

Technical specifications

Continuous galvanic copper coating line

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Rev.	Effective date	Changes
1	29/04/2016	First issue.
2	02/05/2016	Additional requirements for water treatment
3	18/08/2016	Integration material manipulation requirements + water treatment detailing
4	28/09/2016	Redefined requirements for input and output of material
5	30/09/2016	Removed Preferred providers
6	19/10/2016	Description of the line sections

Functionality	Name	Effective date	Signature
Advanced Engineering / originator	Petr Musil	19/10/2016	
Maintenance Supervisor / checked by	Miloslav Brabec	19/10/2016	
Project Leader/Approved	Libor Dolák	19/10/2016	
HS&E supervisor / checked by	Lenka Nováková	19/10/2016	

Purpose of the document

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

Bid Scope

This specification supports the design and production of a single-purpose machine for the customer – Cooper Standard Žďár. The project must contain proposal, design, production, assembly, transport, installation of machinery, training of operators and maintenance personnel, and participation in the commissioning at the customer's facility, as required.

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Contact Persons

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General Requirements for the machinery

- These requirements serve as a general regulation for machinery design.
- The system shall be designed and produced in order to meet the CE requirements and general ergonomic regulations valid in the Czech Republic. The evaluation of ergonomics of the individual worksites shall be included in the handover documentation, and it must fulfil CSA specification of ergonomic factors for operation of machinery.
- 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, hangers, conveyer level, etc.).
- The electric panels should feature a surface finish (powdery coating) shade agreed with the customer. The machine must feature a touch display (at least 4 rows) and five extra inputs and outputs. All the sensors installed in the machine must be connected through connectors due to their simpler and quicker replacements during operation.
- Every machine must be lit in line with the legal hygienic requirements. It shall be possible to control the light separately - independent of the machine controls.
- Each machine has to be equipped with info table (Bosch) A4.
- The machines must feature manual closing valves at the hall central distribution system connection location. The machine must always feature one set of 230 V sockets behind the operator's work area and one 230 V socket in the machine distribution box.

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- Machine process parameters: the process parameters setting must be password-protected. A password change must be possible only with usage of double level of passwording.
- If the machine features measuring and evaluating components (technological parameters, leaks, etc.), their calibration sheets and defined calibration periods must be supplied.
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.
- All the measured process (temperature, speed, etc.) or test values (leaks, pressures, etc.) must be stored in the machine PC. This requirement is valid for all inputs into control and set up system. Each individual entrance or change will be recorded with time / day / month / year.
- 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.
Replaceable tools shall be marked according to adequate mounting assemblies and sub-assemblies – marking agreed with the customer.
- The machine must feature a lighted beacon that indicates production conditions. (GYR). In case of line each individual machine has to have above mentioned light signalization.
- 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 machinery must not exceed $35 \pm 3^\circ\text{C}$.

All machines must be filled with their first operating fluids. The machines whose chemical substances may leak (hydraulic oil, etc.) must feature drip trays for leaking fluids. Chemical liquids relate to direct coating process are excluded from requirement.

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- The completion documentation must include a list of used chemical substances, including their MSDS.
- All the air reducing valves must feature lockable covers, or reducing valves with key-based position blocking must be installed. In case of key solution all valves has to have one central key.
- The machinery has to be equipped with a counter of hours (pieces made) with options to report service intervals in relation to operation hours (pieces made).
- The tool exchange for different references has to comply with SMED guidelines and must not take longer than 10 minutes.
- The machinery must be equipped with elements of the LOTO system that ensures the safe locking of the main controls in case of downtime, or maintenance.

Description of the Machine Functions and Technical Requirements

The enquired "Continuous galvanic copper coating line" machinery is used for two-sided strip copper coating.

The strip is wound into a roll and guided into the continuous line in which a copper layer is applied in a KCN electro-alkaline bath. The copper-coated strip is at the end of the line wound into a roll again. An integral part of the delivery of the machinery must be a complete system for cleaning the wastewater from production, and also a complete system for cleaning the vapours from the production line.

Input material

The input material is a metal strip in the form of a roll. The mechanical and dimensional properties are listed below.

Material class:

DC01/DC03 according to EN 10139 – class LC

Chemical composition:

C	0.02 – 0.07%
Mn	0.1 – 0.3%
P	max. 0.020%
S	max. 0.020%
Al	0.02 – 0.085%
N	max. 0.006%

Mechanical properties (Tensile test according to EN 10002 Part 1, Annex B):

Rm	280-390 N/mm ²
Rp 0.2	180-290 N/mm ²
Ductility	min 28% (Lo=80mm, Clamping length 200mm)

Stripe thickness:

0.34 – 0.35 mm

Tolerance: +0.008 / -0.013

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Inner roll diameter:

400 mm

Outer roll diameter:

1100 – 1550 mm

Roll width:

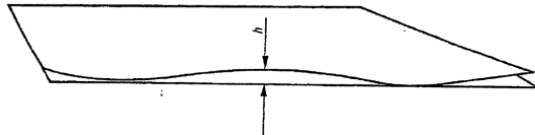
336.44 – 350 mm

Tolerance: 0 / +0.1mm

Permissible flatness deviation 1.5 mm / 1000 mm

Permissible flatness deviation 1.5 mm / 1000 mm

Edge waviness h: should not exceed 2,5mm see picture:



On a crosscut piece of 1m length no more than six (6) waves higher than 1,5mm permitted

Roll weight:

2.7 - 3 tons

Roll length:

3100 m

Technological requirements of the machinery

Continuous galvanic copper coating line

The minimum annual production capacity of the line

(300 days in the year / 3 shifts per day / 7.5 hours per shift OEE 85%:

7000 tons of metal coated strip

Line speed: According to the composition of the individual baths and line technologies upon achievement of the requirement for minimum annual production capacity 7000 tons

Maximum number of operators (including the wastewater cleaning plant) is 2.

The metal-coated strip runs vertically through the line in direction from left to right.

The galvanising line itself must be designed for galvanic copper coating in pure KCN baths. Combination of KCN, acid baths is non-permissible. There is also used demineralised water in the line. The equipment for making demineralised water must be included in the offer.

Description of the Cu coating line:

1. **Decoiler section** with two decoilers-The line input must have a solution that ensures smooth and continuous operation during feed of a new coil to the continuous line. The coil must be fixed on the decoiler to ensure the stability and tension of the inner core.
2. **Coil connecting section**-Connection of two metal strips cannot affect anyhow required quality of coated strip. Connection of two steel strips has to be designed in the way that coating process and steel strip movement is not interrupted. The final solution must have equipment for mechanical jointing (riveting, spot welding, etc.) of the initial and new roll.

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3. **Guiding section**–Line design, system for movement of steel strip in the line, accumulator design and all other line features has to ensure to avoid any kind of plastic mechanical deformation or damages of base steel strip.
4. **Degreasing section** of the line consists of separate cathodic and separate anodic cleaning. All chemical substances to be added for the degreasing bath adjustment will be added from the separate mixing tank through pumps, based on chemical analysis. A leveller, pump, piping, heating and mixer must be part of delivery.
5. **Rinsing section** – 3 x rinsing sections with city water and one rinsing section with DI water. A cascade rinsing system must exist in-between the baths. The de-ionized water rinse is continuously recycled from the deionized water system.
6. **Copper plating** – Copper plating process based on five (5) electrochemical cells with 20 anode baskets per each cell for copper pellets on both sides of the metal strip. Each galvanic bath of the line must have its rectifier.
All the baths must be based only on KCN. The electrolyte temperature is 55 ° C and is regulated automatically.
Each bath and tank has to be filtered minimally 2x per hour.
KCN section of line has to be clearly marked to be clearly identified. Required solution is color-coding of each batch, tube, etc. On the line and floor has to be clearly defined where KCN is used? Only KCN electrolyte will be used in the galvanic coating process, any use of acid is not foreseen.
Supplier of the line must guarantee that KCN electrolyte is always above pH 14 based on the concentration of 60 g/l KCN. Bath adjustment will be conducted through analysis based on chemical instruction.
Aerosol build up will be safely extracted through the exhaust system and washed off in the air scrubber.
All to be added chemical substances (KCN, copper cyanide) will be dosed from the preparing and storage tank through pumps based on chemical analysis.

The copper coating baths must have a **shielding system** to reduce the accumulation of the metallic layer on the edges of the metallic strip. From the viewpoint of stable thickness of the copper layer, the edges of the strip with this layer must not be more than 1.6 mm from the edge of the strip. The shielding system must be adjustable for different width of the strips. The copper must be applied directly to the metal strip without using any organic, or inorganic intermediate layers or any additives. The only manual operation is top-up of the copper pellets in the anodic baskets.

The full galvanic line must be located in dip pans made of PP material to capture any eventual drips. A dip pans have to be equipped with sensor for detection of leak with alarm report to central control panel.

The dip pan system has to be designed in the way that in a case of leak a liquid is distributed to the water treatment. Supplier must guarantee that chemical liquids between degreasing, KCN section and passivation can be mixed in one common dip pan and there is

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no risk of a dangerous chemical reactions. KCN bathes has to be designed in the way a carbonate settlements are regularly removed out of bath.

7. Rinsing section – 5 x rinsing sections with city water and one rinsing section with DI water. A cascade rinsing system must exist in-between the baths. The de-ionized water rinse is continuously recycled from the deionized water system.

8. Passivation -is a bath for application of the passivation layer. Entek CU 56 is required liquid for passivation. All chemical substances to be added for the passivation bath adjustment will be added from the separate mixing tank through pumps, based on chemical analysis. A leveller, pump, piping, heating and mixer must be part of delivery.

9. Blow of section by air

10. Drying section in a furnace

11. Guiding section - system for movement of steel strip in the line, accumulator design and all other line features has to ensure to avoid any kind of plastic mechanical deformation or damages of base steel strip.

12. Coiling sections with two coilers

The line output must have a metal strip accumulator that ensures smooth and continuous operation during removal of the metal coated coils from the continuous line. The coil must be fixed on the coiler to ensure the stability and tension of the inner core.

The line output must have an equipment for coiling an interleave paper between separate layers of coating strip.

13. Free space

The part of the line has to have 3 meters long free section where inline measurement can be placed and section would be used in case any additional chemical process has to be added. A positioning in these free section is under supplier technical decision but should be after copper coating sections due to requirements for inline measurement.

There is an optionally required to offer a measuring device capable of continuously measuring the thickness of the applied copper layer at a minimum number of 5 measuring points with a minimum frequency of every 450 mm.

Each individual section of the line must be completely closed with a lid to prevent the evaporation of chemical substances into the working environment. Each lid has to be equipped with sensor detection of open position with alarm report to central control panel.

Supplier must guarantee that the vapours from degreasing, KCN section and passivation can be mixed in one common exhaust system and there is no risk of a dangerous chemical reactions. The filtration (exhaust) system must ensure the removal of all chemical

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substances created during the galvanising processes. This filtration system must further be connected to the wastewater treatment plant for neutralization and liquidation of chemical deposits. Supplier is responsible for design and delivery of last piece of functional section of exhaust system. Exhaust ways outside of coating system in CSA responsibility.

The entire line must be made of chemical resistant PP material. All metal components must be made of chemical resistant steel or prepared against corrosive environment if required. Preferred solution is without any additional floor changes and requirement for sunken technological channels. In case of any additional requirements for building changes or floor specific modification this has to be handed over in a week after contract signed off.

All treatment with chemicals and with exhaust must be in compliance with Czech legislative requirements.

Wastewater treatment plant

An integral part of the offer must be a wastewater cleaning and treatment plant. The treatment plant must be designed for fully automatic control of chemical processes, control of the concentrations of the individual sections and top-up of the necessary chemical substances. The condition of the individual sections, actually running processes must be located on one control panel.

The wastewater treatment plant is connected to the continuous galvanic copper coating line in a closed circuit. The output from the line should only be the “dry matter” of the settled chemical substances, for subsequent liquidation. Containers for sludge export will be part of delivery. All pumps from sumps are part of delivery.

Water treatment has to be designed to prepare, treat and clean technological waters from other technologies in the plant:

1. 2x conductive brazing line for double wall brake tubes (CB2, CB3)
2. 1x inductive brazing line for double wall brake tubes (CB1)
3. 1x high frequent welding line for single wall fuel line (SW)
4. 2x Hot dip zinc base coating lines MagAlloy

Requirements and volumes for entry and waste water including exchange frequency are in attachment “Chemical liquids overview demi water consumption for water treatment”. Supplier has to guarantee that there can be only one pipe coming from the tube production going into the waste water system.

A galvanic line filtration system is also connected to the wastewater treatment plant.

The wastewater treatment plant and exhaust system must be designed to meet all the legislative and other requirements of the European Union and the Czech Republic as well as the requirements of the permitted ecological burden of the Czech Republic and the local requirements given by region.

Osmosis system and ion exchanger recirculation system

An integral part of the water treatment plant has to be an osmosis system designed to cover demi water volumes required in attachment “Chemical liquids overview demi water consumption for water treatment” with outcome conductivity smaller than 10 $\mu\text{S}/\text{cm}$. Demi water production system has to design as membrane technology – reversing osmosis.

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Entrance water into osmosis system will be connected to main city water pipe system- The ion exchanger recirculation system is designed to withhold the DI rinse water coming from the copper plating line which is contaminated with cyanide and copper.

Hourly maximum discharge of drain waste water to city canalization must not exceed volume:

1. Cu coating 145 l/hour (3500 l/day) for production shift pattern 300 days in the year / 3 shifts per day / 7.5 hours
2. Other technologies (1x CB1, 1x CB2, 1x CB3, 1x SW, 2x MagAlloy) 270 l/hour (6500 l/day) in production shift pattern 250 days in the year / 3 shifts per day / 7.5 hours

Output qualitative requirements

Copper coating structure corresponding to the KCN galvanic bath

Copper layers applied uniformly on both sides

Thickness of layer on one side 2.2 – 3.7 μm with Cpk 1.67

Thickness of layer on other side 2.2 – 3.7 μm with Cpk 1.67

Surface quality

RZ max. 5.0 μm

Rmax. < 10 μm

Any mechanical damage, scratches, cracks and wavy edges of the metal coated strip are non-permissible.

Any kind of poor adhesion (blistering or peeling) is not allowed.

Final coated coil condition has to fulfil following specification:

1. Camber edge definition - Maximal permitted deviation of the straightness 1,5 mm / 1000 mm.
2. Cutting edges have to be smooth without any wave profile or deformation caused by the technological equipment or used technological process.
3. Swaged material in edge area (deformation of waviness of strip) is not allowed.
4. Coil has to be recoiled tight, without any strip release in the any windings, with the equal and the same specific tension in the all windings about 15 - 20 N/mm² (tension 1900 N - 2500 N for the typical processed strip thickness 0,35 mm x width 365,5mm // cross section = about 128 mm²).
5. Not any changes of the circular shape of the inside diameter 400 mm of the coil are allowed. Also any defective damage marks/sign caused by the Decoiler / Recoiler drums and free slots between the drums jaws are not allowed.
6. Flatness of the side surface of the coil has to be max + 2 mm / - 2mm, measured per the full coil outside diameter 1000 mm.
7. Maximum deviation of the two windings in the coil, nearby lying on to itself has to be max 1 mm.
8. Maximum deviation of the first 2-3 windings and last 2-3 windings of the each coil can be with the deviation about + 5 mm / -5 mm compare with the coil side surface, these windings have to be planed to the coil surface slightly by the hand.

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9. End of the coil has to firmly fixed to the coil (adhesive tape) allowed to next handling, without any release of the coil and windings.
10. The length of the bended start of the strip in the inside diameter 400 mm, caused by the recoiler drum clamp is maximum 100 mm.

Assumed area of the machinery

Continuous galvanic copper coating line	ca. 6 x 80 m (height limit 4 m)
Wastewater treatment plant:	ca. 30 x 7 m

Description of the Control Elements

Operation, control and visualisation of the stations is preferentially solved using industrial automatons of the Siemens Simatic S7 brand. Other control elements are only acceptable throughout prior agreement of both parties. Visualisation on the electro-panel must shall all the functional elements of the line, their states and graphically represent their function.

System for monitoring of technological parameters:

Must display and store the following data:

- Line speed in m/min

- Flow characteristics of the individual sections

- Temperatures of the individual sections – continuous frequency of the sample/1sec

- All the setting limits and tolerance fields – always at the moment of change

- All error messages + alarms – always with time stamp and elimination condition with time stamp

Records of individual temperatures, el. current outputs and strip speed must be entered continuously in a graph in relation to time. The machine must be ready for local download of stored data and also connection to the internal server.

The work delivery includes control SW as well as its source codes. Control unit has to be equipped with remote control for service organization based on Internet connection supplied by customer.

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 has to be protected against access of unauthorized personnel (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.

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Document Requirements

Together with the work, it is necessary to provide following documentation in specified language versions:

- Declaration of conformity (Czech and English)
- Maintenance schedule (Czech)
- Commissioning inspection (Czech)
- Parts list (Czech and English)
- Operation manual (Czech and English)
- Assembly drawings / Welded unit drawings (Czech)
- Wiring / pneumatic / hydraulic diagrams (Czech)
- List of spare parts and fast wear parts (Czech)
- Plan of revisions and preventive inspections (Czech)

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.

Dimensional floor quality is in 3m square raster 5mm level deviation.

Machine and Process Capability

The machinery must fulfil the requirement of C_p , C_{pk} , C_m , $C_{mk} \geq 1.67$ for the dimensions defined in point 5.

The control unit must be provided with software that can calculate C_p and C_{pk} from stored values and display these in real time.

Availability of the machinery

OEE machines > 85% 300 days in the year / 3 shifts per day / 7.5 hours per shift

Ensuring Operation

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

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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.

Description of chemical liquids and marking requirements has to be according to GHS (Global harmonized system of chemical liquids identification and marking).

Each individual line section (tanks, reservoirs, line tubs, magazines etc) has to be marked with type of used chemical including in local language with specific pictograms and symbols according table below. These information has to be written on chemical resistance plastic or steel label.

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

Date & revision: 19/10/2016 revision: 6

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Piping and marking of copper according to ČSN 130072.

The machine shall be installed in the following environment: 3. particularly dangerous

1. Normal
2. Dangerous
3. Particularly dangerous

Generally

The machinery must not damage or degrade worked or tested component (as in cause a functional or visual defect). The maximum allowed scrap ratio caused by the machinery for the aforementioned faults is 2 per mil.

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

Handover of the Work

The work can be handed over only if:

- all the requirements of this specification are taken into consideration
- 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"

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 all the to-be-installed items (distribution box, PC, keyboard, scrap box, etc.). Approving individual partial machine nodes is unacceptable. Completed acceptance certificate – see the Acceptance certificate issued for machine and equipment at the manufacturer's facility – document number d1120_1.
Pre- acceptance of hardware at the supplier's facility shall be done – take place after installation at the manufacturer's facility, during which the functional test of the mechanical parts and line controls must be done. Record of acceptance in the acceptance certificate issued for machine and equipment at the manufacturer's facility.

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- 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 (three shifts). The customer shall supply the components at its own cost. If any other components are required, they shall be billed to the supplier.
- The customer shall supply material at own cost in an adequate quantity for a continuous three-shift operation.

Parameters of the Offer

Warranty	36 months after installation and approval
Client's approval	on the basis of defined validation tests

Business terms and conditions according to Annex 3 ZD - Draft business terms and conditions
copper coating

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