooling chamber must be designed in a certain way, so the length of the submerged pipe is 1000 mm.

Pumping tub: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath shall be placed on a metal frame. No collection safety pan is required. The volume of the tub is 800 litres.

Pumping tub equipment: 1pc – pump supplying the media to the cooling chamber, and used to empty the tub into the hall distribution system
4pcs – heating units
1pc – water level sensor in the tub

1pc – thermal level sensor in the tub monitoring the temperature of the media
1pc – opening lid, see the sketch below
1pc – electrically controlled valve used to refill demi water.
1pc – manual valve used as a bypass of the electrically controlled valve used for water refills
1pc – blowing ring. The purpose of the blower ring is to get residual water off the surface of the pipe using pressurized air. The pressure air supply must end with a shutdown valve (on the machine). Also, electrically controlled valve, reduction valve used to set the air pressure, and cascade of filters with outlet filtration particle size up to 5µm and a pressure sensor providing information to the control system must be installed.

All piping systems must be properly marked in line the chapter 13.

The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

The last step is the diameter check using touchless measuring device. The measurement results are to be projected online on the information panel stored in line PC.

The measuring device including the entire evaluation circuitry must be calibrated - after the machine is installed at the facility of the customer.

9. Activation

The pipe coated with the Zinc-Aluminum layer must pass through the conditioning bath. The bath through which the pipe goes is also a part of an closed circuit and it consists of a charged pipe, through which a medium circulates and through which the manufactured pipe travels. The activation zone shall be made of the following machine equipment and components:

Cooling medium:	Bonderite M-AD 4977 + Prepalene X + demi water – refilled from the main water distribution system in the hall
Concentration:	1 %
Demi water refills:	Approximately 30 litres per day
Operating temperature:	20 ÷ 40°C – temperature must be stored in the machine PC
Activation chamber:	made of plastic (bath + lid). The lid must be protected with an electronic safety lock connected to the control system and must allow unlocking through the line control panel - by entering a password. The chamber must be designed in a certain way, so the length of the pipe submerged in the bath is 2600 mm.
Pumping tub:	Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath /tub the shall be placed on

a metal frame and equipped with a safety collection pan. The volume of the tub is 800 litres. The volume of the safety collection tub is approximately 950 litres.

Pumping tub equipment:

- 1pc – pump supplying the media to the activation chamber and used to empty the tub into the hall distribution system
- 2pcs - mixers
- 1pc – water level sensor in the tub
- 1pc – thermal level sensor in the tub monitoring the temperature of the media
- 1pc – opening lid, see the sketch below
- 1pc – electrically controlled valve used to refill demi water.
- 1pc – manual valve as a bypass for the electrically controlled valve used for water refills
- 1pc – blowing ring. Purpose of the blower ring is to get residual water off the surface of the pipe using pressurized air. The pressure air supply must end with a shutdown valve (on the machine). Also, electrically controlled valve, reduction valve used to set the air pressure, and cascade of filters with outlet filtration particle size up to 5µm and a pressure sensor providing information to the control system must be installed.

Safety collection tub the equipment:

- 1pc – media leak sensor

All piping systems must be properly marked in line the chapter 13.

The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

Safety sheet for Bonderite M-AD 4977 – see Annex No. 4

Safety sheet for Prepalene X – see Annex No. 5

10. Phosphating

After the pipe has passed through the activation bath, it must go through a phosphating bath

The bath through which the pipe goes through is again a part of an closed circuit.

The phosphating circuit shall consist of two phosphating chambers in a connected by a pipe, through which the manufactured pipe shall pass through. Both chambers shall be connected via pipes to pumping reservoirs/tanks and shall make an enclosed loop. The phosphating section shall also include one independent tank which will be used to completely empty the media, and shall be connected to the pipe distribution system in the hall – see the functional diagram below.

The phosphating zone shall be made of the following machine equipment and components:

Phosphating chamber and pumping tank No. 1

Cooling medium: mixture of Bonderite M-ZN 1421-AR, Bonderite C-AD 565+ demi water – refilled from the main water distribution system in the hall

Concentration: chemicals (48l+30l) + demi water for a loop containing approximately 1000 litres of water

Demi water refills: Approximately 100 litres per week

Operating temperature: $50 \pm 3^{\circ}\text{C}$ – the temperature value must be stored in the machine PC

Phosphating chamber No. 1: made of plastic (bath + lid). The lid must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel - by entering a password. The chamber must be designed in a certain way, so the length of the pipe submerged and passing through the bath is 10,000 mm (the length includes the chamber No. 2 and the connection pipe).

Pumping tub No. 1: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath /tub shall be placed on a metal frame and equipped with a safety collection pan. The volume of the tub is approximately 800 litres. The volume of the safety collection tub is approximately 950 litres.

Equipment of pumping tub No. 1:

- 1pc – pump supplying media to the phosphating circuit
- 1pc – pump used to empty the tub into the collection tub
- 3pcs – heating units
- 1pc – water level sensor in the tub
- 1pc – thermal level sensor in the tub monitoring the temperature of the media
- 1pc – opening lid, see the sketch below
- 1pc – electrically controlled valve used to refill demi water.
- 1pc – manual valve used as a bypass of the electrically controlled valve used for water refills
- 1pc – pumping tub exhaust: The machine shall be equipped with an exhaust duct with a closing flap - other ducts shall be addressed by the customer. All exhausts must be equipped with flow sensors. The sensors must be installed behind the closing flap (in the direction away from the machine), and must be connected to the line control system and error messaging system.

Safety collection tub the equipment:

- 1pc – media leak sensor

All piping systems must be properly marked in line the chapter 13.

The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

Safety sheet for M-ZN 1421-AR – see Annex No. 6

Safety sheet for Bonderite C-AD 565 – see Annex No. 7

Phosphating chamber and pumping tank No. 2

Cooling medium: the same as for tank No. 1

Concentration: the same as for tank No. 1

Demi water refills: the same as for tank No. 1

Operating temperature: the same as for tank No. 1

Phosphating chamber No. 2: made of plastic (bath + lid). The lid must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel - by entering a password.

Pumping tub No. 2: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath /tub the shall be placed on a metal frame and equipped with a safety collection pan. The volume of the tub is approximately 800 litres. The volume of the safety collection tub is approximately 950 litres.

Equipment of pumping tub No. 2:

1pc – pump supplying the media back to the tank No. 1

1pc – pump used to empty the tub into the collection tub

1pc – water level sensor in the tub

1pc – thermal level sensor in the tub monitoring the temperature of the media

1pc – opening lid, see the sketch below

1pc – electrically controlled valve used to refill demi water.

1pc – manual valve used as a bypass of the electrically controlled valve used for water refills

1pc – pumping tub exhaust: The machine shall be equipped with an exhaust duct with a closing flap - other ducts shall be addressed by the customer. All exhausts must be equipped with flow sensors. The sensors must be installed behind the closing flap (in the direction away from the machine), and must be connected to the line control system and error messaging system.

Safety collection tub the equipment:

1pc – media leak sensor

All piping systems must be properly marked in line the chapter 13.

The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

Collection tank

Cooling medium: the same as for tank No. 1

Concentration: the same as for tank No. 1

Demi water refills: the same as for tank No. 1

Operating temperature: the same as for tank No. 1

Collection tank: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath /tub the shall be placed on a metal frame and equipped with a safety collection pan. The volume of the tub is approximately 800 litres. The volume of the safety collection tub is approximately 950 litres.

Collection tank equipment:

1pc – pump used to empty the tub into the hall distribution system

1pc – water level sensor in the tub

1pc – thermal level sensor in the tub monitoring the temperature of the media

1pc – opening lid, see the sketch below

1pc – pumping tub exhaust: The machine shall be equipped with an exhaust duct with a closing flap - other ducts shall be addressed by the customer. All exhausts must be equipped with flow sensors. The sensors must be installed behind the closing flap (in the direction away from the machine), and must be connected to the line control system and error messaging system.

Safety collection tub the equipment:

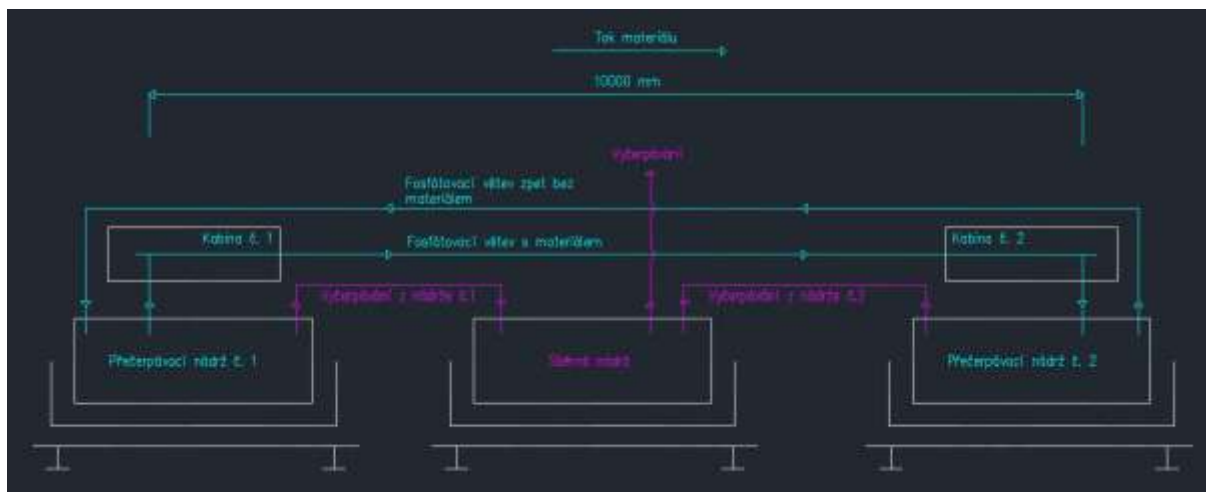
1pc – media leak sensor

All piping systems must be properly marked in line the chapter 13.

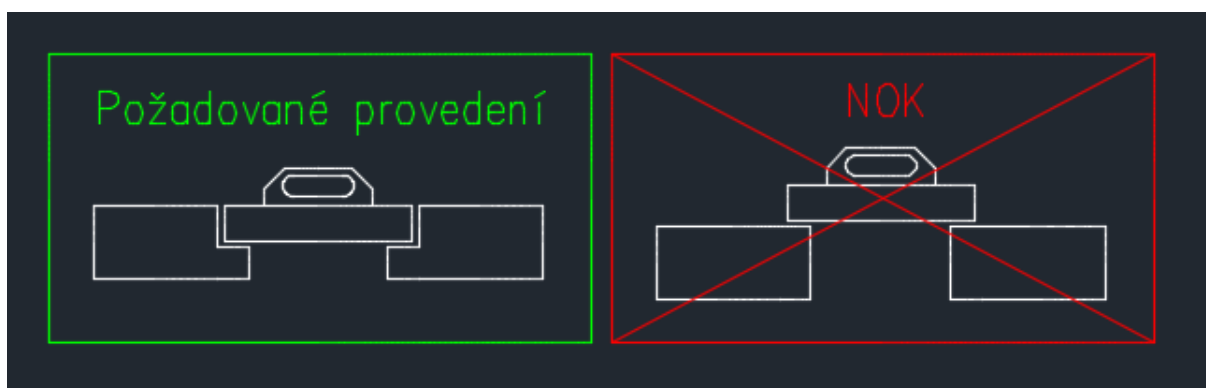
The pumping/emptying pipe branch must be equipped with a one-way valve and manual shutdown valve.

Thermal sensor including the entire evaluation circuitry must be calibrated after the machine is installed at the facility of the customer.

Phosphating circuit functional diagram:



Schematic drawing of the required opening lids for all tanks on the entire production line – made of plastic and stainless steel.



11. Rinse

The pipe must be rinsed in two separate baths. The rinsing process is done in the following way. The pipe goes through the water tank No. 1 which is continuously filled with cooling demi water through an enclosed loop. Then the pipe is dried by pressurized air and goes to the rinsing zone No. 2 where the rinsing is done with a pipe supplied with pressure demi water (the same system as in the phosphating zone). At the end of the cleaning process the residual water is removed from the pipe surface with pressure air. This rinsing process takes place in two independent cooling zones. Both zones create an enclosed rinsing circuit.

Rinsing circuit No. 1

Cooling medium: demi water – refilled from the main water distribution in the hall

Operating temperature: 20 + 5°C – temperature must be stored in the machine PC

Rinsing chamber No. 1 made of plastic (bath + lid). The lid must be protected with an electronic lock connected to the control system and must allow unlocking through the line control panel - by entering a password. The rinsing chamber must be designed in a certain way, so the length of the pipe submerged in the bath is at least 650 mm.

Pumping tub: Made of plastic with removable inspection port which is also used for maintenance and cleaning. The bath shall be placed on a metal frame. No collection safety pan is required. The volume of the tub is approximately 300 litres.

Pumping tub equipment: 1pc – pump supplying the media to the cooling chamber, and used to empty the tub into the hall distribution system
 1pc – water level sensor in the tub
 1pc – thermal level sensor in the tub monitoring the temperature of the media
 1pc – opening lid, see the sketch below
 1pc – blowing ring. The purpose of the blower ring is to get residual water off the surface of the pipe using pressurized air. The compressed air supply on the machine must be terminated by a manual shut-off valve. An electrically operated valve, a pressure reducing valve adjusting the air pressure and a filter cascade with an output filtration of 5 µm and a pressure sensor with information for the control system to be incorporated subsequently.

All piping systems must be marked according to chapter 13.

The exhaust branch must be fitted with a check valve and a manual shut-off valve.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

Rinsing circuit No. 2

Medium:	demi water - refilled from the main hall distribution system
Operating temperature:	20 + 5°C – the value must be stored in the machine PC
Rinsing box No. 2:	plastic version (vat + cover). The lid must be provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The cooling box must be designed so that the distance of the through pipe in a submerged state is 650 mm.
Pumping vat:	Plastic version with removable inspection hole, which also serves as an entry for maintenance and cleaning. The vat will be seated on a metal frame with an installed safety storage vat. Vat volume ca. 800 litres, storage vat volume ca. 950 litres
Equipment of pumping vat:	1pc – pump for supplying the medium into the cooling box 1pc – level detection sensor in the tank 1pc – medium temperature sensor in the tank 1pc – opening cover see sketch below 1pc – electrically operated valve for refilling demi water 1pc – manual valve as a bypass of an electrically controlled valve for refilling water 1pc – blowing wreath, whose purpose is to get rid of the pipe surface of residual water with compressed air. The compressed air supply on the machine must be terminated by a manual shut-off valve. An electrically operated valve, a pressure reducing valve adjusting the air pressure and a filter cascade with an output filtration of 5 µm and a pressure sensor with information for the control system to be incorporated subsequently.
Equipment of safety storage vat:	1pc – leak medium detection sensor

All piping systems must be marked according to chapter 13.

The exhaust branch must be fitted with a check valve and a manual shut-off valve.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

12. Passivation

The pipe must undergo passivation bath past the cleaning section. The bath through which the produced pipe passes is again part of a closed circuit and consists of a supercharged pipe in which the medium circulates and through which the produced pipe passes. The passivation zone will be designed and composed of the following plants and components:

Medium: Gardolene D 6890 + demi water – refilled from the main hall distribution system

Concentration: 2%

Refilling demi water: ca. 30 litres / day

Operating temperature: 20 ÷ 30 °C – the value must be stored in the machine PC

Activation box: plastic version (vat + cover). The lid must be provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The box must be designed so that the distance of the through pipe in a bath is at least 800 mm.

Pumping vat: Plastic version with removable inspection hole, which also serves as an entry for maintenance and cleaning. The vat will be seated on a metal frame with an installed safety storage vat. Vat volume ca. 800 litres. Volume of storage vat ca. 950 litres. The vat itself will be divided by an overflow into two chambers, of which one will be on the return branch pipe and will serve as a natural segment collector and the medium from the other part of the vat will be pumped into the passivation circuit

Equipment of pumping vat: 1pc – pump to deliver medium to the passivation box and to repump the vat into the hall distribution system (membrane)
1pc – level detection sensor in the tank
1pc – medium temperature sensor in the tank
2pcs – opening cover see sketch below
1pc – electrically operated valve for refilling demi water
1pc – manual valve as a bypass of an electrically controlled valve for refilling water
1pc – blowing wreath, whose purpose is to get rid of the pipe surface of residual water with compressed air. The compressed air supply on the machine must be terminated by a manual shut-off valve. An electrically operated valve, a pressure reducing valve adjusting the air pressure and a filter cascade with an output filtration of 5 µm and a pressure sensor with information for the control system to be incorporated subsequently.

Equipment of safety storage vat:

1pc – leak medium detection sensor

All piping systems must be marked according to chapter 13.

The exhaust branch must be fitted with a check valve and a manual shut-off valve.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

Safety data sheet for the chemical substance Gardolene D 6890 – see Appendix No. 8

13. Drying

The passivation is followed by ca. 3 m heat insulated tunnel, in which passivated sediment must dry up. The drying zone will be designed and composed of the following plants and components:

Medium: hot air 400°C

Drying box: 2.5 m length, twin-shell with an installed thermal insulation

Dryer: 6 pcs hot-air blower,

Hot air flow: for 1pc hot-air blower – 200-900 l/min - controllable

Max. exit. temperature: 650°C on hot air blower

Equipment of hot air blowers:

External temperature and air flow control - from the line control, storing the set values in the line PC

Integrated thermoprobe + output alarms for external processing in the control system of the line

Integrated protection against overheating

The drying chamber itself must be equipped with a temperature diaphragm at the inlet and outlet because of shielding the outlet heat that must not influence the plastic device installed in the line next to the drying zone.

Two temperature sensors for detecting the actual temperature must be installed in the drying zone. The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

The values will be stored in the line PC.

14. section for primer

The pipe must undergo a primer bath past the cleaning section. The pipe priming is performed so that a continually produced pipe passes through an overflow tank, into which a primer mix is continuously refilled through the closed circuit. The priming section will be designed and composed of the following plants and components:

Medium: mixture of APC NYLON PRIM NA 5GL and 8196000 Special Thinner

Concentration: depends on the result of measuring the mixture viscosity (39±1s)

Mix refilling: will take place automatically depending on the control system and automatic viscosity check. Both tanks for refilling mixture components must be equipped with a safety storage vat.

Operating temperature: $20 \div 30^{\circ}\text{C}$ – mixture, the proper temperature is influenced by the heated inlet material of the drying section - this must be taken into account when designing the plant

Coating box: plastic version (vat + cover). The lid must be provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The box must be designed so that the distance of the through pipe in a bath is ca. 600 mm.

The box must be equipped with an exhaust: to be led out through the pipe with a shutting flap on the machine - another distribution system to be solved by the customer. A flow sensor connected to the control system of the line and its return error message must be installed for all exhausts past the shutting flap in the direction from the machine.

Pumping vat: Plastic version with removable inspection hole, which also serves as an entry for maintenance and cleaning. The vat will be seated on a metal frame with an installed safety storage vat. Vat volume ca. 300 litres. Volume of storage vat ca. 400 litres.

Equipment of pumping vat:

- 1pc – pump for supplying the medium into the coating box (membrane)
- 1pc – mixer
- 1pc – level detection sensor in the tank
- 1pc – medium temperature sensor in the tank
- 1pc – medium viscosity sensor in the tank
- 1pc – opening cover see sketch below, fitted with a safety lock connected to the control system, enabling unlocking via the control panel of the line with a password
- 1pc – blowing wreath, whose purpose is to get rid the pipe surface of residual water with compressed air. The compressed air supply on the machine must be terminated by a manual shut-off valve. An electrically operated valve, a pressure reducing valve adjusting the air pressure and a filter cascade with an output filtration of $5\ \mu\text{m}$ and a pressure sensor with information for the control system to be incorporated subsequently.
- 1pc - exhaust of pumping vat: to be led out through the pipe with a shutting flap on the machine - another distribution system to be solved by the customer. A flow sensor connected to the control system of the line and its return error message must be installed for all exhausts past the shutting flap in the direction from the machine.

Equipment of safety storage vat:

1pc – leak medium detection sensor

All piping systems must be marked according to chapters below.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

Safety data sheet for the chemical substance 8196000 Special Thinner – see Appendix No. 9

Safety data sheet for the chemical substance APC NYLON PRIM NA 5GL – see Appendix No.

10

15. Drying after priming

The priming is followed by a ca. 5 m heat insulated tunnel, in which the prime deposit must dry up. The drying zone will be designed and composed of the following plants and components:

Medium: hot air 400°C

Drying box: 5,1m length, twin-shell with an installed thermal insulation

Dryer: 8 pcs hot-air blower,

Hot air flow: for 1pc hot-air blower – 200-900 litres/min – controllable

Max. exit. temperature: 650°C on hot air blower

Equipment hot air blowers:

External temperature and air flow control - from the line control, storing the set values in the line PC

Integrated thermoprobe + output alarms for external processing in the control system of the line

Integrated protection against overheating

The drying chamber itself must be equipped with a temperature diaphragm at the inlet and outlet because of shielding the outlet heat that must not influence the plastic device installed in the line next to the drying zone.

Both sides of the drying zone must be provided with an exhaust: The exhaust to be led out through the pipe with a shutting flap - another distribution system to be solved by the customer. A flow sensor connected to the control system of the line and its return error message must be installed for all exhausts past the shutting flap in the direction from the machine.

Two temperature sensors for detecting the actual temperature must be installed in the drying zone. The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer. The values will be stored in the line PC.

16. Induction heating

The manufactured pipe through must be heated to $220 \pm 10^{\circ}\text{C}$ allowing a manual reset. Temperature check by a sensor.

In this operation, we assume the requirement for connecting the machinery to the central cooling water distribution. For this reason, the machinery at the inlet and outlet of the machine distribution system must be fitted with manual shut-off valves indicating the coolant flow and consumption.

Technological temperature data will be stored in the line PC and displayed on the control panel of the line. The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

The inlet of the induction chamber must provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The induction chamber must be designed as extending out of the line axis because of replacement of the glass tube around the induction coils.

17. Extrusion

After preheating the pipe surface the PA layer will be continuously applied on it. The extrusion zone will be designed and composed of the following plants and components:

Coating material:	Granulate: Vestamit X7377 black 9.7504
Extruder:	screw type extruder
Accessories:	complete equipment for granulate drying and regeneration
Thickness of layer applied:	130-190 μm . Layer without bubbles or other visible damage

The area above the PA layer application must be equipped with an exhaust: The exhaust to be led out through the pipe with a shutting flap - another distribution system to be solved by the customer. A flow sensor connected to the control system of the line and its return error message must be installed for all exhausts past the shutting flap in the direction from the machine.

The installed temperature sensors and other detectors in the technological process must be supplied with the input calibration - must be calibrated after installing the machine at the customer. The values will be stored in the line PC.

In this operation, we assume the requirement for connecting the machinery to the central cooling water distribution. For this reason, the machinery at the inlet and outlet of the machine distribution system must be fitted with manual shut-off valves indicating the coolant flow and consumption.

Safety data sheet for the chemical substance Vestamit X7377 black 9.7504 – see Appendix No. 11

18. Pipe description

A description approximately in the format „CSA HH:MM DD.MM.RR X DW 4,75x0,7 CB 2 A“ must be made out on the pipe coated with PA layer using a printer and UV colour, where HH:MM is an automatically assigned printing time and DD.MM.RR is an automatically assigned printing date. The remaining values are arbitrarily entered by the operator and must be stored as recipes for faster setting in case of material change.

The description is made out throughout the manufacture, the space between descriptions is 25 cm, the type height 3.2 mm. The volume of the containers for dyes and solvents must be designed so that the frequency of refilling is maximally 1x per day.

Alarms signalling operational messages from the printer (low levels of colour, etc.) must be transmitted to the control system of the line, unlocking via the control panel and password.

Safety data sheet for the chemical substance paint LINX Clean UV-Readable ink1121 - Appendix No. 12

Safety data sheet for the chemical substance thinner LINX Solvent for UV-Readable ink1590 - Appendix No. 13

19. Cooling

After applying description, the produced pipe is drawn through the cooling section. The cooling section consists of two sections. The hot water cooling takes place in cooling section No. 1 and the cold water cooling in section No. 2. Pipes in both sections pass through the overflow tanks, into which the proper cooling medium is continuously refilled through the closed circuit. This cooling takes place in independent cooling zones, of which each is connected to its closed cooling circuit. Both sections will be designed in the same way and composed of the following plants and components:

Cooling circuit No. 1

Medium: demi water - refilled from the main hall distribution system

Operating temperature: $50 \pm 2^{\circ}\text{C}$ – the value must be stored in the machine PC

Cooling box: stainless steel version (vat + cover). The lid must provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The pipe made in the cooling box must be led by means of adjustable transport rollers. The cooling box must be designed so that the distance of the through pipe in a submerged state is at least 4000 mm.

Pumping vat: Plastic version with removable inspection hole, which also serves as an entry for maintenance and cleaning. The vat will be seated on a metal frame without installing a safety storage vat. Vat volume ca. 800 litres.

Equipment of pumping vat:

1pc – pump for supplying the medium into the cooling box and to repump the vat into the hall distribution system
 2pcs – heating elements
 1pc – level detection sensor in the tank
 1pc – medium temperature sensor in the tank
 1pc – opening cover see sketch below
 1pc – electrically operated valve for refilling demi water
 1pc – manual valve as a bypass of an electrically controlled valve for refilling water

All piping systems must be marked according to chapter 13.

The exhaust branch must be fitted with a check valve and a manual shut-off valve.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

Cooling circuit No. 2

Medium:	cooling water - refilled from the main hall distribution system
Operating temperature:	20 ± 5°C – the value must be stored in the machine PC
Cooling box:	plastic version (vat + cover). The lid must be provided with an electrical safety lock connected to the control system, enabling unlocking via the control panel of the line with a password. The pipe made in the cooling box must be led by means of adjustable transport rollers. The cooling box must be designed so that the distance of the through pipe in a submerged state is at least 7000 mm.
Pumping vat:	Plastic version with removable inspection hole, which also serves as an entry for maintenance and cleaning. The vat will be seated on a metal frame without installing a safety storage vat. Vat volume ca. 800 litres.
Equipment of pumping vat:	1pc – pump for supplying the medium into the cooling box and to repump the vat into the hall distribution system 1pc – level detection sensor in the tank 1pc – medium temperature sensor in the tank 1pc – opening cover see sketch below 1pc – electrically operated valve for refilling demi water 1pc – manual valve as a bypass of an electrically controlled valve for refilling water 1pc – blowing wreath, whose purpose is to get rid of the pipe surface of residual water with compressed air. The compressed air supply on the machine must be terminated by a manual shut-off valve. An electrically operated valve, a pressure reducing valve adjusting the air pressure and a filter cascade with an output filtration of 5 µm and a pressure sensor with information for the control system to be incorporated subsequently.

All piping systems must be marked according to chapter 13.

The exhaust branch must be fitted with a check valve and a manual shut-off valve.

The temperature sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

20. Indirect measurement of PA layer and diameter

After the previous operation, the pipe diameter and ovality must be 100% checked by a contactless measurement equipment. These data are continually stored in the machine PC in the same way as the previous measurements and also serve as output information after applying the PA layer.

Measurements will be made in 4 axes with the measurement accuracy of ± 0.001 mm.

The other detection system is an ultrasonic thickness measurement of the PA layer. This must also be measured 100% in a continuous feed of the produced material. All data will be stored in the line PC and all meters must be supplied with the input calibration - must be calibrated after installing the machine at the customer.



Fig. 5 Diameter measurement



Fig. 6 Example of information panel

21.+ 22. Control and transport equipment

The manufacturing section connects with the section of cooling and diameter checking.

CHECKING EQUIPMENT:

The checking equipment will be designed and composed of the following plants and components:

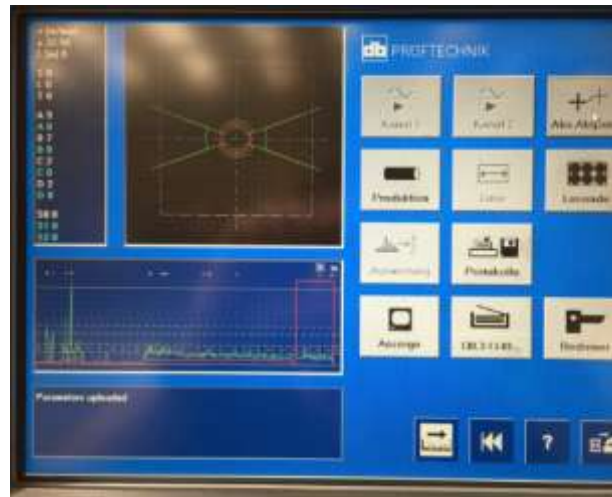
- Horizontal straightening section: consists of 3 fixed and 2 movable rollers, their adjustment will be carried out manually.
- Vertical straightening section: consists of 3 fixed and 2 movable rollers, their adjustment will be carried out manually
- Testing section - the tube must be 100% checked by electromagnetic vortex currents for the presence of noppens (stamped marks from the previous operation) and joints.

The Eddycheck5 tester from the company Prüftechnik must be used for this purpose. The tester must be connected to the control SW of the line depending on the found defects. Saw the pipe into NOK pieces.

- It is not necessary to install this device at the beginning of the production line. The location of this device depends on the decision of the designing department of the line depending on the processing itself. The condition is that it must be installed before the saw at such a distance that the line automatics and its own machinery are able to detect all described defects and subsequently sort them out as NOK pieces.
- All checked data must be stored depending on the production time.
- The measuring equipment must be calibrated after installation at the customer and supplied with a calibration certificate. The calibration must be performed throughout the system only after installation at the supplier.



➤ Fig. 7 electromagnetic vortex currents equipment



➤ Fig. 8 Tester screen

- Horizontal straightening section: consists of 3 fixed and 2 movable rollers, their adjustment will be carried out manually.
- Vertical straightening section: consists of 3 fixed and 2 movable rollers, their adjustment will be carried out manually

TRANSPORT EQUIPMENT:

Traction drives in this section to ensure smooth movement of the material through the line must be at the beginning and end of the machine. Subsequently, two straightening sections will be incorporated. We prefer horizontal and vertical straightening with the same structure where the fixed side will be fitted with 5 pcs straightening rollers and the movable side with 4 pcs straightening rollers. The movable rollers to be positioned using equipment with

external connection to the control system of the line and with the possibility of storing positioning data because of traceability. The rollers must be adjusted automatically, selecting a recipe from the line control.

The equipment includes the installation of length and speed measurement. The sensor including the entire evaluation circuit must be supplied with the input calibration - must be calibrated after installing the machine at the customer.

Permanent charges of transmission housings and control cubicles will be supplied with a safety data sheet of the chemical substance and a potential visual check (level indicator indicating the minimum amount and type of charge on the machine). If drive units with the central cooling are used, the input and output parts of the machine must be provided with manual shut-off valves, indicating the flow of the cooling medium.

23. SAW - Sawing in the running / Flying saw

The coated and described pipe enters the last part - saw. It must be able to perform a right section with the line fully running.

The operator sets the required length of lines without having to sign under the banner of the range 250 - 7500 mm. He can set up to 3 references and the cutting priority.

Chips must be exhausted and trapped in an easy-to-clean filter.

The requirement for *flatness of the pipe* after cut: The maximum allowable deviation of 2.5mm is per 1m pipe. Tolerances are not summed to check longer pipes but the same requirement applies in general.

24. Automatic sorting + packing

The sorting table must be able to accommodate up to 4 references with different lengths (3 required set ones + 1 position for NOK pieces). A belt conveyor conveying the pipe in place is within the length of the entire table. Pipes can fall on both sides of the line because of line shortening. It must be ensured that the pipes do not fall out of the belt before, not even in case of slight bending of the pipe. The perforated sheet for the fall of any impurities should be used as a working area.

25. Coiler + packing

The last device in the line flow is a coiler. We prefer the location of the coiler in the line axis. The end system will be selected from the line control (either flying saw or winder). The requirement for winding only relates to pipes $\varnothing$ 4,75 mm.

The specification of the reel will be clarified on the basis of negotiations.

6. Description of the Control Elements

The supervision, control and visualization of the stations is preliminarily carried out using Siemens Simatic automatons. Other control elements are only acceptable throughout prior agreement of both parties. The reason is , to ensure compatibility with the existing control system of other equipment.

The work handed over also encompasses the control SW including source codes.

7. Control Equipment Documentation

The contractor is obliged to provide the operation manual in variant scope for "engineers" and "operators" with different privileges. The control SW must be protected against interference by an irresponsible person (password, fingerprint,...).

The machinery delivery has to include a crisis plan (as long as it is possible to compose one for such equipment). It has to contain instructions on how to proceed in case of operation outage of various peripherals and what to use as a substitute until the situation has been rectified. The crisis plan has to be discussed with the ordering party representative during the concept approval phase.

8. Document Requirements

Together with the work it is necessary to deliver the following documentation in the specified languages. The documentation shall be handed over in duplicate - set No. 1 - paper version, set No. 2 - data carrier.

- Declaration of Conformity (Czech)
- Commissioning inspection (Czech)
- Bill of material (Czech and German)
- Service instructions (Czech)
- Drawings of assemblies / welded units (complete drawing documentation)
- Wiring / pneumatic / hydraulic diagrams (Czech)
- List of spare parts and fast wear parts (Czech)

- Plan of revisions and preventive inspections (Czech)
- Completion certificate + data on output test (Czech)
- Record of training operators and maintenance personnel (Czech)
- Lubrication plan and TPM (can be part of the operating instructions)(Czech)
- Analysis of the risks of safety and health protection at work – including the methodology by which it was created (Czech)
- Software (complete including control and control panels) (Czech)

9. Limitations

9.1 Floor area and anchoring

The machine shall be installed on a concrete floor. The anchoring requirements must not exceed the depth of 22 cm from the floor level.

Due to the envisaged vibrations, the line must be permanently and sufficiently robust fixed to the ground.

9.2 Electrical protection

From the standpoint of electric shock safety, the manufacturing area is defined as an "Area with risk of flammable substance fire – BE2N1". That is why all the electrical equipment has to be provided with a minimal protection of IP4x (IP44 and higher).

10. Capability, Precision, Tolerance and Availability of the Equipment

10.1 Machine and Process Capability

The plant must meet the requirement of $C_p, C_{pk} \geq 1.67$ for all dimensions (diameter, thickness, length).

The control unit must have SW to calculate C_p and C_{pk} of the stored values and display these in real time.

10.2 Tolerance of the Input Parts

The plant must be capable of making parts in repeatability within the tolerance range controlled by the following table:

quantity	nominal	tolerance
length	1 - 500 mm	± 0.50 mm
	501 - 2000 mm	± 0.75 mm
	2001 - 5000 mm	± 1.25 mm
	5001 - 6100 mm	± 2.50 mm
diameter	4.75 6.00	± 0.05 mm
thickness of layers	According to specification	

10.3 Equipment Availability

OEE of the machine > 85%, the machine is to be operated in three shifts, 15 shifts a week, 8 hours a shift.

11. Ensuring Operation

In case of malfunction, it is necessary that the contractor installs a remote access fault diagnostic device.

12. Work Safety and Health & Environmental Protection

The machinery must comply with loudness standards according to the relevant laws of the Czech Republic.

The device must include sufficient means of worker protection. All moving or rotating parts have to be covered and inaccessible during operation.

The machinery must not diminish the air quality or pollute its surroundings and/or environment.

All baths must be secured with an electronic lock not allowing to open the cover in operation. The lock can only be unlocked with a password on the main control panel.

All bath covers must be designed so that no liquid leaks out of the designated storage vats in the closed or open position.

All vats and vessels shall be labelled according to the GHS labelling system (globally harmonized system and labelling of chemicals). The description must be in the Czech language and the proper description tables on a plastic backing. A description to be specified according to safety data sheets attached to the individual chemical substances.

Globálně harmonizovaný systém klasifikace a označování chemikálií (GHS)		
Symbol	Označení	Název – význam symbolu
	GHS01	výbušné látky
	GHS02	hořlavé látky
	GHS03	oxidační látky
	GHS04	plyny pod tlakem
	GHS05	korozivní a žíravé látky
	GHS06	toxické látky
	GHS07	dráždivé látky
	GHS08	látky nebezpečné pro zdraví
	GHS09	látky nebezpečné pro životní prostředí

Fig. 9 GHS labelling system

Media labelling on the piping:

Perform labelling according to ČSN 130072. The basic description table is exempt from the standard:

ČSN 13 0072

Tab. 1 BAREVNÉ OZNAČOVÁNÍ PROVOZNÍCH TEKUTIN

Číslo skupiny	Název	Barva pruhu a štítku		Barva písma a okraje štítku
		Název odstínu	Příklad odstínu podle přílohy k ČSN 67 3067 ¹⁾	
1	Voda	zeleně světlá	5014	černá
2	Pára vodní	šed' stříbrná	1010	černá
3	Vzduch	modř světlá	4400	bílá
4	Plyny hořlavé	okr žlutý	6600	černá
5	Plyny nehořlavé	okr žlutý	6600	černá
6	Kyseliny a tekutiny povahy kyselé	fialová	—	bílá
7	Zásady a tekutiny povahy zásadité	fialová	—	bílá
8	Tekutiny hořlavé	hnědá	2320	bílá
9	Tekutiny nehořlavé	hnědá	2320	bílá
10	Ostatní	černá	1999	bílá

Poznámka: ¹⁾ Odstíny musí vyhovovat vymezeným oblastem kolorimetrického trojúhelníka podle obr. 1

Marking operations on the line:

Individual machines on the line will be indicated by a description table, see below - description according to the table

The upper and middle line will not be changed - the bottom part (in the green box) and the number of pieces according to the table. Dimensions - length 40cm/height 20cm. Material: plastic Location after the line installation and by agreement with the customer.

Item No.	Description in the table (text in the green rectangle)	Number of pieces
1	UNWINDING NO. 1	1pc
2	UNWINDING NO. 2	1pc
3	PIPE JOINING	1pc
4	TRANSPORT, STRAIGHTENING AND CALIBRATION	1pc
5	INDUCTION HEATING	1pc
6	HOT-DIP COATING OF ZINC-ALUMINUM ALLOY +MAGNETIC WIPER SYSTEM	1pc
7	COOLING NO. 1	1pc
8	COOLING NO. 2	1pc
9	ACTIVATION	1pc
10	PHOSPHATING - TANK NO. 1	1pc
11	PHOSPHATING - TANK NO. 2	1pc
12	PHOSPHATING - COLLECTING TANK	1pc
13	RINSE NO. 1	1pc
14	RINSE NO. 2	1pc
15	PASSIVATION	1pc
16	DRYING PRIOR TO PRIMING	1pc
17	PRIMING	1pc
18	DRYING AFTER PRIMING	1pc
19	INDUCTION HEATING	1pc
20	EXTRUSION	1pc
21	COOLING NO. 1	1pc

22	COOLING NO. 2	1pc
23	INSPECTION	1pc
24	TRANSPORT AND STRAIGHTENING	1pc
25	DIVISION	1pc
26	SORTING OK/NOK PIECES	1pc
27	WINDING	1pc

Paint coats of machinery:

RAL 7004/7035 – an exact specification will be clarified later after consultation with the customer.

13. In general

The machinery must not damage or degrade worked or tested component (as in cause a functional or visual defect).

During the design and construction periods, the contractor is obliged to seek solutions to reduce costs without compromising the quality or the specification.

The same requirements as for the entry through a single-level password apply to the manual mode.

Requirements for TPM and replacement of individual charges will be inserted into the line SW, enabling time data setting and a subsequent message to the machine panel. Unblock the message only with an entry password. It will be determined after the plant installation.

Storing of exchangeable tools must be part of the line. We prefer steel boxes of the same colour as machinery capable of being locked.

14. Handover of the Work

The work can be delivered only if:

- all the requirements of Technical Specification 2016.18 are taken into account,
- all the required records and documents are available,
- the R&R inspection procedure results in no objections,
- SMED guidelines are complied with
- presentation of a suitable protocol on “Inspection of the commissioning of safety elements”
- Detailed handover points - see below

The machinery may only be accepted as a whole, not its partial components:

- Draft design acceptance – relates to machinery completeness approval.
This shall be completed through e-mail or visit paid to the manufacturer - design acceptance requires a complete machine assembly with its main sub-assemblies. The assembly must contain everything that will be installed on the machine (switchboard, PC, keyboard, working units, vats, media distribution systems, reject box, etc.). Approving individual partial machine nodes is unacceptable. Record of acceptance - see CE requirements and general ergonomic regulations valid in the Czech Republic – see Appendix No. 1.
- Pre-acceptance at the supplier - completeness of the line and its visual appearance will only be checked. Only individual mechanical machines without materials will be further tested.
- Transport, assembly, and installation at the customer's facility – must be included in the bid price – trial operation during which the machine must reach the required time cycle during one-day production (two shifts). The customer shall supply the components at its own cost.
- In case of any requirements for other components, these will be charged to the supplier unless otherwise agreed.
- The line acceptance and approval itself will take place after a 5-day output test in two-shift operation. The Cooper standard methodologies shall be applied to the acceptance with the resulting calculation of the line capacity, its scrap and problems encountered during the output test. Material for the output test shall be provided by the customer

15. Appendices

Appendix No. 1	CE requirements and general ergonomic regulations valid in the Czech Republic
Appendix No. 3	Safety data sheet for the chemical substance SurTec 198 - ART.NR.S04218
Appendix No. 4	Safety data sheet for the chemical substance Bonderite M-AD 4977
Appendix No. 5	Safety data sheet for the chemical substance Prepalene X
Appendix No. 6	Safety data sheet for the chemical substance Bonderite M-ZN 1421-AR
Appendix No. 7	Safety data sheet for the chemical substance Bonderite C-AD 565
Appendix No. 8	Safety data sheet for the chemical substance Gardolene D 6890
Appendix No. 9	Safety data sheet for the chemical substance 8196000 Special Thinner
Appendix No. 10	Safety data sheet for the chemical substance APC NYLON PRIM NA 5GL
Appendix No. 11	Safety data sheet for the chemical substance Vestamit X7377 black 9.7504
Appendix No. 12	Safety data sheet for the chemical substance paint LINX Clean UV-Readable ink1121
Appendix No. 13	Safety data sheet for the chemical substance thinner LINX Solvent for UV-Readable ink1590