IE LICENCE APPLICATION

OPERATION REPORT

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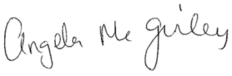
Angela McGinley		19 August 2019

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1 INTRODUCTION

The proposed activity will be subject to license application to the EPA under the Industrial Emissions Directive (2010/75/EU) (IED) which has been transposed in the Republic of Ireland (RoI) via Schedule I of the Environmental Protection Agency (EPA) Act 1992 as amended. Section 12.3 states that 'the surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m3' must be subject to IED licensing.

An Operational Report has been prepared as part of the license application for the proposed tinning plant in the manufacturing process of Powerbar technology products at E&I Engineering Ltd in Burnfoot, Co. Donegal (Drawing IBR1105/001. The proposed process involves the surface treatment of metals (aluminium and copper conductors) using an electrolytic or chemical process. All of the works will be contained within the existing footprint of the factory or within the approved extensions. The original site was established under Planning Ref no 03/4471 which granted permission for a new manufacturing premises/industrial unit which has since been extended a number of time as evidenced in the planning history outlined in Section 2.4 of the EIAR. Planning permission is currently being sought is for to develop of the proposed tinning plant. The proposed boundary for this IED licence application is shown in Drawing No IBR1105/002 in Appendix A. This Operational Report describes the plant and outline methods, processes, abatement, recovery and treatment systems, and operating procedures of the activity. The site plan is provided in Drawing IBR1105/003.

2 PROCESS DESCRIPTION

2.1 Description of Process

The process involves the surface treatment of busbars (aluminium and copper conductors) using an electrolytic and chemical process. The surface treatment of the aluminium and copper conductors will involve the dipping of the conductors in a number of different tanks with a different combination of chemicals and rinse water in order to provide a tin plate on the conductors to prevent corrosion.

The proposed tinning plant will be capable of three separate processes that will require a different combination of treatments in a different sequence of tanks with varying chemistry and rinse water:

1. Aluminium process – tin plating of aluminium conductor
2. Copper process – tin plating of copper conductors
3. Rework cycle – a nitric acid dip and a rinse – this is a process to repair any poor quality issues.

There are 23 single tanks and 2 double tanks, making a total of 27 tanks used across the 29 different stages of the process. The plan layout and long section of the tanks for a similar facility is provided in DWG No. Z01-01. A Cross section is also provided in DWG No. Z02-01. A flight bar will lower the conductors into the chemical and rinse water baths as they move along the manufacturing line.

A simple flow diagram of the treatment process activity is provided below in Figure 2.1 for Aluminium busbars and in Figure 2.2 for Copper busbars with a more detailed flow diagram provided in Appendix A.

Figure 2.1 Aluminium Busbar Process Diagram

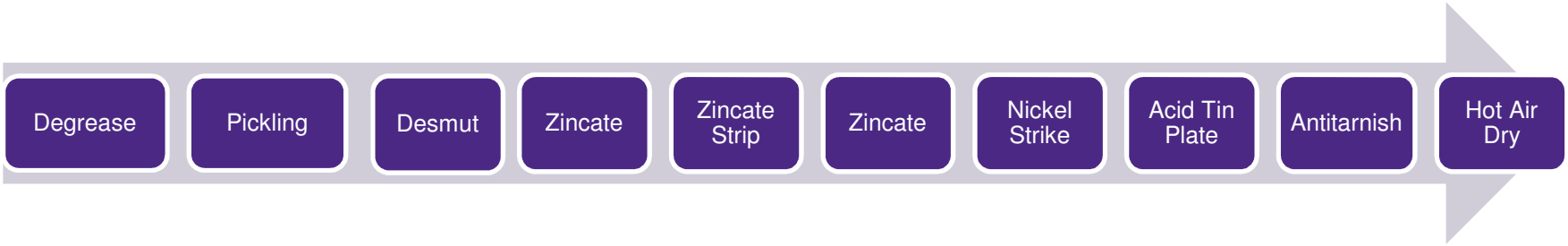
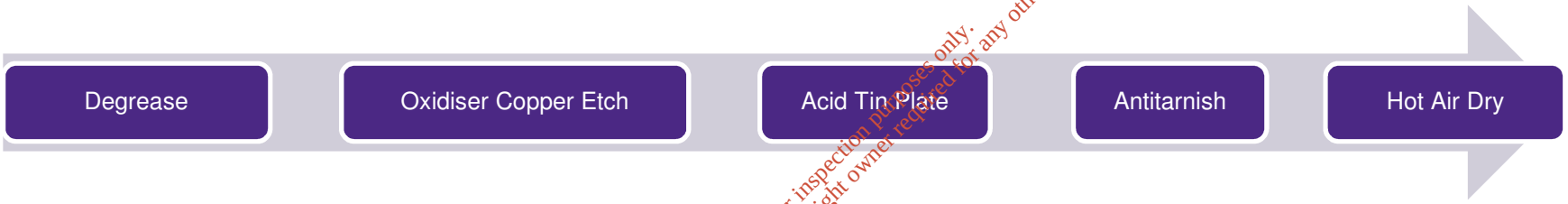


Figure 2.2 Copper Busbar Process Diagram



Whilst the proposed process to be used at E&I Engineering has 29 stages for the surface treating of aluminum or copper busbars, a brief summary of the key stages is provided in Tables 2.1 and 2.3 below. The busbars are rinsed with deionised water after each immersion.

Table 2.1 Aluminium Busbars Process

Stage	Process Bath & Stage Number	Bath Solution	Description
Pre-treatment	Degrease (Stage 28)	Degreaser SLOTOCLEAN AK90	Immersion for 5 minutes at 65°C
	Pickling (Stage 25)	Aluminium Pickle SLOTOCLEAN AK60	Immersion for 40 seconds at 55°C
	Desmut (Stage 22	SLOTOCLEAN DS10	Immersion for 2 minutes at room temperature
Core activity	Zincate (Stage 16)	Zincate CNF 10	Immersion for 2 minutes at 24°C
	Zincate Strip (Stage 21)	SLOTOSTRIP ZN 10	Immersion for 2 minutes at room temperature
	Zincate (Stage 16)	Zincate CNF 10	Immersion for 2 mins at 24°C
	Nickel Strike (Stage 12/13)	Nickel Plate Solution NORMA	10 minutes at 60°C
	Acid Tin Plating (Stage 6/7)	Bright Tin CULMO 1	10 minutes at room temperature
After treatment	Antitarnish (Stage 4)	Antitarnish ALS 30	Acid based process (pH approximately 1-2) for the post-treatment protect the finish.
	Hot Air Dry (Stage 2)	Hot Air Drying	Jigs placed in a tank-shaped drier and hot air is evenly re-circulated from the top to the bottom of the tank at temperatures of 60-80°C.

Table 2.2 Copper Busbars Process

Stage	Process Bath & Stage Number	Bath Solution	Description
Pre-treatment	Degrease (Stage 28)	Degreaser SLOTOCLEAN AK90	Immersion for 5 minutes at 65°C
	Oxidiser Copper Etch (Stage 9)	SLOTETCH 584	Immersion for 2 minutes at 25°C
Core activity	Acid Tin Plating (Stage 6/7)	Bright Tin CULMO 1	10 minutes at room temperature
After treatment	Antitarnish (Stage 4)	Antitarnish ALS 30	Acid based process (pH approximately 1-2) for the post-treatment protect the finish.
	Hot Air Dry (Stage 2)	Hot Air Drying	Jigs placed in a tank-shaped drier and hot air is evenly re-circulated from the top to the bottom of the tank at temperatures of 60-80°C.

Table 2.3 Rework Cycle Process

Stage	Process Bath & Stage Number	Bath Solution	Description
Core activity	Rework (Stage 20)	To be confirmed	Rework is a process used to strip or rework unsatisfactory coatings on busbars.

2.2 Unit Operations to be carried out

2.2.1 Workpiece Loading for Processing

The busbars will be transported via jigs (frames which will carry the busbars singly). The jig will be hung on a flight bar which moves the jig through the core process steps. The flight bar is moved by a transporter or beam mechanism.

2.2.2 Pre-Treatment

The busbars to be surface treated must be clean to ensure the uniform application and permanent adhesion of the surface treatment.

2.2.2.1 Degrease

The busbars will be degreased using an aqueous solution at increased temperature to improve the cleaning effect. Degreaser SLOTOCLEAN AK 99 is a weak alkaline immersion degreasing process for the removal of processing oils and drawing compounds from copper or aluminium.

2.2.2.2 Pickling

Pickling is a chemical metal-stripping procedure used to brighten and/or remove oxides from the degreased metallic surface prior to other surface treatment processes.

The pickling bath will be made up of Pickle Additive SLOTOCLEAN AK61 and Sodium Hydroxide. Pickle Additive SLOTOCLEAN AK61 is a weak alkaline concentrate used as an additive in sodium hydroxide long-running pickle. It has excellent wetting and dispersing properties and contains specific organic oxides and complexing agents to prevent the formation of scale even at high aluminium concentrations.

2.2.2.3 Oxidizer Copper Etch

Oxidizer Copper Etch is a chemical metal-stripping procedure used to brighten and/or remove oxide. The grease of subsurface detritus may also be removed during this process.

2.2.2.4 Desmut

Desmutting is used for the removal of smut formed during the chemical etching of aluminium prior to electrolytic plating to produce quality deposits on the aluminium busbars.

2.2.3 Rinsing

Rinsing with deionised water will be carried out between process steps to prevent cross contamination of the process solutions and to ensure there is no deterioration of the busbar surface by residual chemicals. Busbars will be rinsed in deionised water for 1-2 minutes. Stage 3 rinse is a Hot Rinse and Stage 5 rinse is an Acid Rinse. All other rinse in the process are a cold-water rinse.

2.2.4 Core Activities

2.2.4.1 Zincate & Zincate Strip

Zincate treatment is necessary for good adhesion in subsequent electrolytic metal plating. With aluminium and its alloys, because of their very high surface reactivity, it is necessary to deposit a thin layer of zinc on the surface of the workpiece by non-electrolytic chemical treatments known as the 'zincate' or 'double zincate' processes. A two-step zincate treatment allows better adhesion of the subsequently deposited coating.

2.2.4.2 Nickel strike & Acid Tin Plating

The nickel strike bath is only used in the aluminium process and the acid tin plating is used in both the aluminium and copper processes. The aluminium or copper busbar is emerged in a bath which contains an electrolytic solution which serves as a conductive medium during electrodeposition.

A rectifier is a transformer that converts alternating current from utilities to direct current suitable for electroplating. The rectifier electrifies the rack causing the aluminium or copper busbar substrate to act as a cathode (negatively charged electrode) in an electrolytic cell. The tin or nickel anodes (positively charged electrodes) are also electrified. The electrical current causes positively charged ions at the anode to flow through the electrolytic solution in the plating bath toward the negatively charged cathode where nickel (nickel strike bath) or tin (acid tin plating bath) is electrodeposited onto the surface of the busbar. The current then flows back toward the anode to complete the circuit.

Rectifiers are only used in electroplating baths; Nickel strike bath and acid tin plating bath. Four sets of 8V, 400Amps and four sets of 8V, 800Amps switching type air cooled rectifiers will be used in the process with less than 5% ripple (<5% variation in the direct current voltage within the power supply).

2.2.4.3 Rework Process

The rework is a process used to strip or rework unsatisfactory coatings on busbars. The busbars are submerged in a bath solution, the chemical composition of which is still being formulated with the E+I Engineering Chemists, with the remainder consisting of deionised water. Additionally, the rework bath can be used to remove nickel and tin that accumulates on plating racks. Use of the rework bath will be kept to a minimum.

2.2.5 After Treatment

2.2.5.1 Antitarnish

Antitarnish is an acid based process (pH approximately 1-2) for the post-treatment of tin plated components to protect the finish.

2.2.5.2 Hot Air Dry

After treatment processes involve drying the busbars using hot air. The jigs are placed in a tank-shaped drier and hot air is evenly re-circulated from the top to the bottom of the tank at temperatures of 60-80°C.

2.3 Process Control System

The Process Control System is a Programmable Logic Controller (PLC) system which controls the operation of the transporter to move the busbars throughout the tanks according to the process sequence. All side equipment including heaters, filters, rectifiers, pumps etc. will be controlled on the control panel through cable wiring to the side equipment. Limit switches and proximity sensors are incorporated to ensure safe operation of the process control system.

2.4 Bath Temperature Control

Some processes require bath solutions to be heated which will be achieved by the use of electrical immersion heaters. The duty and material of electrical immersion heaters is outlined in Table 2.4.

There will be a temperature sensor in each heating bath. The temperature sensor will feedback to the temperature controller which switches the heating system on or off if the measured temperature is not within the control range. Simultaneously, a signal from the temperature controller will be sent to the PLC and the Human-Machine Interface (HMI) to monitor the temperature of each heating bath.

Table 2.4 Electrical immersion heater duty and material for each process bath

Process Bath	Electrical Immersion Heater Duty and Material
Degrease (Stage 28)	24kW 304SS
Pickling (Stage 25)	24kW 304SS
Oxidiser Copper Etch (Stage 9)	12kW Titanium
Zincate (Stage 16)	4kW 316SS
Nickel Strike (Stage 12/13)	30kW Titanium
Hot Water Rinse (Stage 3)	24kW 304SS
Hot Air Dryer (Stage 2)	27kW SS

2.5 Agitation Systems

2.5.1 Air Agitation

Process solutions will be air agitated to keep a consistent solution concentration throughout the bath. Table 5.1 below outlines the baths which will have air agitation. This replaces depleted solution at the surfaces and prevents the build-up of gas bubbles and contaminants at the workpiece or substrate surface, which can result in uneven finishes, pitting etc. Agitated air is used to increase the velocity of the bath solutions across the busbars to increase the cleaning efficiency. The agitated air is also used to circulate the solution inside the chemical tanks to provide even temperature distribution and bring even distribution of chemical on the surface of the busbars.

Low pressure air is generated from a low pressure air blower and directed to different rinsing tanks or chemical tanks through piping. Air agitation pumps air through the solution to provide agitation in the bath. The air blower for agitation system supplies air via nozzles at the bottom of the tanks providing agitation similar to bubbles throughout the liquid. The air blower has 300 cfm capacity with suction filter and pressure relief valve.

2.5.2 Pump Agitation

Pumped agitation recirculates the liquid in the tank to provide liquid movement through the solution. Table 5.1 below outlines the baths which will have pump agitation. During pumped or liquid agitation, the liquid is re-circulated throughout the tank through the use of a circulation pump and passes through a filter to distribute evenly throughout the tanks. Liquid exits the tanks and before entering the pump, the liquid passes through a cartridge filter which will filter the impurities in the chemical to improve the process results. The filter will need replaced periodically and the used filters will be discarded as hazardous waste. Nine sets of polypropylene filters and two sets of 304 stainless steel filters will be utilised.

3 DESCRIPTION OF BATHS, BATH SOLUTIONS & THROUGHPUT

There are 23 single tanks and 2 double tanks, making a total of 27 tanks used across the 29 different stages of the process. The material of the bath depends on the chemical properties of each bath solution. The number of baths, type of bath used and bath dimensions for each process are outlined in Table 3.1 below. The table also details the bath solution make-up and estimated annual throughput of bath solutions.

Table 3.1 Bath Dimensions and Material Type, Bath Solution Make-Up and Estimated Annual Chemical Throughput

Process Bath	Number of Baths	Bath Dimensions	Type of Bath	Bath Solution	Bath Solution Make-Up	Estimated Annual Chemical Throughput[1]
Degrease (Stage 28)	1	760mmL x 4300mmW x 1270mmH (3660L Volume)	304 stainless steel	Degreaser SLOTOCLEAN AK90	Degreaser Salt SLOTOCLEAN AK91	38 kg/year
Pickling (Stage 25)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	304 stainless steel	Aluminium Pickle SLOTOCLEAN AK60	Pickle Additive SLOTOCLEAN AK61	1085 L/year
					Sodium Hydroxide	2035 kg/yr
Oxidizer Copper Etch (Stage 9)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	SLOTETCH 584	Sulphuric acid	95 L/yr
					Slotetch 584	543 kg/yr
Desmut (Stage 22)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	SLOTOCLEAN DS10	Product DSZN 11	163 kg/yr
					Acid Concentrate DSZN 12	136 L/yr
Zincate (Stage 16)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	Zincate CNF 10	Concentrate CNF 11	407 L/yr
Zincate Strip (Stage 21)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	SLOTOSTRIP ZN 10	Product DSZN 11	54 kg/yr
					Sulphuric acid 96%	

[1] Calculations based on replenishment figures per m2 from Schlotter's technical data sheets. The surface area is based on surface area actually processed (non-epoxy covered) parts rather than total submerged area. Based on aluminium usage assuming all bus bars are 3m length. These are estimated only, operation will determine more accurate figures.

Process Bath	Number of Baths	Bath Dimensions	Type of Bath	Bath Solution	Bath Solution Make-Up	Estimated Annual Chemical Throughput[1]
Nickel Strike (Stage 12/13)	1	1730mmL x 4300mmW x 1270mmH (8332L Volume)	25mm Polypropylene	Nickel Plate Solution NORMA (Nickel Watts + BFL)	Nickel Sulphate Nickle Chloride Boric Acid Nickel Additive BFL	No available data
Acid Tin Plate (Stage 6/7)	1	1730mmL x 4300mmW x 1270mmH (8332L Volume)	25mm Polypropylene	Bright Tin CULMO 1	Sulphuric acid (96%) Tin Salt SU Starter CULMO 1	No available data
Antitarnish (Stage 4)	1	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	Antitarnish ALS 30	Antitarnish Concentrate ALS31	No available data
Rework (Stage 20)	1	760mmL x 4300mmW x 1270mmH (3660L Volume)	316SS	Nitric Stripper OR Proprietary custom non nitric stripper (development in progress) OR No stripping process used	40% Nitric acid OR TBC OR None	No available data
Rinse (Stage 8, 10, 11, 14, 15, 17, 18, 19, 23, 24, 26, 27)	12	610mmL x 4300mmW x 1270mmH (2938L Volume)	25mm Polypropylene	Rinse	De-ionised water	3250 m^3/yr

4 MAKEUP & MAINTENANCE OF BATH SOLUTIONS

4.1 Bath Solution Makeup

This section outlines how bath solutions for each process will be made up in accordance with Schlötter Product Data Sheets.

4.1.1 Degrease (Degreaser SLOTOCLEAN AK 90)

The degrease bath solution consists of Degreaser SLOTOCLEAN AK 90. The bath solution for a 100L bath will be made up of 70L of deionised water and Degreaser Salt SLOTOCLEAN AK 91 will be added and dissolved. The bath solution will be made up to the final volume with deionised water and mixed thoroughly.

Deionised water will be used for the bath make-up and replenishment of evaporation losses to obtain good degreasing results. Hard water will not be used as it results in the precipitation of the active components of Degreaser SLOTOCLEAN AK 90. An optimum pH value (measured at 20°C) of 8.2 should be maintained in the degreasing system.

When the operating temperature in the bath reaches a certain point, the degreaser additives start to oil out and reduce effectiveness. This is known as the cloud point and is indicated by cloud formation in the electrolyte. The maximum operating temperature is defined by the cloud point. The cloud point depends on the quality and type of degreaser additive, and the salt content of the solution. The higher the salt content, the lower the cloud point. No surface cleaning with overflow will be undertaken in the degrease bath but an oil skimmer will be used.

4.1.2 Pickling (Aluminium Pickle SLOTOCLEAN AK 60)

The Pickling bath solution is Aluminium Pickle SLOTOCLEAN AK60 which is made up of Pickle Additive SLOTOCLEAN AK61 and Sodium Hydroxide. The bath solution for a 100L bath will be filled with 75 litres of deionised water. 5kg of sodium hydroxide will be added with constant stirring and dissolved in compliance with valid safety measures. Pickle Additive SLOTOCLEAN AK 61 (0.9-2.2L) will be added and the final volume will be made up with deionised water and mixed thoroughly. The pickle is ready for use once the operating temperature (50-60°C) is reached. Treatment time for electroplating ranges from 20-60 sec and is dependent on the surface quality of the aluminium, concentration of pickle and the temperature.

Consumption of the additives is dependent on drag-out, shape and surface condition of the busbars. Drag-out is the liquid, which remains, adhered to the workpiece surface when removed from a process bath. Replenishment depends on analytical results of the aluminium, sodium hydroxide and Pickle Additive SLOTOCLEAN AK 61 concentrations. The recommended replenishment of Pickel Additive SLOTOCLEAN AK 61 is 80ml/m2 of busbar throughput and sodium hydroxide is 150g/m2 busbar throughput.

The aggressivity of the pickle and degree of attack on the base material is dependent on the content of sodium hydroxide which is determined analytically.

4.1.3 Oxidiser Copper Etch (SLOTETCH 584)

The oxidiser copper etch bath solution consists of SLOTETCH 584 which is a micro-etch for the pre-treatment of copper materials. SLOTETCH 584 is made up of sulphuric acid and Slotetch 584 salt. The bath solution for a 100L bath will be filled up to 90% of its final volume with deionised water. Sulphuric acid and Slotetch 584 salt will be stirred in until the salt is completely dissolved and the final volume will be made up with deionised water. The operating temperature ranges from 20-30°C.

Slotetch 584 salt should be added on a regular basis to maintain a constant concentration and hence a stable etch rate. The concentration of Slotetch 584 will be regularly monitored.

4.1.4 Desmut (SLOTOCLEAN DS 10)

The desmut bath solution of SLOTOCLEAN DS10 is made up of DSZN 11 and DSZN 12. The bath solution for a 100L bath is prepared by filling the bath with 75% of the final volume with deionised water. Acid Concentrate DSZN 12 Concentrate (optimum concentration 80 ml/l) and Product DSZN 11 (optimum concentration 150 ml/l) will be stirred in and mixed until dissolved. The final volume will be made up with deionised water. The bath solution is ready for use once the operating temperature is reached.

The desmut solution will be consumed by drag out loss and dissolution of the smut layer. The consumption of Product DSZN 11 is 12-16g/m2 of bus bar surface area throughput and Acid Concentrate DSZN 12 is 10-15ml/m2 bus bar surface area throughput. The concentration of DSZN 11 and DSZN 12 will be regularly monitored to ensure the solution is completely removing the smut layer to produce quality deposits on the aluminium busbars.

4.1.5 Zincate (Zincate CNF 10)

The zincate bath solution consists of Zincate CNF 10 which is made up of CNF 11 and deionised water. The bath solution for a 100L bath will be filled with 50L of deionised water and 30L of Concentrate CNF 11 (optimum concentration 300 ml/l) and mixed well. The bath will be made up with deionised water to the final volume. Zincate is ready for use once the operating temperature (18-25°C) has been reached. The optimum time for Zincate treatment is 30 seconds.

The consumption of the solution is dependent on the shape and surface condition of the busbar and drag-out losses. The Zincate CNF 10 solution is enriched with aluminium with increased surface throughput. The replenishment value for Concentrate CNF 11 is 30ml/m2 surface throughput. If the formation of the zinc coating is significantly slow or uneven then a new electrolyte will be made-up.

4.1.6 Zincate Strip (SLOTOSTRIP ZN 10)

The zincate strip bath solution consists of SLOTOSTRIP ZN 10 which is made up of DSZN 11 and sulphuric acid (96%). The bath solution for a 100L bath will be filled with 90% final volume with deionised water. Sulphuric acid (optimum concentration 10 ml/l) will be stirred in followed by Product DSZN 11 (optimum temperature 30 g/l) which will be mixed until dissolved. The final volume will be made up with deionised water. Zincate strip is ready for use once the operating temperature has been reached.

Stripping of the first zincate layer is important in producing quality deposits on aluminium therefore the concentration of Product DSZN 11 and zinc will be regularly monitored.

4.1.7 Nickel Strike (Nickel Plate Solution NORMA)

The Nickel strike bath solution consists of Nickel Sulphate solution, Nickel Chloride solution, Boric Acid and Nickel Additive BFL. New baths must be thoroughly cleaned and leached out for several hours with warm acidified water prior to bath solution make-up. The bath solution for a 100L bath is made up with 40 litres of deionised water and heated to 60-70°C. The required quantities of Nickel Sulphate solution (550 g/l) and Nickel Chloride solution (720g/l) are added. Boric acid is added and mixed until dissolved. The pH will be checked and maintained at 4.0 and the solution will be filtered and 0.5L of Nickel Additive SLOTONIK M will be added. Nickel Additive BFL will be added to the bath solution. The final volume will be made up of deionised water and mixed thoroughly. The bath solution is ready for use when the operating temperature is reached.

The consumption of additive is due to drag-out which is dependent on the shape and surface condition of the busbars. An addition of 1-2ml/l of Nickel Additive SLOTONIK M to the bath solution is recommended. Nickel Additive SLOTONIK M is a wetting agent for mechanically agitated applications to stabilise the nickel electrolyte and prevent the formation of pores on the busbar.

Visual assessment of the plated deposit on the busbar is used to determine if Nickel Additive BFL requires replenishment.

The optimum concentration of Nickel is 65 g/l. The optimum concentration of Chloride is 10g/l and it increases the conductivity of the electrolyte and anode solubility. The optimum Boric Acid concentration is 40g/l. Lower concentrations can cause a loss of buffer action and pH variation and higher concentrations may cause roughness in the plated deposit on the busbar. The solubility limit for Nickel Additive BFL is 50-55 ml/l. Nickel Additive BFL consumption is dependent on drag-out and is usually dosed according to visual appearance as crystallised Nickel Additive BFL can lead to inclusions in the nickel coating.

The optimum pH is 4.0. High pH causes instability in producing the correct brightness level and a low pH reduces the levelling power of the nickel deposits and can reduce the cathodic current efficiency effecting deposition. The pH can be adjusted by adding diluted hydrochloric acid, chem.pure or sulphuric acid.

4.1.8 Acid Tin Plate (Bright Tin CULMO 1)

Bright Tin CULMO 1 deposits fully bright tin coatings. The acid tin plating bath consists of Bright Tin CULMO 1 which is a sulphuric acid based electrolyte made up of Sulphuric Acid (96%), Tin Salt SU and Starter CULMO 1. The bath solution for a 100L bath will be filled with 70 litres of deionised water and Sulphuric Acid (96%) will be added while stirring constantly. The required quantity of Tin Salt SU will be added and stirred vigorously until completely dissolved. When making up the electrolyte, the temperature of the solution increases quickly due to the exothermic reaction which forms by the addition of Sulphuric Acid (96%). Care will be taken when adding the Sulphuric Acid (96%) because if it is added too quickly, an intense heat can develop which causes spattering of the corrosive liquid.

The solution will be cooled to operating temperature and Starter CULMO 1 will be added and mixed well. Deionised water will be added to make up the final volume and mixed thoroughly.

Tin content depends on the electrolyte application and should range between 10 to 30 g/l. Sulphuric Acid concentration should not fall below 85 ml/l or 160 g/l. Starter CULMO 1 concentration should be between 25 to 35 ml/l and is only used for the make-up of a new electrolyte.

4.1.9 Antitarnish (Antitarnish ALS 30)

The antitarnish bath solution consists of Antitarnish ALS 30 which is made up of Antitarnish Concentrate ALS 31. The antitarnish solution for a 100L bath is made up of 70L deionised water and 10L of Antitarnish Concentrate ALS 31. The final volume is made up with deionised water and mixed thoroughly. The bath solution is ready to use when the operating temperature is reached. The optimum concentration of Antitarnish Concentrate ALS 31 is 100ml/l.

Baths and filtration equipment require thorough cleaning prior to use. The optimum treatment time is 30 seconds and temperature is 30°C. The optimum pH value should range between 1.0 and 2.0 and can be decreased by adding Antitarnish Concentrate ALS 31.

4.1.10 Rework Process

As previously stated in 2.2.4.3 the rework is a process used to strip or rework unsatisfactory coatings on busbars. The busbars are submerged in a bath solution, the chemical composition of which is still being formulated with the E+I Engineering Chemists, with the remainder consisting of deionised water. Use of the rework bath will be kept to a minimum.

4.1.11 Rinse Baths

Rinse baths are made up of de-ionised water. A de-ioniser will be installed onsite using the mains connection for water supply and the recovery water from the Vacudest wastewater treatment system. An estimate of 13m^3 of water per day will be utilised for rinsing.

4.2 Laboratory Facilities

Visual assessment of the quality of busbar surfaces will be undertaken regularly throughout the treatment process to assess if bath solutions are working effectively.

A small laboratory facility will be located on site within the dedicated tinning plant area for analysing the composition of bath solutions to determine if solutions need to be replenished. The laboratory will contain a pH meter, fume cupboard, hot stirring plate, range of pipettes (from 1 mL to 50 mL), 50 mL burettes (and burette stands), conical flasks (250 mL), measuring cylinders (25, 50 & 100 mL), beakers (100, 500, 1000 mL) and a magnetic stirring bars, pipette fillers. Personal Protective Equipment (PPE) will be available for laboratory users including safety glasses, gloves and laboratory coats.

The method used to analyse the concentration of chemicals in each bath solution to determine if the solution needs to be replenished is outlined in Table 4.1 below. The analytical method for BFL additive bath solution requires a UV-Vis spectrometer which will be conducted by the chemical supplier Schlötter. This is not a regular test as the plating finish usually provides an indication of the BFL content.

Table 4.1 Method to Analyse Composition of Bath Solutions

Process Bath	Bath Solution	Bath Solution Make-Up	Bath Solution Analytical Method
Degrease (Stage 28)	Degreaser SLOTOCLEAN AK90	Degreaser Salt SLOTOCLEAN AK91	Titration
Pickling (Stage 25)	Aluminium Pickle SLOTOCLEAN AK60	Pickle Additive SLOTOCLEAN AK61 Sodium Hydroxide	Titration
Oxidizer Copper Etch (Stage 9)	SLOTETCH 584	Sulphuric acid Slotetch 584	Titration
Desmut (Stage 22)	SLOTOCLEAN DS10	Product DSZN 11 Acid Concentrate DSZN 12	Titration
Zincate (Stage 16)	Zincate CNF 10	Concentrate CNF 11	Titration
Zincate Strip (Stage 21)	SLOTOSTRIP ZN 10	Product DSZN 11 Sulphuric acid 96%	Titration

Process Bath	Bath Solution	Bath Solution Make-Up	Bath Solution Analytical Method
Nickel Strike (Stage 12/13)	Nickel Plate Solution NORMA (Nickel Watts + BFL)	Nickel Sulphate Nickle Chloride Boric Acid Nickel Additive BFL	Hull cell test Titration
Acid Tin Plate (Stage 6/7)	Bright Tin CULMO 1	Sulphuric acid (96%) Tin Salt SU Starter CULMO 1	Titration Hull Cell test
Antitarnish (Stage 4)	Antitarnish ALS 30	Antitarnish Concentrate ALS31	Titration
Rework (Stage 20)	To be confirmed	To be confirmed	To be confirmed
Rinse (Stage 8, 10, 11, 14, 15, 17, 18, 19, 23, 24, 26, 27)	Rinse	De-ionised water	Conductivity meter

5 EMISSIONS & ABATEMENT SYSTEMS

5.1 Operations Causing Emissions to the Environment

There will be no discharges from the facility other than to air. Some processes may lead to emissions of concern, for example: pickling, certain etching processes, certain plating tanks, etc. Air emissions abatement systems will be in place as detailed in Section 5.3 below.

There will be no discharges to groundwater or surface water as all waste liquid will be stored within an appropriately sized bunded area until collection. All hazardous waste will be stored within a bunded area until collection by a licenced hazardous waste management company.

5.2 Wastewater Treatment System

De-ionized water will be used in rinse baths for rinsing busbars between process stages. Spent rinse water will be stored within an appropriately bunded area until collection for treatment offsite. Table 5.1 below outlines the tanks where spent bath solutions drain to and where they can be treated and process water recovered at minimum of 95% recovery rate. Certain bath solutions will not be suitable for treatment in the Vacudest System and will be stored in the tanks in the bunded area for removal by licensed waste contractor for treatment at a suitable licensed facility.

A bespoke Wastewater Treatment (WWT) System is to be installed on site to treat spent rinse water and alkaline chemical solutions. A Schematic of the treatment plant is included in Appendix A and the layout is included in the overall layout drawing for the proposal (IBR1105/003) also in Appendix A.

The proposed wastewater treatment system will be capable of treating wastewater on site via the VACUDEST L 4,500. The VACUDEST L4,500 is based on the simple principle of separation of materials due to boiling point deviations. First, industrial wastewater is pumped into a heat exchanger where the water is heated and evaporates, the residue volume is reduced to anywhere between 0.5 and 5 percent of the original wastewater volume. The steam condenses as liquid without any contaminants and outflows to the distillate tank to be pumped out and reused in the production process, creating a complete zero liquid discharge production. The evaporated concentrate is drained off and has only a fraction of the original amount of wastewater, creating savings on disposal costs and minimising environmental impact.

Table 5.1 Drainage Infrastructure (waste tank number and description as per schematic of wastewater treatment system included in Appendix A)

Spent Bath Solution (Stage number)	Waste Tank	Wastewater Treatment System
HW Rinse, CW Rinse, Acid Rinse	1.7.1 Rinse wastewater tank I 1.7.2 Rinse wastewater tank II	Treated in the Vacudest System with Distillate stored in Tank 1.8 Distillate Tank for reintroduction into the process and evaporation residue stored in Tank 1.9.1 Evaporation residue tank for disposal by licensed waste contractor
Pickling (25), Degrease (28)	1.7.3 Active bath tank Alkaline II	
Antitarnish (4), Acid Tin Plate (6/7), Oxidiser Copper Etch (9), Nickel Strike (12/13), Zincate Strip (21), Desmut (22))	1.9.2 Active bath tank Acid	Stored in bunded area for disposal by licensed waste contractor
Zincate (16)	1.9.3 Active bath tank Alkaline II	

The resultant evaporation residue is stored in the evaporation residue tank. The energy return feature of the VACUDEST can allow up to 95% energy savings compared with evaporation at a normal pressure due to the heat exchanger. The heat exchanger is where the outgoing 120° steam meets the bundle of pipes containing the inflowing wastewater. The transfer of heat allows the wastewater to be heated and evaporated without any external heating while simultaneously cooling and condensing the steam.

The aluminium process begins with the pre-treatments; degrease, pickling, and desmut. Pickling and degreasing involve the busbars being dipped in alkaline solutions which drain to the two active bath alkaline tanks. The spent alkaline chemicals used in the pre-treatment processes, aluminium pickle (Slotoclean AK60) and degreaser (Slotoclean AK90), cannot be treated by the VACUDEST system and will drain directly to an active bath tank (alkaline 2) for storage and this will be removed via tanker by a suitable licenser contractor. Those that can be treated will drain to the active bath tank alkaline 1 and consequently pumped to the VACUDEST system to be treated. The zincate process takes place after pre-treatment has finished and uses an alkaline solution to apply a layer of zinc. This solution is treatable in the VACUDEST system and drains directly to active bath tank alkaline 1 for onward treatment and water recovery. The evaporation residue will be stored in the evaporation residue tank to be collected and disposed of by suitable licensed contractor. The distillate will be stored in the distillate tank, ready to be pumped back to the production process.

The desmut process uses an acidic solution which is drained to active bath tank acid. This is the only acid storage tank as no acids used in the tinning process are treatable and therefore all can be stored collectively.

The nickel strike process and acid tin plating process then take place. The spent acid from these processes is drained to active bath tank acid. The final stage is the after-treatment. Anti-tarnish is an acid based process applied to protect the finish on tinplated components. The spent acid from this process drains to the active bath tank acid after treatment. Finally, the busbars are dried using a hot air dry at temperatures of 60-80°C.

The copper busbar process differs slightly. Pre-treatment consists of two processes; a degreasing and an oxidised copper etch. This uses an acidic solution and thus is drained to the active bath tank acid for storage and disposal by licensed waste contractor. The busbars then receive acid tin plating, and is finished with an anti-tarnish and hot air dry.

After each treatment in the process the busbars will be rinsed with de-ionised water to prevent cross contamination between stages. This rinse water will be drained to rinse wastewater tank 1. This tank is connected to rinse wastewater tank 2 via valve and they function as one larger storage tank with a capacity of 30m³. The rinse water is pumped from these tanks to the VACUDEST to be treated and then pumped back into production. There are cold water, hot water rinses and an acid rinse that take place throughout the process; all of which drain to the rinse water storage for onward treatment and water recovery in the VACUDEST system.

5.3 Air Abatement Systems

There will be no discharges from the facility other than to air.

All plating baths will be operated in ventilated areas and the occupational exposure limits (OELs) will be considered in accordance with the Code of Practise for the chemical agents, HSA, 2016. An occupational health and safety officer may be required to complete air monitoring to ensure the safety of all staff.

An air scrubber system and push-pull system will be installed to control emissions of concern and particulates in the process area. Some of the baths solutions are not static and are aerated by an air blower for air agitation or by pump agitation. Table 5.1 below outlines which baths are agitated.

The abatement system is controlled by the control system outlined in Section 2.4 and will start prior to the process and will continue after the process has finished.

5.3.1 Neutral Pressure System

The area around acid tin plating baths will be maintained under neutral pressure conditions at times of operation. Supply air will be introduced at high level through a central fan unit and G4 filter system. Air will be distributed evenly through a heavy duty wind sock. The supply fan will be speed inverted and it will vary airflow to the tinning area proportional to the tinning plant air extraction system ensuring a neutral pressure is maintained. This control will be assisted by air pressure sensors strategically placed to monitor pressure differences between the tinning area and the factory floor.

5.3.2 Push-Pull System

The Push-Pull system is designed to create an airflow over the surface of the processing bath. A stream of low pressure air is generated from a low pressure air ring blower to blow the air across the top of the exhausted tank on one side. The air is being extracted at the other side through a lip extraction duct sending any fumes from above the bath to the scrubber system. This design will prevent the fume coming out from the tank and increase the extraction efficiency.

The air blower for push-push pull system takes air from the area and pushes it through an air pressure system that is high volume low pressure. It takes air from the process room so does not create a negative air flow to the plant.

The push-pull system has a 300cfm capacity with a suction filter and pressure relief valve

5.3.3 Air Scrubber

The air scrubber will pull air from within the process area to the scrubber, where fumes are treated then released. The air scrubber is used to neutralize the fumes coming out from the process tanks through water spraying, separation and condensing. The fume is neutralized through auto dosing of chemical to the rinsing water in the scrubber.. The fume will be extracted to the atmosphere after treatment with achievement of the local emission standards.

Emissions associated with electroplating include particulate matter, volatile organic compounds and hazardous air pollutants (e.g. metals and acids). Emissions are determined using a mass balance with emission factors from AP42, Ch 12.20 Electroplating and National Pollutant Inventory Emission Estimation Technique Manual for Electroplating and Anodising, including 98% control efficiency from a wet scrubber.

below provides a breakdown of the uncontrolled and controlled potential to emit values for key contaminants from the tinning process. The processes that have the potential to generate these air pollutants are

- Degrease - Degreaser (AK90) soap Cleaner
- Pickling - Slotoclean AK 60 (Aluminium Pickle/ Oxide Pickle)
- Zincate - Zincate CFN 10
- Zinc Strip - Slotostrip ZN10
- Acid Tin Plating - Bright Tin Culmo 1
- Oxidiser Copper Etch - Slotetch 584 Micro Etch

The manufacturing facility wide uncontrolled and controlled criteria pollutants are less than major source thresholds as indicated in the Material Safety Datasheet MSDS for the chemicals used in the above stages of the tinning process.

Table 5.2 Breakdown of the uncontrolled and controlled potential to emit values for key contaminants from the tinning process

Contaminant	Uncontrolled PTE kg/yr	Controlled PTE kg/yr
PM	716.68	18.14
PM10	716.68	18.14
PM2.5	716.68	18.14
Sulfuric Acid	11911.34	235.87
Acrylic Acid	5134.67	99.79
VOC	5134.67	99.79
Hydrofluoric Acid	163.29	3.27
Copper	263.08	5.24
Nickel	27.22	0.63
Tin	127.01	2.46
Zinc	326.59	6.56
Sodium Hydroxide	5.44	0.11
Phosphoric Acid	2.72	0.05

PTE – Potential to emit

Acidic water generated from the treatment circulates to a tank that will be stored within a bunded area until collection for treatment offsite. The air scrubber will have 19,200cfm capacity and polypropylene (PP) vertical type material.

The air scrubber will pull air from within the process area to the scrubber, where fumes are treated then released. The air scrubber is used to neutralize the fumes coming out from the process tanks through water spraying, separation and condensing. The fume is neutralized through auto dosing of chemical to the rinsing water. The fume will be extracted to the atmosphere after treatment with achievement of the local emission standards.

The air extracted from the tinning plant shall be treated by passing the air stream through a wet scrubber system before releasing to atmosphere. The wet air scrubber design falls in line with guidelines quoted in ASHRAE Publication HVAC Systems and Equipment Chapter 30 section 2.5.

The wet scrubber will use three following mechanisms to capture particulate.

- Inertial Impact
- Brownian Diffusion
- Condensation

Inertial Impact

Occurs when dust particles and liquid droplets collide resulting in the capture of the particle

Brownian Diffusion

Occurs when dust particles, which are extremely small and have independent motion in the gas stream, collide with one another making larger particles, which then collide with the liquid droplets.

Condensation

Occurs when gas or air is naturally cooled below its dew point. Fogging occurs. As a result, the condensed liquid particles become larger and the probability of their removal is increased.

5.3.4 Local Exhaust Ventilation (LEV)

The exhaust ductwork from the wet scrubber shall terminate 1,200mm above the apex of the roof and 8,875.26 mm

This will avoid any possible downdraughts generated from air passing over the apex of the roof. The air being exhausted from the scrubber shall be a room ambient temperature of 20°C. No heat gains will be generated from the fan motor, as the motor will be located outside the air stream.

The common exhaust air duct will be carrying the air at a velocity of 9.911m/s. When entering the wet scrubber the velocity will reduce to 1.957m/s thus allowing some particulate to fall out of the air stream. After going through the wet scrubbing process, the airflow will again increase to through the throat of the scrubber to a velocity of again 9.911m/s and then be increased to 19.72m/s by creating a venturi at the exit by reducing the diameter of the said exit to 800mm. The air temperature will be at a steady state of 20°C ambient and considered neutral stability conditions. Using a derivative of the Gaussian Plume dispersion model it is expected that the exhaust plume will disperse to over 5 meters into the atmosphere to give maximum dispersion.

$$\Delta h = 0.35\,\frac{Vd}{u} + 2.64\,\frac{\sqrt{Qh}}{u}$$

Δh = 1.86 meters

Where:

Δh = Height of Plume

V = Velocity of air stream

d = Diameter of duct

u = Average Wind Speed

Qh = Emission Rate

Air dispersion from finished floor level = 9.231 meters.

5.4 Summary of Air Treatment & Agitation Systems

Table 5.3 below outlines the proposed air treatment system and agitation system to be installed for each bath in the process. Air treatment systems will extract to an exhaust duct.

Table 5.3 Air Treatment & Agitation Systems

Process Bath & Stage Number	Bath Solution	Air Treatment Present	Agitation Present
Degrease (Stage 28)	Degreaser SLOTOCLEAN AK 90	Push air (extraction)	Pumped agitation/ circulation
Pickling (Stage 25)	Aluminium Pickle SLOTOCLEAN AK60	Push air (extraction)	Air agitation
Oxidizer Copper Etch (Stage 9)	SLOTETCH 584	Push air (extraction)	Air agitation
Desmut (Stage 22)	SLOTOCLEAN DS10	Push air (extraction)	Air agitation
Zincate (Stage 16)	Zincate CNF 10	Push air (extraction)	Air agitation
Zincate Strip (Stage 21)	SLOTOSTRIP ZN 10	Push air (extraction)	Air agitation
Nickel Strike (Stage 12/13)	Nickel Plate Solution NORMA (Nickel Watts + BFL)	Push air (extraction)	Air agitation
Acid Tin Plate (Stage 6/7)	Bright Tin CULMO 1	Push air (extraction)	Air agitation
Antitarnish (Stage 4)	Antitarnish ALS 30	Push air (extraction)	Air agitation
Rework (Stage 20)	To be confirmed	To be confirmed	To be confirmed
Rinse (Stage 8)	De-ionised water	No	Air agitation
Rinse (Stage 10, 11, 14, 15, 17, 18)	De-ionised water	No	Pumped agitation
Rinse (Stage 19)	De-ionised water	No	No
Rinse (Stage 23, 24, 26, 27)	De-ionised water	No	Pumped agitation

5.5 Throughput and capacity of treatment and abatement systems

5.5.1 Air treatment systems

The air scrubber will pull air from within the process area to the scrubber, where fumes are treated then released. The air scrubber is used to neutralize the fumes coming out from the process tanks through water spraying, separation and condensing. The fume is neutralized through auto dosing of chemical to the rinsing water. The fume will be extracted to the atmosphere after treatment with achievement of the local emission standards. The air scrubber will have 19,200cfm capacity.

5.5.2 Waste Water Treatment System

A bespoke Wastewater Treatment (WWT) System is to be installed on site to treat spent rinse water and alkaline chemical solutions. The maximum capacity of Vacudest WWT will be 4,500 m^3/year

6 STORAGE FACILITIES

This section outlines storage conditions and their location within the site, segregation systems used and transport systems within the site for raw materials, intermediates and products.

The bath solutions are a mixture of chemicals that will be made up on site. Chemicals as described in Section 4 will be supplied by Schlötter Ireland and delivered to the site by a hazardous chemical licensed contractor. Chemicals are to be stored in original packaging as supplied by Schlötter Ireland and in accordance with Schlötter Product Data Sheets (PDS) provided in Appendix C. Packaging will range from 2.5-200L. All containers (including drums, barrels and IBCs) containing substances which may pose a risk to the environment will be stored within appropriately sized containment bunds (110% capacity). There will be an integral bund associated with the Tinning Plant itself and chemical baths. There will also be a bund inside the existing facility to ensure appropriate storage and location of the WWT system and the associated storage tanks for spent chemicals awaiting disposal by a waste contractor. There will also be a bund established in the yard in order to service the WWT system storage tanks located here also. The layout drawing in support of the planning application illustrated the location of the bunding within the existing facility (Appendix A).

Storage of non-compatible chemicals will be segregated on site in accordance with section 7 and 10 of the SDS for incompatibilities and storage requirements. All containers will be tightly sealed in storage in accordance with *HSG71 Chemical Warehousing: The storage of packaged dangerous substances* (HSE, 2009).

Spill Kits will be available on site to contain any potential spill that could occur when transporting products on site.

Chemical storage on site will be minimal once the process is operating with small drums of nickel nuggets and tin for addition to tanks when required (220ltr drums). Other chemicals will be ordered from the supplier on an as need basis to avoid the need for significant storage on site.

Storage of finished tinned busbars will be located adjacent to the unloading area. On average approximately 15,000m of aluminium busbars will be produced per month and therefore stored in the loading and unloading areas.

E&I Engineering Ltd have standard operating procedures in place for handling hazardous materials and managing spills including the ‘SOP-006 Management of Hazardous Materials’ and ‘SOP-031 Management of Spillages & Leaks’.

7 WASTE GENERATION

This section outlines details of waste quarantine and waste inspection areas, traffic control and delivery and reception of waste.

Waste generated from pre-treatment processes such as degreasing should be minimal as the workpiece surfaces should be clean following the painting process. Cartridge filters from pumped agitation will be replaced periodically and are classified as hazardous waste.

Residue from baths will accumulate in filters and the filter will be disposed of by suitable hazardous waste contractor. A WWT system will be installed to treat spent rinse water for re-use in rinse baths.

The liquid identified as waste will be labelled as such and stored in a designated area. Waste liquid will be stored in an appropriate UN certified container (IBC/200L Barrel) which will be less than 2 years old for shipment of waste. Waste liquid will be stored within an appropriately sized bunded area until collection. Table 7.1 outlines the estimated annual waste generated from the process.

Waste streams will be segregated on site and clearly labelled. All hazardous waste will be stored within bunded area. All hazardous wastes will be collected by an authorised and licensed hazardous waste management company. E&I Engineering Ltd will be furnished with certificates of transfer and destruction by the waste handling company; these should be retained for record (Schlötter Ireland contract SRCL).

The estimated number of collections of spent acid and alkaline solution by a licenced chemical waste contractor is two per week.

Table 7.1 Estimated Annual Waste Generation

Waste Type	Estimated Waste Generated Per Year
Spent Chemicals: Degreaser: Every 3 months (15m^3 per year) Pickle: Every 6 months (6m^3 per year) Desmut: Every 6 months (6m^3 per year) Zincate Strip: Every Year (3m^3 per year) Nitric Rework: Negligible (low use) Zincate CNF: Never (only decant) Oxidizer copper etch: Every Year (3m^3 per year) Acid Tin: Never (deacant) Antitarnish: Every year (3m^3 per year) Assume decant one bath volume worth of Zn Ni and Tin every year (8m^3 per year)	44 m^3/year
Spent Rinse Water	3,250 m^3/year
Filters from agitation & air treatment systems	To be confirmed

8 ALTERNATIVE MEASURES CONSIDERED

8.1 Reduction of Hazardous Substances Use

The process design has been developed to ensure that the use of hazardous substances is minimised and E&I Engineering Ltd have been working with their suppliers to establish the best chemical process to reduce the risks to health and safety and the environment without compromising quality.

8.2 Reduction of Heat Loss

The thickness of Polypropylene tanks was increased from 10mm to 25mm to increase insulation and reduce heat loss.

8.3 Reduction of Material Consumption

Inclined jigging of busbars will allow the adhering solution to run down the part, improving drainage and reducing drag-out. Furthermore, jigs will be slowly removed from bath solutions and provided sufficient drainage time to reduce drag-out. The reduction of drag-out will prevent the loss of metals and other raw materials.

The concentration of bath solutions will be monitored, benchmark usage will be recorded and deviations from the benchmark will be reported to reduce the loss of materials through overdosing.

8.4 Reduction of Water Consumption

A state of the art Wastewater Treatment System (Vacudest) will also be installed to treat rinse water and certain spent chemicals. Certain chemicals cannot be treated in the vacudest system and where this is the case, the spent chemicals will be stored on site in the bunded area and taken off site by a licensed waste contractor for disposal at a licensed facility.

A de-ioniser will be installed onsite using the mains connection for water supply and the recovery water from the Vacudest wastewater treatment system. Use of DI sparger at critical rinse stages will reduce required rinse flowrate.

Water consumption is reduced by using multiple stage counter flow rinsing. During operation, water usage will be assessed to find the optimum between lowest rinse flowrate and plating quality to reduce water consumption.

8.5 Reduction of Energy Consumption

The bath solution temperatures are monitored and controlled to prevent over cooling. The energy return feature of the VACUDEST wastewater treatment system can allow up to 95% energy savings compared with evaporation at a normal pressure due to the heat exchanger.

8.6 Storage

Chemical storage on site will be minimal once the process is operating. Acids and alkalis will be stored separately. Flammable chemicals and oxidising agents will be stored separately. The degradation of workpieces will be prevented by having minimum storage time and by reducing humidity and temperature by use of the scrubber and push pull system.

9 HOURS OF OPERATION

Initially the tinning plant will start with one shift and build to two shifts, i.e., weekdays from 6am-2pm and 2pm-10pm. The assessments assume continuous operation of the tinning process, e.g., the air quality assessment is based on continuous emission to air. Weekends will be kept free for maintenance however if required may be used to run production.

The plant will not operate on a continuous/daily basis as the surface treatment of metals (aluminium and copper conductors) will be dependent on the specification of orders received.

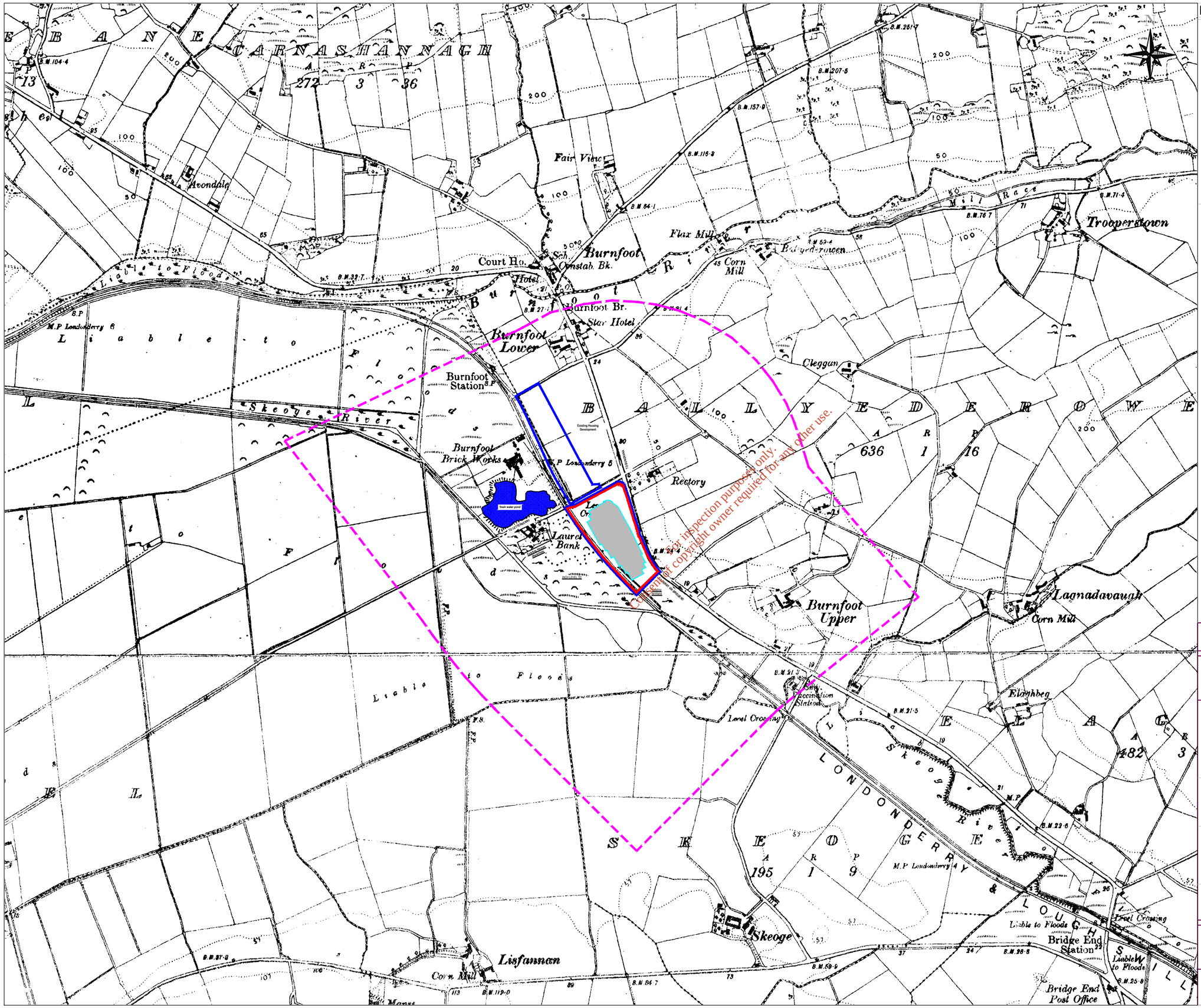
Five staff members will be employed to operate the plant including four loaders and one plating technician.

10 EMERGENCY PROCEDURES

E&I Engineering Ltd have standard operating procedures in place for handling hazardous materials and managing spills including the 'SOP-006 Management of Hazardous Materials' and 'SOP-031 Management of Spillages & Leaks'. The company has an emergency response procedure for spills based on seven different steps:

1. assess the risk - begins the moment the spill occurs and continues throughout the response
2. select personal protective equipment - protect yourself by choosing proper PPE
3. confine the spill - cover drains and use socks/dikes to control the spread of liquid
4. stop the source - Stop the flow before attacking the spill
5. evaluate incident / implement clean-up - Use mats and pillows to soak up the spill
6. decontaminate - Thoroughly decontaminate personnel, equipment, and spill area
7. complete required reports - Follow all appropriate regulations

Appendix A Drawings



NOTES

1. Verifying Dimensions.
   The contractor shall verify dimensions against such other drawings or site conditions as pertain to this part of the work.
2. Existing Services.
   Any information concerning the location of existing services indicated on this drawing is intended for general guidance only. It shall be the responsibility of the contractor to determine and verify the exact horizontal and vertical alignment of all cables, pipes, etc. (both underground and overhead) before work commences.
3. Issue of Drawings.
   Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg, dxf etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors arising from the use of these files, either by human error by the recipient, listing of un-dimensioned measurements, compatibility issues with the recipient's software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
4. Datum

Legend

- Overall Land Holding of Applicant
- IE Licence Boundary
- Existing Building
- 500m from IE Licence Boundary

rev	amendments	drawn	date

Elmwood House
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Client
E + I Engineering Ltd

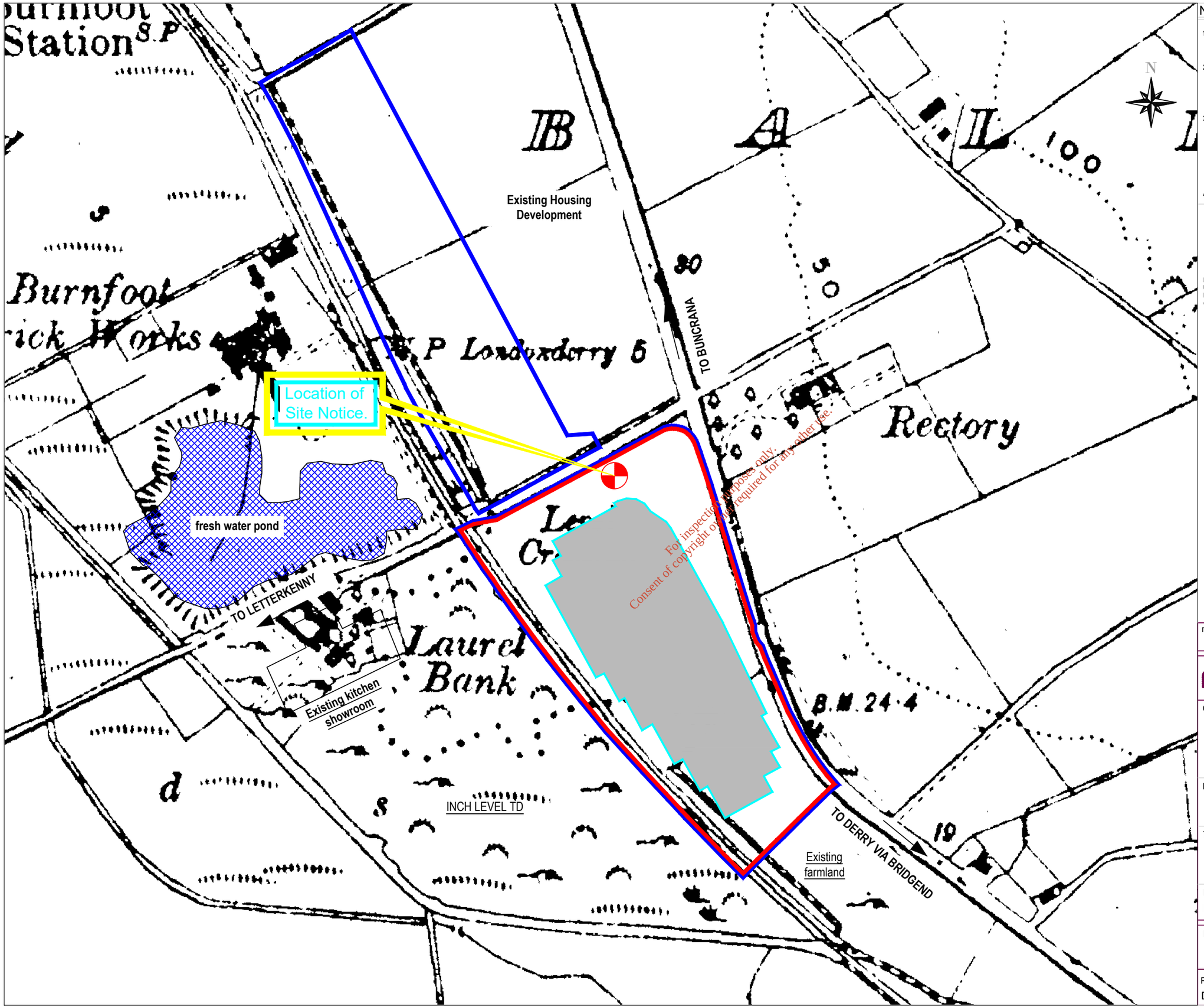
Project
IE Licence Application

Title
Site Location

Drawing Status	Sheet Size	Drawing Scale
Preliminary	A3	1:10,000

Drawing Number	Rev
IBR1105 /001	-

Project Leader	Drawn By	Date	Initial Review
DD	MC	Aug '19	AMcG



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4. Datum

Legend

- Overall Land Holding of Applicant
- IE Licence Boundary
- Existing Building

rev	amendments	drawn	date

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Client: E + I Engineering Ltd

Project: IE Licence Application

Title: IE Licence Boundary

Drawing Status	Sheet Size	Drawing Scale
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Drawing Number	Rev
IBR1105 /002	-

Project Leader	Drawn By	Date	Initial Review
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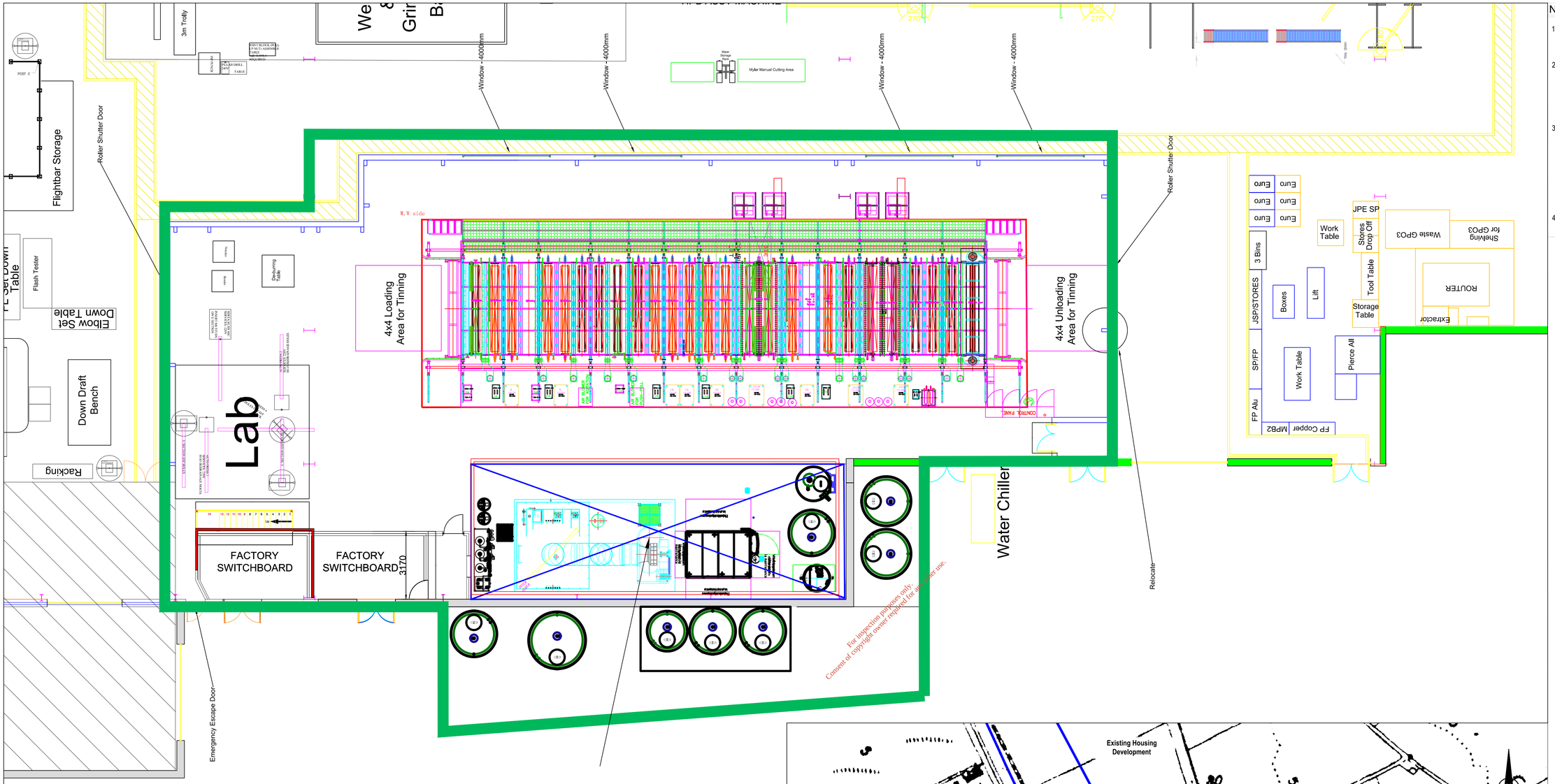

Air Emission Point
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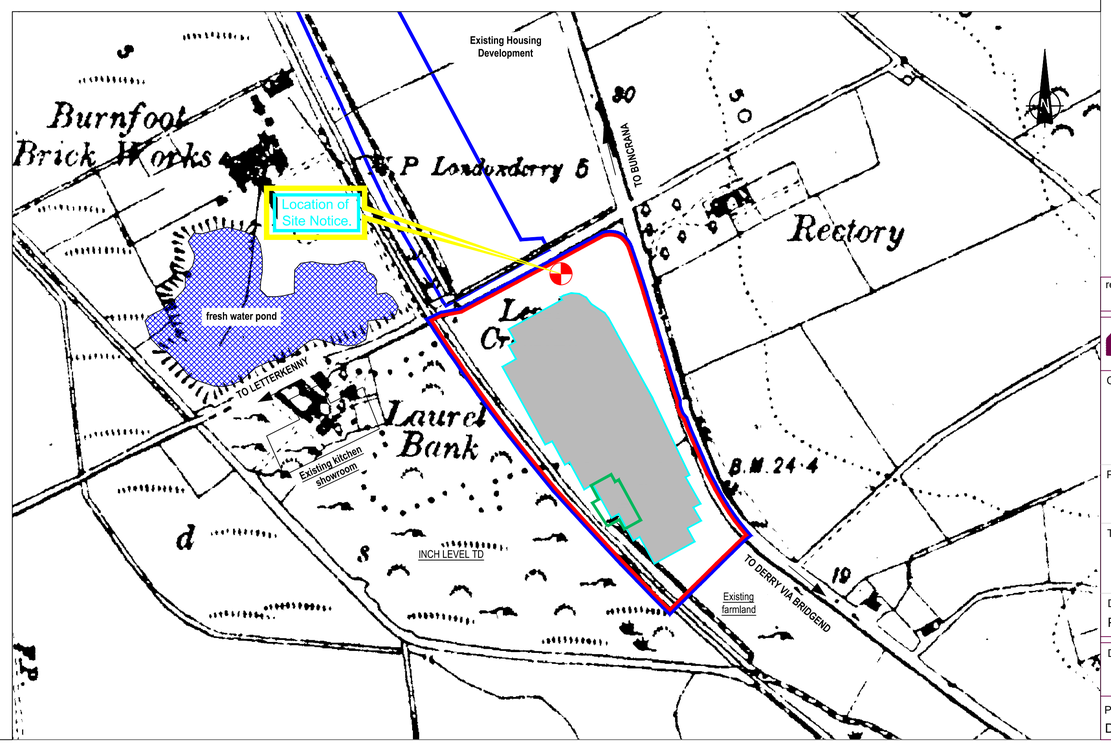
Services Layout. Scale 1:100



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4. Datum OD Malin.

Legend

- Overall Land Holding of Applicant
- IE Licence Boundary
- Existing Building
- Proposed Tinning Plant Area

rev	amendments	drawn	date

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Client
E + I Engineering Ltd

Project
IE Licence Application

Title
Site Plan - Detailed

Drawing Status	Sheet Size	Drawing Scale
Preliminary	A1	As Shown

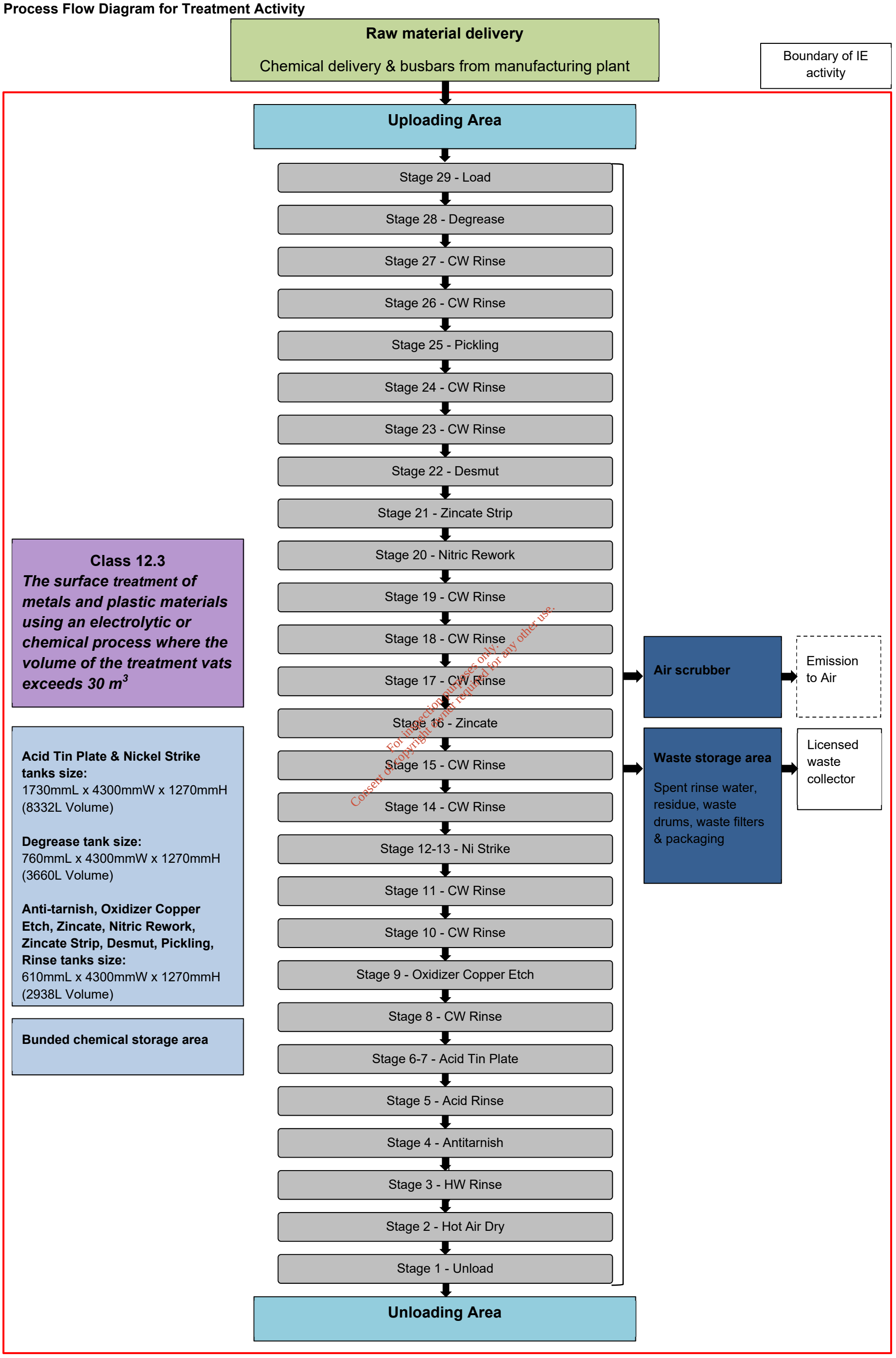
Drawing Number	Rev
IBR1105 /003	-

Project Leader	Drawn By	Date	Initial Review
DD	MC	Aug '19	AMcG

Appendix B

Process Flow Diagram for Treatment Activity

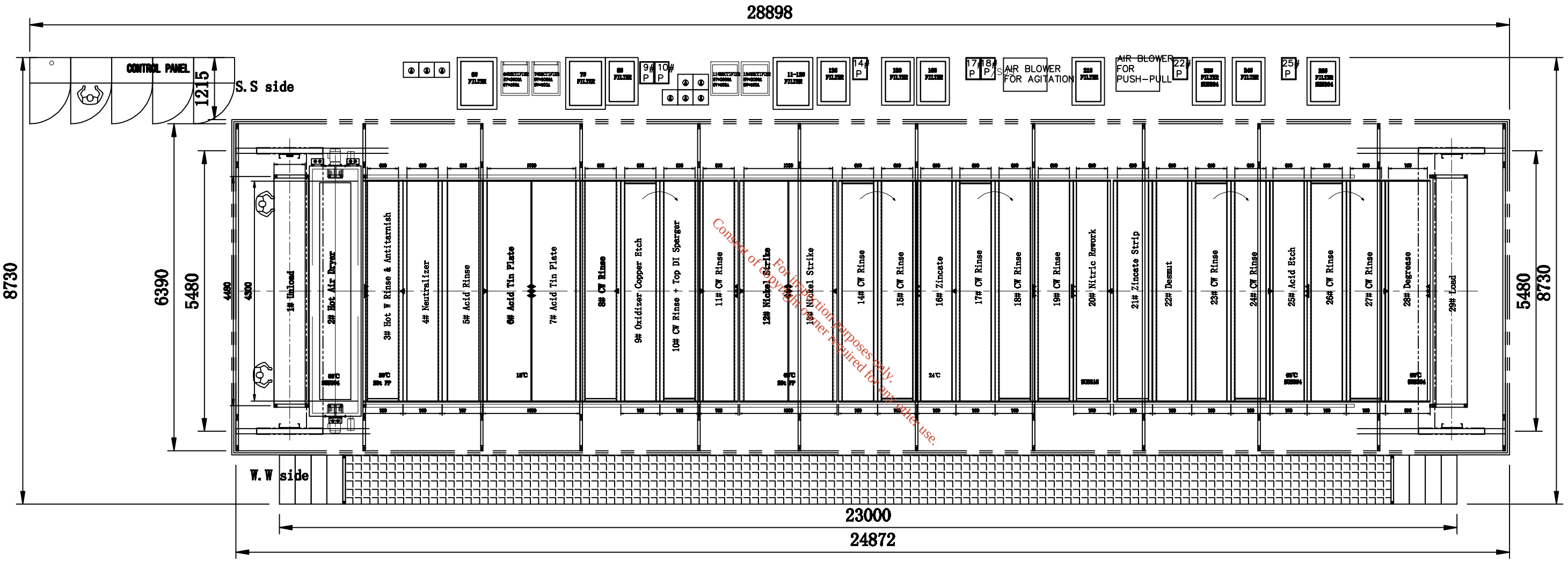
Process Flow Diagram for Treatment Activity



Three processes are in operation and involve the following stages:

1. Aluminium process: 29, 28, 27, 26, 25, 24, 23, 22, 18, 17, 16, 15, 14, 21, 18, 17, 16, 15, 14, 12/13, 11, 10, 6/7, 5, 4, 3, 2, 1
2. Copper process: 29, 28, 27, 26, 9, 8, 6/7, 5, 4, 3, 2, 1
3. Rework Cycle process: 29, 20, 19, 29

REV.	ECN.	NO.	APPD.



NO.	DWG NO./SIZE	NAME	Q'TY:	NOTE
02				
01				

X. ± 0.3	X°. ± 0.3	CASE NO.	Q75-2017R3
.X ± 0.1	.X° ± 0.1	UNITS: mm	
.XX ± 0.02	.XX° ± 0.02	MAT'L: /	
These drawings and specifications are the property of Sun Pride Semi-Conductor Technology Co.,Ltd.		Q'TY: /	

Sun Pride Semi-conductor Technology Co.,Ltd.

NAME OF COMPONENT: LAYOUT	NAME OF PART: LAYOUT			
APPD:	DWG NO.	Z01-01		
CHKD:		SCALE	SHEET	REV.
DRAWN: luoxiaoying20171222				A

Sun Pride Semi-conductor Technology Co.Ltd.

Address : 2/F, 55A, Lam Tsuen Shan Tsuen, Lam Tsuen, Tai Po, NT,HK Tel : 852-26388173

Specification sheet **Customer: ECB / UK** **Equipment: Automatic Ni Strike & Tin Plating Line** **Quotation No : Q75-2017 R5** **REV : 7** **Date :4/9/2018**

1.1 Equipment Property & Data
Cycle time：10 min
Capacity/ hour：1248 Kg
Plating window：4000mmW x 1280mmH x 300
Type：Gate Type Transporter 2 sets
Framework：304SUS

1.2 Equipment dimension :

2.1 Product specification
Parts size：3000mmW x 200mmH x 8mmT
Parts size（typ)：
Thickness：N/A

2.2 Exhaust
Capacity：19200CFM
Pressure：800Pa
Main duct mat'l & size：
Int. dia 1070 mm PP

3.1 Service Requirement
DI water：30L/Min
MW water：50L/Min
Compressed air：L/Min
Chilled water：L/Min
Drain speed：60 min

3.2 Power Requirement
Power source：380V,60Hz,3Phase +N+G
Main Machine Power ： KW
Rectifier Power：
Carbon Treatment ：

4.1 Piping
DI pipe：Dia. 1-1/2" PVC
MW pipe：Dia.2" PVC
Drain pipe R：Dia. 4" PVC
Drain pipe C：Dia. 4" PVC

5.1 Mech Agitation
Type：
Angle： deg
Amp：mm
Frame Mat'l：
Qty：

5.2 Rack
Size：
Loading：

Stage No	Process	Imm. Time	Process Tank					Water Intet	Drain	AGIT-ATON	PUMP AGIT-ATON	Over flow	Rectifier					Process Temperature				Circulation Pump				Filtration	Exhaust(CFM)			Flow Meter			Autodosing		Remarks
			Mat'l	Int. Dimen. (MM)			Vol						Type	CD	Voltage / Amp	Qty	An/Ca	Temp	Heat/ Cooling	Qty	Level	Mat'l	Turnover (per hr)	Capacity	Power		Tank Ex	Enclosure	Push Air	Air	Chem	Chem	Auto	Cup	
		(min)		L	W	H	(L)							(ASD)				（℃）						(L/hr)										
29	Unload	-	SUS/PP	610	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Movable Trolley On Ground Level
28	Hot Air Dryer	-	304SS	610	4300	1270	-	-	-	-	-	-	-	-	-	-	-	80	27 KW SS	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	Hot W Rinse	1-3	25mmPP	610	4300	1270	-	DI	T1	A	-	O	-	-	-	-	-	50	24 KW 304SS	2	L	-	-	-	-	-	1800	-	Y	-	-	-	-	-	-
26	Anti-tarnish	1-3	25mmPP	610	4300	1270	2938	DI	T2	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1800	-	-	-	-	-	-	-	-
25	CW Rinse	1-3	25mmPP	610	4300	1270	-	DI	T2	A	-	O	-	-	-	-	-	RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-24	Acid Tin Plate	10	25mmPP	1730	4300	1270	8332	DI	T2 Double Valve	-	P	-	DC	4	8V 4000A & 8V 800A	2	-	18	Ti Cooling Coil	1	L	PP	5	21000 x 2	-	10um cartridge	5000	-	Y	-	-	-	3 sets	-	-
22	CW Rinse	1-2	25mmPP	610	4300	1270	-	DI	T1	A	-	O	-	-	-	-	-	RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Oxidizer Copper Etch	1	25mmPP	760	4300	1270	3660	DI	T2	A	P	-	-	-	-	-	-	25	12KW Ti	1	L	PP	3	9000	-	-	1800	-	Y	-	-	-	-	-	-
20	DI Rinse + Top DI Sparger	1-2	25mmPP	610	4300	1270	-	DI	T1	-	P	-	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	10um cartridge	-	-	-	-	-	-	-	-	Filter for stage 20 Connect to top spray
19	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	O	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	-	-	-	-	-	-	-	-	-	Circulation Pump for stage 19
17-18	Nickel Strike	10-15	25mmPP	1730	4300	1270	8332	DI	T2 Double Valve	A	P	-	DC	4	8V 4000A & 8V 800A	2	-	55	30 KW Ti	4	L	PP	2	21000	-	10um cartridge	5000	-	Y	-	-	-	5 sets	-	-
16	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	-	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	10um cartridge	-	-	-	-	-	-	-	-	Counterflow. Filter/Circulation Pump for stage 15 and stage 16
15	CW Rinse ←	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	O	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	-	-	-	-	-	-	-	-	-	
14	Zincate	15s-2	25mmPP	610	4300	1270	2938	DI	T3 Double Valve	-	P	-	-	-	-	-	-	24	4 KW 316SS	1	L	PP	3	9000	-	10um cartridge	1800	-	Y	-	-	-	-	-	-
13	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	-	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	10um cartridge	-	-	-	-	-	-	-	-	Counterflow. Filter/Circulation Pump for stage 12 and stage 13
12	CW Rinse ←	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	O	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	-	-	-	-	-	-	-	-	-	
11	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	A	-	O	-	-	-	-	-	RT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Nitric Rework	1-3	316SS	760	4300	1270	3660	DI	T4	-	P	-	-	-	-	-	-	RT	-	-	L	316SS	3	9000	-	-	1800	-	Y	-	-	-	-	-	316SS Cover
9	Zincate Strip	1-3	25mmPP	610	4300	1270	2938	DI	T2	A	-	-	-	-	-	-	-	RT	-	-	-	-	-	-	-	-	1800	-	-	-	-	-	-	-	-
8	Desmut	30s-2	25mmPP	610	4300	1270	2938	DI	T2	A	-	-	-	-	-	-	-	RT	-	-	-	-	-	-	-	-	1800	-	-	-	-	-	-	-	-
7	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	-	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	10um cartridge	-	-	-	-	-	-	-	-	Counterflow. Filter/Circulation Pump for stage 6 and stage 7
6	CW Rinse ←	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	O	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	-	-	-	-	-	-	-	-	-	
5	Pickling	20-60s	304SS	610	4300	1270	2938	DI	T5	A	P	-	-	-	-	-	-	50-60	24 KW 304SS	2	L	SS	3	9000	-	10um cartridge	1800	-	Y	-	-	-	-	-	-
4	CW Rinse	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	-	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	10um cartridge	-	-	-	-	-	-	-	-	Counterflow. Filter/Circulation Pump for stage 3 and stage 4
3	CW Rinse ←	1-2	25mmPP	610	4300	1270	-	MW	T1	-	P	O	-	-	-	-	-	RT	-	-	L	PP	3	9000	-	-	-	-	-	-	-	-	-	-	
2	Degrease	1-5	304SS	760	4300	1270	3660	DI	T5	-	P	-	-	-	-	-	-	60	24 KW 304SS	2	L	SS	3	9000	-	10um cartridge	2000	-	Y	-	-	-	-	-	Oil Skimmer
1	Load	-	SUS/PP	610	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																																			Movable Trolley on Ground Level

Remarks
= direction
= up/dowm
= counterflow

Material
PP = Polyproprene
SS = 304 SS
TE = Teflon
TI = Titanium
MS = Mild Steel
Q = Quartz

AGITATION
M = Mechanical agitation
A = Air agitation
V = Vibration
B = Bumping
U = Ultrasonic
E = Eductor

Suply Pipe
DI = De-ionized water
MW = Main water
RO = Recovery water

Drain
C# = Concentrated waste drain
R = Rinse water drain
CT = Carbon treatment

22,800

Level Sensor
L = Low level
LL = Low low level
H = High Level
HH = High high level

Appendix C PDS

Aluminium Busbars Process

Degreaser
SLOTOCLEAN AK 90

The Degreaser SLOTOCLEAN AK 90 is a weak alkaline immersion degreasing process for the removal of **processing oils and drawing compounds** from copper, brass, aluminium or German silver 2.0740. A separate station should be available for each type of metal in order to prevent cementation (e.g. copper ions on aluminium).
A treatment with this cleaning system results in a **hydrophile** surface.

In order to support the removal of **pigmented drawing compounds, polishing or grinding paste** from the above mentioned base materials, the cleaning process can be enhanced effectively by the ultrasonic support.

Please refer to technical data sheet BATH 02300-E Summary of Degreaser Additives which informs you about cleaning enhancers suitable for ultrasound installations.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the TRGS 510 must be followed.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	isolated tanks made of steel respectively rubber-lined steel (heat resistant hard rubber lining), stainless steel or reinforced plastic vessels made of polypropylene for smaller volumes
Local Exhaust Ventilation:	tank rim extraction
Part/Electrolyte Agitation:	recommended; stirrer or circulation by educators, surface cleaning with overflow- respectively dirt collecting compartment
Ultrasound:	power > 8 W/l for the removal of polishing- and grinding residues
Heating/Cooling:	alkaline resistant immersion heaters, heating coils/heat exchanger made of stainless steel or PTFE
Filter units/oil separators or similar	recommended
Spray register:	optionally e.g. surface rinsing by pressure bottle

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Degreaser Salt SLOTOCLEAN AK 91	020091	--
Degreaser additive depends on application, refer to TDS BATH 02300-E		
Sodium hydroxide, 50 % (756 g/l aqueous)	supplied by user*	1.52
Phosphoric acid, (75 %)	supplied by user*	1.58

* The current product qualities respectively -specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

2.2 Composition

Degreaser Salt SLOTOCLEAN AK 91	borates, polyphosphate (complexing compounds), tensides; free from silicon and NaOH

2.3 Requirements for a 100 litre bath

Product name	**AN**	**SG**	**Quantity**	
Degreaser Salt SLOTOCLEAN AK 91	020091	--	3.5	kg
Degreaser additive depends on application, refer to TDS BATH 02300-E				

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2.4 Make up sequence for a 100 litre bath

All tanks and equipment to be used should be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add the required quantity of Degreaser Salt SLOTOCLEAN AK 91 and dissolve
- add the required quantity of degreaser additive
- make up to final volume with preferably deionised water
- mix thoroughly

The degreaser is ready for use when the operating temperature has been reached.

2.5 Concentrations- and operating conditions

2.5.1 for the removal of processing oils and drawing compounds

	Range	Optimum	
Degreaser Salt SLOTOCLEAN AK 91	25 - 35	30	g/l
Treatment time	2 - 10	--	min.
Temperature range	50 - 80	--	°C
pH value	approx. 8.2	--	
Ultra sound	--	--	

2.5.2 for the removal of pigmented drawing compounds and grinding pastes

	Range	Optimum	
Degreaser Salt SLOTOCLEAN AK 91	25 - 35	30	g/l
Degreaser additive depends on application, refer to TDS BATH 02300-E			
Treatment time	1 - 5	--	min.
Temperature range	70 - 85	--	°C
pH value	approx. 8.2	--	
Ultra sound	--	> 8	W/l

raise pH value ↑: Sodium hydroxide, 50 % (765 g/l aqueous)
decrease pH-Wert ↓: phosphoric acid, (75 %)

3.0 PROCESS SEQUENCE

Our service department or technical field service would be pleased to provide you information on suitable process sequences respectively methods.

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4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

The water quality used for make-up and continuous replenishment of the evaporation losses is essential to obtain good degreasing results. Therefore we strictly recommend the use of deionised- or partly desalted water. Tap water may only be used if the hardness degree does not exceed 6° dH. Using hard water results in precipitation of the active components of Degreaser SLOTOCLEAN AK 90.
This'll therefore necessarily result in unusable cleaning results !

4.1 Degreaser Salt SLOTOCLEAN AK 91

Degreaser Salt SLOTOCLEAN AK 91 contains all the components necessary for the operation of the degreaser. The content of Degreaser Salt SLOTOCLEAN AK 91 can be determined by acidimetric titration. Correction is made to nominal value according to the difference determined by titration. We're pleased to provide a suitable analysis description upon request.

4.2 Degreaser additives

Degreaser Salt SLOTOCLEAN AK 91 already contains tensides. But the cleaning effect can be enhanced by the use of suitable cleaning additives. Degreaser additives are only consumed by drag-out. A determination of the concentration isn't possible with justifiable methods. They're replenished either during replenishment of Degreaser Salt SLOTOCLEAN AK 91 proportionately or with decreasing effect.

4.3 Cloud point

When the operating temperature reaches a certain point - the cloud point - degreaser additives start to oil out and effectiveness diminishes. This is indicated by cloud formation in the electrolyte. Maximum operating temperature is defined by the cloud point.
The cloud point depends on quality and type of degreaser additive, as well as on the salt content of the solution. The salt content results from the degreaser salt added and the carbonate that forms during operation. The higher the salt content, the lower is the cloud point.

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4.4 pH value

The optimum pH value 8.2 should be maintained in the degreasing system (Degreaser Salt SLOTOCLEAN AK 91 with cleaning enhancer suitable for ultrasound) especially when removing grinding paste or similar products. (The pH value is measured at 20 °C).

pH value < 8.0	The solubility of the surfactants decreases. Degreaser solution turns cloudy. Cleaning effect deteriorates.
pH value > 8.7	Depending on temperature and immersion time there's the risk, that e.g. brass for example starts more or less tarnishing. Pigment removal decreases.

Corrections of the ph value if necessary

raise pH value ↑: sodium hydroxide, 50 % (765 g/l aqueous)
decrease pH-Wert ↓: phosphoric acid, (75 %)

5.0 TROUBLE SHOOTING

No information available at present.

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6.0 EFFLUENT

Legal regulations must be observed for disposal of the Degreaser SLOTOCLEAN AK 90. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Resulting rinse waters must be batch detoxified. Therefore the pH must be adjusted to approx. 2 with diluted acid, e.g. with technical hydrochloric acid, (10 %). After the addition of 5 g/l technical calcium chloride ($CaCl_2 \times H_2O$) the pH is increased to pH 9 with technical sodium hydroxide solution. After metal precipitation and flocculation it's filtered.

7.0 SAFETY

Reasonable care is required when handling Schlötter chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Degreaser SLOTOCLEAN AK 90 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Aluminium Pickle
SLOTOCLEAN AK 60

Pickle Additive SLOTOCLEAN AK 61 is used as an additive in sodium hydroxide long-running pickle.

Pickle Additive SLOTOCLEAN AK 61 is a weak alkaline concentrate (approx. pH 9) and it is free from nitrate, nitride, chlorate and chloride. It has excellent wetting- and dispersing characters and contains specific organic oxidants and complexing agents to prevent the formation of scale even at high aluminium concentrations.

Pickle Additive SLOTOCLEAN AK 61 provides the achievement of equal E 6-surfaces on aluminium and its alloys.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the TRGS 510 must be followed.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	steel or steel with alkali-resistant rubber-lining
Local Exhaust Ventilation:	required
Part-/Electrolyte Agitation:	stirring device or air agitation
Heating/Cooling:	heat exchanger, immersion heaters or heating coils; at high material throughput a cooling system is required

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Pickle Additive SLOTOCLEAN AK 61	010228	1.16
Sodium hydroxide	supplied by user*	--

* The current product qualities respectively -specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

2.2 Composition

Pickle Additive SLOTOCLEAN AK 61	Complexing agents and organic oxidants

2.3 Requirements for a 100 litre bath

Product name	**AN**	**SG**	**Quantity**	**Optimum**	
Pickle Additive SLOTOCLEAN AK 61	010228	1.16	0.9 - 2.2	1.5	ltr.
Sodium hydroxide	--	--	5	--	kg

2.4 Make-up sequence for a 100 litre bath

All tanks and equipment to be used must be thoroughly cleaned prior to use.

- fill the tank with 75 litres of deionised water
- carefully add with constant stirring 5 kg of sodium hydroxide and dissolve in compliance with the valid safety measures
- add the required quantity of Pickle Additive SLOTOCLEAN AK 61
- make up to final volume with water
- mix thoroughly

When the operating temperature is reached the pickle is ready for use.

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2.5 Concentrations and operating conditions

	Quantity	Optimum	
Pickle Additive SLOTOCLEAN AK 61	9 - 22	15	ml/l
Sodium hydroxide	--	50	g/l
Treatment time:			
In the field of Electroplating	20 - 60	--	sec.
In the field of Eloxal	5 - 15	--	min.
Temperature range	50 - 60	--	°C

NB
The treatment time depends on the particular surface quality of the aluminum, the aluminum alloy, the concentration of the long-term pickle and the temperature.

At higher aluminum concentrations in the pickle the following operating ranges are recommended:

	Range		
	at < 50 g/l Al	at > 50 g/l Al	
Pickel Additive SLOTOCLEAN AK 61	12 - 18	20 - 25	ml/l
Sodium hydroxide	50 - 60	80 - 90	g/l

2.6 Consumption and replenishment

The consumption of the additives is due to drag-out, geometry and surface condition of the parts.

The replenishment depends on analysis results of aluminum- and sodium hydroxide concentration as well as the content of Pickle Additive SLOTOCLEAN AK 61.

Approximate values for replenishment:

Additive	Replenishment / Consumption
Pickel Additive SLOTOCLEAN AK 61	80 ml/m²
Sodium hydroxide	150 g/m²

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2.7 Etch rates

The data of the etch rates listed below are relating to the basic material AlMg1.

Make-up	Aluminium content of the pickle	Etch rate					
		50 °C			60 °C		
		5 min.	10 min.	20 min.	5 min.	10 min.	20 min.
50 g/l sodium hydroxide 15 g/l Aluminium Pickle SLOTOCLEAN AK 61 1 ml/l spraying suppresant	--	19 µm	36 µm	69 µm	34 µm	70 µm	141 µm
	20 g/l	27 µm	41 µm	89 µm	36 µm	65 µm	140 µm
	40 g/l	21 µm	45 µm	91 µm	41 µm	75 µm	153 µm
80 g/l sodium hydroxide 25 g/l Pickle Additive SLOTOCLEAN AK 61 1 ml/l spraying suppresant	80 g/l	20 µm	39 µm	85 µm	41 µm	90 µm	182 µm

3.0 PROCESS SEQUENCE

3.1 Pre-treatment

Depending on the base material, the parts to be plated are pre-treated as usual. Our technical field service and our service department would be pleased to provide you with information about suitable process sequences respectively -methods as well as suitable products from our pre-treatment programme.

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3.2 Process sequence

- hot-soak degreasing
- rinsing
- Aluminium Pickle SLOTOCLEAN AK 60
- rinsing
- lighten, depending on the basic material
- zincate
- rinsing
- further coating

4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Pickle Additive SLOTOCLEAN AK 61

The Pickle Additive SLOTOCLEAN AK 61 contains all, except sodium hydroxide, necessary components for the operation of the pickle. The content of the pickle additive can be determined analytically.
We're pleased to provide you with an analysis method upon request.

4.2 Sodium hydroxide

The content of sodium hydroxide is, among others responsible for the aggressivity of the pickle and so for the degree of attack on the base material. Normally, a higher content of sodium hydroxide is required (see point **2.5**) at a higher aluminium concentration in the pickle.

The content of sodium hydroxide can be determined analytically. We're pleased to provide you with an analysis method upon request.

5.0 TROUBLE SHOOTING

No information available at present.

6.0 EFFLUENT

Legal regulations must be observed for disposal of the Aluminium Pickle SLOTOCLEAN AK 60. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

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7.0 SAFETY

Reasonable care is required when handling chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Aluminium Pickle SLOTOCLEAN AK 60 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Schloetter
Surface Technology

Desmut
SLOTOCLEAN DS 10

Desmut SLOTOCLEAN DS 10 Nitric-Free is a new generation process for the pre-treatment of aluminium prior to electroless or electrolytic plating.

Desmut SLOTOCLEAN DS 10 Nitric-Free is used for the removal of smut formed during the chemical etching of aluminium.

Desmut SLOTOCLEAN DS 10 Nitric-Free is especially suited for the processing of wrought aluminium alloys, it is also suitable for use on some cast alloys.

Desmut SLOTOCLEAN DS 10 :

- has a long life.
- is easily maintained.
- has negligible attack on the substrate.
- is easy to waste treat.
- is a viable alternative to nitric acid.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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11.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	highly compressed polypropylene
Local Exhaust Ventilation:	recommended
Part/Electrolyte Agitation:	Not essential but solution and/or work movement is suggested
Filtration:	Not necessary
Heating/Cooling:	PTFE coated heating coils if required

12.0 MAKE-UP AND OPERATING CONDITIONS

12.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Product DSZN 11	018111	-
Acid Concentrate DSZN 12	018112	1.39

12.2 Requirements for a 100 litre bath

Product name	AN	SG	Quantity	
Product DSZN 11	018111	-	15	kg
Acid Concentrate DSZN 12	018112	1.39	8	ltr

12.3 Make-up sequence for a 100 litre bath

New, but also used tanks and equipment to be used must be thoroughly cleaned prior to use.

- Fill the clean process tank to 75% of final volume with deionised water.
- Add with stirring the required amount of Acid Concentrate DSZN 12 Concentrate.
- Add the required amount of Product DSZN 11 and mix until dissolved.
- Make up to final volume with deionised water.
- Ensure the temperature is correct and the solution is ready to use.

12.4 Concentrations and operating conditions

	Range	Optimum	
Product DSZN 11	135 - 165	150	g/1
Acid Concentrate DSZN 12	70 - 90	80	ml/1
Copper	-	<1	g/1
Temperature	15 - 30	22	0C
Immersion time	0.25 - 2	1	min

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12.5 Consumption

Consumption is through drag out loss and dissolution of the smut layer.
Product DSZN 11 12 - 16 g / m^2 surface area processed.
Acid Concentrate DSZN 12 10 - 15 ml/ m^2 surface area processed.

13.0 PROCESS SEQUENCE

The specific processing cycle varies from aluminium alloy to alloy. The following guideline should provide a basic outline of the pre-treatment necessary to obtain a uniform adherent deposit.

13.1 Process Sequence

- degreasing in a mild alkaline cleaner e.g SLOTOCLEAN AK 340
- rinsing
- Aluminium Pickle SLOTETCH 590 (alloys with a high purity can be etched stronger)
- rinsing
- desmut e.g SLOTOCLEAN DS 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- zinc strip e.g SLOTOSTRIP ZN 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- plating

  Electroless nickel e.g SLOTONIP 2010, 1850, 90
  Electrolytic nickel e.g Norma, SLOTONIK 20, Nickel Sulphamate MS
  Electrolytic copper e.g SLOTOCOUP CC 10

14.0 MAINTENANCE

Complete removal of the smut layer is essential in producing quality deposits on aluminium alloys. The concentration of DSZN 11, DSZN 12 and copper should be monitored on a regular basis.

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15.0 TROUBLE SHOOTING

No information available at present.

16.0 EFFLUENT

Legal regulations must be observed for the disposal of the Desmut SLOTOCLEAN OS 10. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section 13 of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Rinse water can be directly neutralised.
Spent solutions should be diluted 10 times prior to neutralisation with calcium hydroxide to pH 7-9.

17.0 SAFETY

Reasonable care is required when handling Schlotter chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage exposure controls. Toxicological and ecological information etc. It is required to ensure the supply and use of suitable protective clothing and equipment.

The user must verify the designated purpose of the bath. Previous experience has shown that not all metal surfaces are suitable for a trouble:.free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Desmut SLOTOCLEAN OS 10 is a process of Dr. Ing Max Schlotter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service and quality commitments (quality assurance).

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Schloetter
Surface Technology

Desmut
SLOTOCLEAN DS 10

Desmut SLOTOCLEAN DS 10 Nitric-Free is a new generation process for the pre-treatment of aluminium prior to electroless or electrolytic plating.

Desmut SLOTOCLEAN DS 10 Nitric-Free is used for the removal of smut formed during the chemical etching of aluminium.

Desmut SLOTOCLEAN DS 10 Nitric-Free is especially suited for the processing of wrought aluminium alloys, it is also suitable for use on some cast alloys.

Desmut SLOTOCLEAN DS 10 :

- has a long life.
- is easily maintained.
- has negligible attack on the substrate.
- is easy to waste treat.
- is a viable alternative to nitric acid.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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11.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	highly compressed polypropylene
Local Exhaust Ventilation:	recommended
Part/Electrolyte Agitation:	Not essential but solution and/or work movement is suggested
Filtration:	Not necessary
Heating/Cooling:	PTFE coated heating coils if required

12.0 MAKE-UP AND OPERATING CONDITIONS

12.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Product DSZN 11	018111	-
Acid Concentrate DSZN 12	018112	1.39

12.2 Requirements for a 100 litre bath

Product name	AN	SG	Quantity	
Product DSZN 11	018111	-	15	kg
Acid Concentrate DSZN 12	018112	1.39	8	ltr

12.3 Make-up sequence for a 100 litre bath

New, but also used tanks and equipment to be used must be thoroughly cleaned prior to use.

- Fill the clean process tank to 75% of final volume with deionised water.
- Add with stirring the required amount of Acid Concentrate DSZN 12 Concentrate.
- Add the required amount of Product DSZN 11 and mix until dissolved.
- Make up to final volume with deionised water.
- Ensure the temperature is correct and the solution is ready to use.

12.4 Concentrations and operating conditions

	Range	Optimum	
Product DSZN 11	135 - 165	150	g/1
Acid Concentrate DSZN 12	70 - 90	80	ml/1
Copper	-	<1	g/1
Temperature	15 - 30	22	0C
Immersion time	0.25 - 2	1	min

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12.5 Consumption

Consumption is through drag out loss and dissolution of the smut layer.
Product DSZN 11 12 - 16 g / m^2 surface area processed.
Acid Concentrate DSZN 12 10 - 15 ml/ m^2 surface area processed.

13.0 PROCESS SEQUENCE

The specific processing cycle varies from aluminium alloy to alloy. The following guideline should provide a basic outline of the pre-treatment necessary to obtain a uniform adherent deposit.

13.1 Process Sequence

- degreasing in a mild alkaline cleaner e.g SLOTOCLEAN AK 340
- rinsing
- Aluminium Pickle SLOTETCH 590 (alloys with a high purity can be etched stronger)
- rinsing
- desmut e.g SLOTOCLEAN DS 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- zinc strip e.g SLOTOSTRIP ZN 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- plating

  Electroless nickel e.g SLOTONIP 2010, 1850, 90
  Electrolytic nickel e.g Norma, SLOTONIK 20, Nickel Sulphamate MS
  Electrolytic copper e.g SLOTOCOUP CC 10

14.0 MAINTENANCE

Complete removal of the smut layer is essential in producing quality deposits on aluminium alloys. The concentration of DSZN 11, DSZN 12 and copper should be monitored on a regular basis.

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15.0 TROUBLE SHOOTING

No information available at present.

16.0 EFFLUENT

Legal regulations must be observed for the disposal of the Desmut SLOTOCLEAN OS 10. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section 13 of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Rinse water can be directly neutralised.
Spent solutions should be diluted 10 times prior to neutralisation with calcium hydroxide to pH 7-9.

17.0 SAFETY

Reasonable care is required when handling Schlotter chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage exposure controls. Toxicological and ecological information etc. It is required to ensure the supply and use of suitable protective clothing and equipment.

The user must verify the designated purpose of the bath. Previous experience has shown that not all metal surfaces are suitable for a trouble:.free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Desmut SLOTOCLEAN OS 10 is a process of Dr. Ing Max Schlotter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service and quality commitments (quality assurance).

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Zinc Strip
SLOTOSTRIP ZN 10

Zinc Strip SLOTOSTRIP ZN 10 Nitric-Free is a new generation process for the pre-treatment of aluminium prior to electroless or electrolytic plating.

Zinc Strip SLOTOSTRIP ZN 10 Nitric-Free is used for the removal of the first stage zincate layer in the double zincate process sequence.

Zinc Strip SLOTOSTRIP ZN 10 Nitric-Free is equally suited for the processing of both wrought and cast aluminium alloys.

Zinc Strip SLOTOSTRIP ZN 10 :

has a long life.
is easily maintained.
has negligible attack on the substrate.
is easy to waste treat.
is a viable alternative to nitric acid.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important :
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	highly compressed polypropylene
Local Exhaust Ventilation:	recommended
Part/Electrolyte Agitation:	Not essential but solution and/or work movement is suggested
Filtration:	Not necessary
Heating/Cooling:	Porcelain or PTFE coated heating coils if required

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Product DSZN 11	018111	-
Sulphuric acid pure 1.84	163030	1.84
Alternatively		
Sulphuric acid 50% w/w	164000	1.4

2.2 Requirements for a 100 litre bath

Product name	**AN**	**SG**	**Quantity**	
Product DSZN 11	018111	-	3	kg
Sulphuric acid pure 1.84	163030	1.84	1	ltr
Alternatively				
Sulphuric acid 50% w/w	164000	1.4	2.6	ltr

2.3 Make-up sequence for a 100 litre bath

New, but also used tanks and equipment to be used must be thoroughly cleaned prior to use.

- Fill the clean process tank to 90% of final volume with deionised water.
- Add with stirring the required amount of sulphuric acid (or sulphuric acid 50% w/w).
- Add the required amount of Product DSZN 11 and mix until dissolved
- Make upto final volume with deionised water.
- Ensure the temperature is correct and the solution is ready to use.

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2.4 Concentrations and operating conditions

	Range	Optimum	
Product DSZN 11	20 - 40	30	g/l
Sulphuric acid	5 - 15	10	ml/l
Zinc	-	<20	g/l
Temperature	15 - 30	22	°C
Immersion time	0.25 - 2	1	min

2.5 Consumption

Consumption is primarily by drag out loss
Product DSZN 11 4 - 6 g / m^2 surface area processed.

3.0 PROCESS SEQUENCE

The specific processing cycle varies from aluminium alloy to alloy. The following guideline should provide a basic outline of the pre-treatment necessary to obtain a uniform adherent deposit.

3.1 Process Sequence

- degreasing in a mild alkaline cleaner e.g SLOTOCLEAN AK 340
- rinsing
- Aluminium Pickle SLOTETCH 590 (alloys with a high purity can be etched stronger)
- rinsing
- desmut e.g SLOTOCLEAN DS 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- zinc strip e.g SLOTOSTRIP ZN 10
- rinsing
- zincate e.g Zincate CNF 10
- rinsing
- plating

  Electroless nickel e.g SLOTONIP 2010, 1850, 90
  Electrolytic nickel e.g Norma, SLOTONIK 20, Nickel Sulphamate MS
  Electrolytic copper e.g SLOTOCOUP CC 10

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4.0 MAINTENANCE

Clean stripping of the first zincate layer is essential in producing quality deposits on aluminium alloys. The concentration of Product DSZN 11 and zinc should be monitored on a regular basis.

5.0 TROUBLE SHOOTING

No information available at present.

6.0 EFFLUENT

Legal regulations must be observed for the disposal of the Desmut SLOTOCLEAN DS 10. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Rinse water can be directly neutralised.
Spent solutions will contain zinc and will need neutralising with sodium hydroxide to pH 8.5 - 10.
If the pH is too low (< 7.0) there will be incomplete precipitation of the zinc. If the pH is too high (>11) the zinc will re-dissolve as zincate.

7.0 SAFETY

Reasonable care is required when handling Schlötter chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage exposure controls. Toxicological and ecological information etc. It is required to ensure the supply and use of suitable protective clothing and equipment.

The user must verify the designated purpose of the bath. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. **Zinc Strip SLOTOSTRIP ZN 10** is a process of Schloetter UK Ltd. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service and quality commitments (quality assurance).

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Nickel Bath
NORMA

Nickel Bath NORMA is a sturdy electrolyte which is operated in most cases without additives, which is mainly used for plating of intermediate nickel layers in the field of electrical and electronic application. Its deposits are very ductile and extremely active which is especially important for subsequent electroplating. On blank surfaces Nickel Bath NORMA produces light and relatively uniform nickel coatings.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important :
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:		rubber-lined steel, polypropylene or PVC
Local Exhaust Ventilation:		recommended
Part Agitation	PCBs	from and to the anodes; work piece movement 0.5 - 0.8 m/min at a stroke length of approx. 30 mm
	conventional	parallel to the anodes; work piece movement 2 - 3 m/min at a stroke length of 80 - 100 mm
	barrel rotation	4 - 8 rpm., preferably 4 rpm
Filtration:		continuous filtration with 1 - 2 turnovers per hour; filter mesh approx. 10 µm
Anodes:		usual nickel quality, preferably S-nickel e.g. rounds, pellets, etc. in titanium baskets
Anode bags:		polypropylene fabric
Heating/Cooling:		porcelain immersion heaters or heat exchangers made of graphite, titanium or suitable plastic

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Nickel Sulphate Solution 550 g/l	160044	1.31
Alternatively		
Nickel Sulphate Hexahydrate	160043	--
Nickel Chloride Solution 720 g/l	160048	1.35
Alternatively		
Nickel Chloride Salt	160042	--
Boric Acid	160000	--
Nickel Additive SLOTONIK M	041203	1.01
optional:*		
Nickel Additive BFL	041010	1.06

* Product quality specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

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2.2 Requirements for a 100 litre bath

Product name	AN	SG	Quantity	
Nickel Sulphate Solution 550 g/l	160044	1.31	46.4	ltr.
Alternatively				
Nickel Sulphate Hexahydrate	160043	--	25.5	kg
Nickel Chloride Solution 720 g/l	160048	1.35	4.6	ltr.
Alternatively				
Nickel Chloride Salt	160042	--	3.3	kg
Boric Acid	160000	--	4.0	kg
Nickel Additive SLOTONIK M	041203	1.01	0.5	ltr.
optional:*				
Nickel Additive BFL	041010	1.06	0.5	ltr.

* If light bright deposits are required, 5 ml/l of Nickel Additive BFL must be added after the addition of Nickel Additive SLOTONIK M.

2.3.1 Tank preparation

New, but also used tanks, filter equipment, anode bags etc. must be thoroughly cleaned prior to make-up.
New unused tanks, filtration equipment etc. should be leached out for several hours with warm acidified water (10 - 20 ml/l of hydrochloric acid and 2 - 5 ml/l Nickel Additive SLOTONIK M or with diluted sodium hydroxide solution 20 - 30 g/l) before use. If sodium hydroxide solution is used, neutralization with acidified water (hydrochloric acid) is required.

2.3.2 Make-up sequence for a 100 litre bath (Using nickel solutions)

- fill the clean tank with 40 litres of deionised water and heat to 60 - 70°C.
- add the required quantities of Nickel Sulphate Solution 550 g/l and Nickel Chloride Solution 720 g/l.
- add the required amount of Boric Acid and mix until dissolved.
- check and adjust pH to 4.0 (see point **4.6**)
- filter solution.
- add 0.5 litre Nickel Additive SLOTONIK M.
- **optional :** where required add the stipulated quantity of Nickel Additive BFL.
- make up to final volume with deionised water .
- mix thoroughly.

The electrolyte is ready for use when the operating temperature has been reached.

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2.3.3 Make-up sequence for a 100 litre bath (Using nickel salts)

- fill the clean tank with 70 litres of deionised water and heat to 60 - 70°C.
- add the required quantities of Nickel Sulphate Hexahydrate and Nickel Chloride Salt.
- add the required amount of Boric Acid and mix until dissolved.
- check and adjust pH to 4.0 (see point **4.6**)
- filter solution.
- add 0.5 litre Nickel Additive SLOTONIK M.
- **optional :** where required add the stipulated quantity of Nickel Additive BFL.
- make up to final volume with deionised water .
- mix thoroughly.

The electrolyte is ready for use when the operating temperature has been reached.

2.4 Concentrations and operating conditions

		Range	Optimum	
Nickel		40 - 80	65	g/l
Chloride		8 - 15	10	g/l
Boric acid		35 - 45	40	g/l
Nickel Additive SLOTONIK M		3 - 8	5	ml/l
Nickel Additive BFL		0 - 25	--	ml/l
pH value		3.8 - 4.2	4.0	
Temperature	PCB	28 - 32	30	°C
	conventional	30 - 60	50	°C
Deposition rate at 2 A/dm^2		approx. 0.4 µm/min		

raise ↑ pH value: Potassium hydroxide, 5 % (52 g/l aqueous)
decrease ↓pH value HCl, chem. pure diluted 1 : 1 **alternatively** H_2SO_4, (10 %)

2.5 Consumption and replenishment

The consumption of the additives is more or less due to drag-out depending on the part geometry and surface condition.
In the case of a lack of wetting agent, visible by the formation of pores, we recommend an addition of 1 - 2 ml/l of Nickel Additive SLOTONIK M. The replenishment of Nickel Additive BFL is made in accordance with the visual appearance of the plated deposit.

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3.0 PROCESS SEQUENCE

3.1 Pre-treatment

3.1.1 for PCB technology

- panel gold plating before etching:

PCBs plated in an acid copper electrolyte are rinsed and pre-dipped in sulphuric acid. Subsequently a layer thickness of 5 - 8 µm nickel is deposited from Nickel Bath NORMA. After rinsing the PCBs are plated with a 1 - 3 µm gold layer.

- partial gold plating

After the etching process the circuit boards are brightened. Then the areas of the PCB not to be gold plated are screened. Now, the lead-tin layer can be removed partially by a metal stripper. Then it's activated. Nickel plating of the PCBs is necessary to create a diffusion barrier. A layer thickness of 6 - 8 µm is sufficient. Finally the boards are gold plated.

3.1.2 for conventional electroplating

Thorough cleaning is essential to achieve a stain-free perfect nickel layer with good adhesion. After hot-soak degreasing in an alkaline degreaser solution follows the electrolytic degreasing. Iron and steel parts cathodically degreased have finally to be degreased anodically. Normally, non-ferrous metals are only degreased cathodically. Subsequently they're neutralized in diluted acid (e.g. sulphuric acid, 2 - 3 %).

3.2 Process sequence

3.2.1 for PCB technology

- panel gold plating:

- bright acid copper plating
- rinsing
- activation in diluted sulphuric acid
- rinsing
- nickel plating in Nickel Bath NORMA
- rinsing
- gold plating

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3.2.2 for PCB technology

- partial gold plating

- etching
- rinsing
- drying
- screening of the areas on the PCB which aren't to be gold plated
- partial stripping (lead-tin)
- rinsing
- copper activation
- rinsing
- immersing in diluted sulphuric acid
- nickel plating in Nickel Bath NORMA
- rinsing
- gold plating

3.2.3 for conventional electroplating

- base material steel

- hot-soak degreasing
- rinsing
- pickling
- rinsing
- electrolytic degreasing
- rinsing
- immersing in diluted sulphuric acid
- nickel plating in Nickel Bath NORMA

- base material non-ferrous metal

- hot-soak degreasing
- rinsing
- electrolytic degreasing
- rinsing
- immersing in diluted sulphuric acid
- nickel plating in Nickel Bath NORMA

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4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Nickel

The recommended concentration of nickel is 40 - 80 g/l, optimum of 65 g/l. Within the working range, the achievable current density increases with increased nickel concentration.

4.2 Chloride

The chloride content is 8 - 15 g/l, optimum 10 g/l. Chloride increases the conductivity of the electrolyte and anode solubility.

4.3 Boric acid

The boric acid content of the electrolyte is 35 - 45 g/l, optimum 40 g/l. Significant lack of boric acid causes a loss of buffer action and greater pH variations. High concentrations may exceed the solubility limit causing roughness in the plated deposit.

4.4 Nickel Additive SLOTONIK M

Nickel Additive SLOTONIK M is a wetting agent for mechanically agitated applications. It prevents formation of pores and stabilizes the operation of the nickel electrolyte. If the process is only operated with Nickel Additive SLOTONIK M the nickel deposits are sulphur-free. If an activated carbon treatment (A/C) with 6 g/l is performed, a loss up to approx. 50 % of the concentration has to be expected.
Nickel Additive SLOTONIK M is only consumed by drag-out. Experience has shown that 0.2 - 0.4 litre Nickel Additive SLOTONIK M has to be added after a throughput of 10 kAh.

4.5 Nickel Additive BFL

Nickel Additive BFL is only used if light bright deposits are required. The solubility limit is 50 - 55 ml/l. Crystallized Nickel Additive BFL leads to inclusions in the nickel coating. If Nickel Additive BFL is used the nickel deposits are sulphur containing. The content of Nickel Additive BFL can be monitored analytically. Usually the additive is dosed according to visual appearance. Consumption of Nickel Additive BFL is 0.5 - 1.0 l/10 kAh depending on local drag-out losses.
In case of carbon treatment (6 g/l) a loss of up to approx. 20 - 30 % of the additive concentration must be expected.

4.6 pH value

The pH should be between 3.8 and 4.2 and practically maintained at 4.0. Low pH will reduce the levelling power of the nickel deposits. In extreme cases it results in a reduction of the cathodic current efficiency subsequently effects the deposition. A high pH will cause instability in achieving the correct brightness level. The pH value must always be adjusted with diluted hydrochloric acid, chem. pure or sulphuric acid.
If in exceptional cases the pH value is too low, it is raised ↑ by an addition of diluted potassium hydroxide solution (52 g/l aqueous).
The addition of potassium hydroxide must be made extremely slowly and with intensive electrolyte agitation because due to local overconcentration nickel precipitates as hydroxide.

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5.0 TROUBLE SHOOTING

5.1 Fault finding chart

Fault	Cause	Correction
brittle and hard nickel coatings	organic impurities	6 g/l of activated carbon, decrease ↓ pH value to 3.2; after filtration add 3 - 5 ml/l of Nickel Additive SLOTONIK M
dark coatings		
dark deposits in the low current density range	foreign metal impurities	dummy plating of foreign metals at 0.4 A/dm^2 approx. 15 hours
coatings too matt	electrolyte is operated without Nickel Additive BFL	Addition of up to 5 ml/l of Nickel Additive BFL
Pores/pitting	lack of wetting agent	add 1 - 2 ml/l of Nickel Additive SLOTONIK M

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6.0 EFFLUENT

Legal regulations must be observed for disposal of the Nickel Bath NORMA. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Salts and additives recommended for the operation of Nickel Bath NORMA do not contain complexing agents. Resulting rinse waters may therefore be fed directly into the neutralisation step of the effluent plant.
For concentrates should be evaluated if a recycling respectively an electrolytic recovery of nickel by an external refinery is economical or an appropriate dilution (at least 1 : 10) which allows the solution to be fed directly into the neutralisation step of the effluent plant is reasonable.

7.0 SAFETY

Reasonable care is required when handling chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Nickel Bath NORMA is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Bright Tin
CULMO 1

Bright Tin CULMO 1 is a sulphuric acid based electrolyte which is mainly applied for printed circuit boards manufacturing, electro-technical component finishing - also in barrel application -, and in the field of household accessories as well.

Bright Tin CULMO 1 deposits fully bright tin coatings in an extremely wide range of throwing power. High stability and easy maintenance are the features of this bright tin electrolyte.

Bright tin layers of any thickness are deposited from Bright Tin CULMO 1. Even thin layers are bright, and the brightness still improves with increasing layer thickness due to the good levelling quality. The tin deposits from Bright Tin CULMO 1 are resistant towards fingerprints to a great extent and also solderability is still excellent after prolonged storage periods.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the TRGS 510 must be followed.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	rubber-lined steel, polypropylene or PVC
Local Exhaust Ventilation:	not required
Part/Electrolyte Agitation:	**Printed Circuit Boards (PCBs):** work piece movement from and to the anodes, at a rate of 0.5 - 0.8 m/min, stroke length approx. 30 mm **Rack application:** parallel to the anodes, at a rate of 3 - 4 m/min, stroke length approx. 50 - 70 mm **Barrel application:** barrel rotation 4 - 6 rpm
Filtration:	continuous, 2 - 3 turnovers per hour
Anodes:	pure tin, min. 99.90 %, preferably 99.93 % according to DIN EN 610; higher impurities would increase the formation of anode sludge
Anode bags:	polypropylene fabric
Cooling:	plastic coated steel pipes, thin-walled plastic pipes or stainless steel 1.4571

NB
Titanium should not be used for cooling coils or anode hooks. Plastic coated anode hooks are especially recommended for tin electrolytes.

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Sulphuric acid, conc. (96 %) chem. pure	supplied by user*	1.84
Tin Salt SU	100000	--
Starter CULMO 1 (for new make-up see point **4.3**)	101501	1.03
Brightener CULMO 2	101502	1.00
Additive CULMO AN 11 1	101508	1.03
Additive CULMO IRA 1	101507	1.00
Corrector ACR (see point **4.6**)	100019	1.00

***** The current product qualities respectively -specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

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2.2 Requirements for a 100 litre bath

2.2.1 when used as barrel application

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	10	ltr.
Tin Salt SU	100000	--	3	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.2.2 when used as rack application (high current densities)

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	6.5	ltr.
Tin Salt SU	100000	--	6	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.2.3 when used for the processing of PCBs

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	10	ltr.
Tin Salt SU	100000	--	4	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.3 Make-up sequence for a 100 litre bath

All tanks and equipment to be used should be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add the required quantity of sulphuric acid, conc. (96 %) chem. pure while stirring constantly; observe safety measures!
- add the required quantity of Tin Salt SU while stirring vigorously and dissolve completely
- cool to operating temperature
- add the required quantity of Starter CULMO 1
- mix well
- make up to final volume with deionised water
- mix thoroughly
-

The electrolyte is ready for use when the operating temperature has been reached.

NB
When making-up the electrolyte, it has to be taken into consideration that the temperature of the solution raises quickly by the exothermic reaction which forms by the addition sulphuric acid, conc. (96 %) chem. pure. If the sulphuric acid is added too quickly, an intensive heat can develop which causes spattering of the corrosive liquid.
It's absolutely necessary to observe the safety measures applicable to make-up and handling (protective clothing, goggles, rubber gloves).

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2.4 Concentrations and operating conditions

2.4.1 when used as barrel application

	Range	Optimum	
Tin(II)		15	g/l
Free sulphuric acid	85 - 108 160 - 200	100 185	ml/l g/l
Starter CULMO 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	min. 0.6	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

2.4.2 when used as rack application (high current densities)

	Range	Optimum	
Tin(II)		15	g/l
Free sulphuric acid		65 120	ml/l g/l
Starter CULMO AT 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	2 - 4	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

2.4.3 when used for the processing of PCBs

	Range	Optimum	
Tin(II)		20	g/l
Free sulphuric acid		100 185	ml/l g/l
Starter CULMO AT 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	1.5 - 2	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

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2.5 Consumption and replenishment

Consumption of the additives is mainly due to drag-out.

Approximate values for replenishment:

Additive	Replenishment / Consumption
Brightener CULMO 2	approx. 2.5 l/10 kAh

Depending in the local drag-out losses the following replenishment is required:

Additive	Replenishment / Consumption
Additive CULMO AN 11	approx. 4 ml/m² surface throughput
Additive CULMO IRA 1	approx. 1 ml/m² surface throughput

2.6 Deposit characteristics

Hardness of the tin deposit: 20 - 30 $HV_{0.05}$

3.0 PROCESS SEQUENCE

Our technical field service or service department will be pleased to provide you with detailed information on suitable process sequences respectively methods upon request.

3.1 Pre-treatment

Steel or copper parts are pre-treated as usual followed by dipping into diluted sulphuric acid and then transferred into Bright Tin CULMO 1. Please note that hydrochloric acid solutions may not be used in the pre-treatment process. Chloride contamination ≥ 0.3 g/l lead to irreparable disturbances in the form of matt tin deposition that starts in the low current density range.

Non-ferrous metal alloys containing zinc cannot be tin plated directly, since zinc would diffuse from the base material into the tin layer above even at room temperature. Therefore a 3 - 5 µm intermediate copper- or nickel layer as diffusion barrier should be plated. Therefore an intermediate copper- or nickel layer is applied as a diffusion barrier. Intermediate copper layers should be deposited from acidic- or cyanide high performance electrolytes. The adhesion of the tin layers would decrease if intermediate copper layers are deposited from additive-free cyanide pre-copper electrolytes.

Printed circuit boards is rinsed immediately after the electroplated copper deposition, followed by dipping into sulphuric acid, conc. (96 %) chem. pure (50 ml/l) and then transferred into Bright Tin CULMO 1. The copper layer may be precautionary activated in an aqueous sodium peroxodisulfate solution (100 g/l of sodium peroxodisulfate solution, 30 ml/l of sulphuric acid). Then it's carefully rinsed and also dipped into diluted sulphuric acid and immediately tin plated.

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3.2 Process sequences

Base material steel	Base material copper	Printed Circuit Boards (PCBs)
• immersion degreasing • rinsing • pickling in HCl diluted 1:1 • rinsing throughly • electrolytic degreasing, anodically • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating in Bright Tin CULMO 1 • rinsing • drying	• immersion degreasing • rinsing • electrolytic degreasing, anodically • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating Bright Tin CULMO 1 • rinsing • drying	• through hole plating • pattern plating • acid cleaner • rinsing • micro-etch • rinsing • acid dipping in **sulphuric acid**, (10 %) • copper plating in a sulfuric copper electrolyte • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating in Bright Tin CULMO 1 • rinsing • drying

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4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Tin

The tin content depends on the electrolyte application and should range between 10 and 30 g/l. The optimum for barrel parts is 15 g/l and for parts with difficult surface geometry or PCBs at 20 g/l.
If high demand is set on deposition speed, current densities of up to 4 A/dm² can be plated with a tin content of 30 g/l, but it would however impair the metal distribution. Lack of tin is replenished with Tin Salt SU (50 % tin).

4.2 Sulphuric acid

The sulphuric acid concentration should not fall below 85 ml/l or 160 g/l, except for the "rack high current density - version". As optimum concentration 100 ml/l respectively 185 g/l and max. 108 ml/l respectively 200 g/l are recommended. A higher concentration of sulfuric acid leads to disturbances caused by anode passivation and must therefore be avoided. In the high current density version with 30 g/l tin the optimum content of sulphuric acid is approx. 65 ml/l respectively 120 g/l. Lack of acid is replenished with sulphuric acid, conc. (96 %) chem. pure acid only.

4.3 Starter CULMO 1

Starter CULMO 1 is only used for make-up of a new electrolyte and contains all components required for deposition. The concentration should be 25 - 35 ml/l. The single components Brightener CULMO 2, Additive CULMO IRA 1 and Additive CULMO AN 11 1 are used for replenishment during electrolyte operation.

4.4 Brightener CULMO 2

Brightener CULMO 2 is responsible for the good brightness over the entire current density range. Lack of Brightener CULMO 2 starts with decreasing brightness in the low current density range. Lack of Brightener CULMO 2 can first of all be recognized by a decrease of brightness in the low current density area. At parts with a large surface, processed with low electrolyte agitation, the lack of brightener can be recognized by matt zones. Then, additions of 1 - 2 ml/l Brightener CULMO 2 are required.

First of all, excess dosing of Brightener CULMO 2 leads in areas with a favourable electrolyte flow (breakthroughs) to a matt-, partly stepped tin deposition with a brownish discolouration. In an extreme case the deposition will be completely inhibited. At parts with a large surface excess dosing is recognized by burnings in the high current density range. In this case the tin deposition is matt with a brownish discoloration. Excess dosing can be compensated (see point **4.5**) by the addition of the Additives CULMO AN 11 1 and IRA 1.
The continuous consumption of Brightener CULMO 2 is at a operating temperature of approx. 20 °C about 2.5 l/10 kAh. At a higher temperature an increased consumption must be expected.

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4.5 Additives CULMO IRA 1 and AN 11 1

The Additives CULMO IRA 1 and CULMO AN 11 1, are only indirectly involved in the brightening effect of the electrolyte. Both additives are consumed due to drag-out losses. Normally, 4 ml of Additive CULMO AN 11 1 and 1 ml of Additives CULMO IRA 1 must be added per m² surface throughput.

Lack of the Additives CULMO IRA 1 and CULMO AN 11 1 cause almost the same faulty depositions as described for excess dosing of Brightener CULMO 2 (see point **4.4).** Incremental additions of a total of 3 ml/l Additives CULMO IRA 1 followed by up to 20 ml/l of Additive CULMO AN 11 1 are may be required. If accidentally too much of the Additives CULMO IRA 1 and CULMO AN 11 1 is dosed, then this will result in decreasing brightness of the deposited tin coatings but can be corrected by an addition of 1 - 2 ml/l Starter CULMO 1. Although the alternating correction may be repeated but leads to an uneconomical and unnecessary raise of the total organic concentration and in some cases soldering problems cannot be excluded.

4.6 Corrector ACR

Corrector ACR contains an auxiliary brightener component which is partly included in Additive CULMO IRA 1. The required component concentration is maintained by continuous replenishment of Additive CULMO IRA 1. However, depending on the local working conditions, a lack can occur (see point **4.5**).
We recommend an addition of Corrector ACR if despite of an addition of 1 - 2 ml/l Additive CULMO IRA 1 the problem with step plating cannot be solved and so the deposition not be improved.
Additions with Corrector ACR should be performed in increments of 1 up to max. 5 ml/l.

4.7 Bright tin plating in barrel plants

In barrel application sufficient rectifier capacity must be available during plating. The current density should be > 0.6 A/dm² and the anode surface must be in such a dimension that the anodic current density does not exceed 2.5 A/dm². Too small anode surfaces lead to anode passivation and to oxidation of Sn(II) to Sn(IV). Combining rack and barrel application is not recommended since different operating conditions would require different dosing quantities of the additives which would result in bath instability.

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5.0 TROUBLE SHOOTING

5.1 Fault finding chart

Fault	Cause	Correction
step plating	extremely high concentration of Brightener CULMO 2	add 1 - 2 ml/l of Additive CULMO IRA 1 **and/or** 5 ml/l of CULMO AN 11 1; repeat the addition if required
dark rings around boreholes		work the electrolyte through for maybe 1 - 2 h/2 A/dm²
total inhibition of the tin deposition (no deposition around boreholes, no deposition on a large area		
frosted deposition around boreholes		
strong hydrogen formation at the cathode		
formation of pores in the high current density range	minor excess dosing of Brightener CULMO 2	add 1 - 2 ml/l of Additive CULMO IRA 1 **and/or** 5 ml/l of Additive CULMO AN 11 1
matt deposition in the low current density range	lack of Brightener CULMO 2	addition 1 - 2 ml/l of Brightener CULMO 2
	electrolyte temperature is too high	decrease the temperature to e.g. 15 °C
	tin content too high	dilute the electrolyte to optimum
	chloride contamination	it can be tried to correct chloride contaminations up to approx. 300 mg/l by incremental additions of 1 ml/l ; Brightener CULMO 2; at contaminations > 300 mg/l the electrolyte must be replaced by a new make-up
hazy or milky matt deposition in the entire current density range	lack of Brightener CULMO 2	incremental additions of 1 ml/l Brightener CULMO 2

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Fault	Cause	Correction
white-grey coating on the anodes	the anodic current density is too high (> 2,5 A/dm²)	increase the anode surface
the anodes are passive		
pitting, uneven erosion of the anode	sulphuric acid content too high	analyse the electrolyte and adjust to optimum
	poor flow conditions in the plating tank	improve the electrolyte exchange at the anode, e.g. by cleaning of the anode bags

6.0 EFFLUENT

Legal regulations must be observed for disposal of the Bright Tin CULMO 1. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Bright Tin CULMO 1 doesn't contain complexing agents. The rinse waters resulting from Bright Tin CULMO 1 are acidic and contain dissolved tin(II) sulphate as well as Sn(IV)-compounds (metastannic acid) as suspended particles. Resulting rinse waters must therefore be neutralised to insoluble tin hydrate and sedimented. The sedimentation, depending on the effluent plant, must if necessary be supported by a flocculant.

7.0 SAFETY

Reasonable care is required when handling chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.
EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Bright Tin CULMO 1 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Antitarnish
ALS 30

Antitarnish ALS 30 is an acid based process (pH value approx. 1 - 2) for post-treatment of tin or tin-lead plated components. A liquid concentrate is used for make-up.

Antitarnish ALS 30 is non-foaming and can be used for rack-, barrel-, and reel-to-reel application.

The treatment of bright tin- or tin alloy layers in Antitarnish ALS 30 prevents discolouration during heat treatment > 200 °C and therefore improves the long term solderability.

Antitarnish ALS 30 is AOX-free.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance only. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important :
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	rubber-lined steel, stainless steel
Local Exhaust Ventilation:	required
Part-/Electrolyte Agitation:	stirring device
Heating/Cooling:	heating made of stainless steel and controlled by thermostat

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product names	**Article no. (AN)**	**SG**
Antitarnish Concentrate ALS 31	120031	1.16

2.2 Requirements for a 100 litre bath

Product name	AN	SG	Quantity	Optimum	
Antitarnish Concentrate ALS 31	120031	1.16	7.5 - 15	10	ltr.

2.3 Make-up sequence for a 100 litre bath

New, but also unused tanks, filtration equipment etc. or tanks and equipment must be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add 10 litres of Antitarnish Concentrate ALS 31
- make up to final volume with deionised water
- mix thoroughly

When the operating temperature is reached the antitarnish is ready for use.

NB
The water quality is very important for an optimum way of operating Antitarnish ALS 30. We recommend the use of deionised water since tap water from a hardness degree of 6 °dH may lead to a precipitation of Antitarnish ALS 30 components.

2.4 Concentrations and operating ranges

	Range	Optimum	
Antitarnish Concentrate ALS 31	75 - 150	100	ml/l
Treatment time	> 5	30	sec.
Temperature range	20 - 60	30	°C
pH value (at 20 °C)	1.0 - 2.0	--	

raise ↑ pH value: shouldn't be necessary
decrease ↓ pH value: with Antitarnish Concentrate ALS 31

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2.5 Consumption

Consumption of the additives is mainly due to drag-out.

3.0 PROCESS SEQUENCE

Our service department or technical field service would be pleased to provide you information on suitable process sequences respectively methods.

3.1 Process sequence

- plating with tin or tin-lead
- rinsing
- Antitarnish ALS 30
- rinsing
- drying

4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Antitarnish Concentrate ALS 31

Antitarnish Concentrate ALS 31 contains all the necessary components required for the operation of the degreaser.

The Antitarnish Concentrate ALS 31 may be determined by alkalimetric titration and replenished according to analysis results. We're pleased to provide you with suitable analysis description upon request.

4.2 pH value

The pH should be measured at regular intervals at a temperature of 20 °C. The optimum pH value is between 1.0 and 2.0.

5.0 TROUBLE SHOOTING

No information available at present.

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6.0 EFFLUENT

Legal regulations must be observed for disposal of the Antitarnish ALS 30. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Antitarnish ALS 30 doesn't contain complexing agents so a simple neutralisation for the treatment of resulting rinse waters is sufficient.

7.0 SAFETY

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The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Antitarnish ALS 30 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Copper Busbars Process

Degreaser
SLOTOCLEAN AK 90

The Degreaser SLOTOCLEAN AK 90 is a weak alkaline immersion degreasing process for the removal of **processing oils and drawing compounds** from copper, brass, aluminium or German silver 2.0740. A separate station should be available for each type of metal in order to prevent cementation (e.g. copper ions on aluminium).
A treatment with this cleaning system results in a **hydrophile** surface.

In order to support the removal of **pigmented drawing compounds, polishing or grinding paste** from the above mentioned base materials, the cleaning process can be enhanced effectively by the ultrasonic support.

Please refer to technical data sheet BATH 02300-E Summary of Degreaser Additives which informs you about cleaning enhancers suitable for ultrasound installations.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the TRGS 510 must be followed.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	isolated tanks made of steel respectively rubber-lined steel (heat resistant hard rubber lining), stainless steel or reinforced plastic vessels made of polypropylene for smaller volumes
Local Exhaust Ventilation:	tank rim extraction
Part/Electrolyte Agitation:	recommended; stirrer or circulation by educators, surface cleaning with overflow- respectively dirt collecting compartment
Ultrasound:	power > 8 W/l for the removal of polishing- and grinding residues
Heating/Cooling:	alkaline resistant immersion heaters, heating coils/heat exchanger made of stainless steel or PTFE
Filter units/oil separators or similar	recommended
Spray register:	optionally e.g. surface rinsing by pressure bottle

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Degreaser Salt SLOTOCLEAN AK 91	020091	--
Degreaser additive depends on application, refer to TDS BATH 02300-E		
Sodium hydroxide, 50 % (756 g/l aqueous)	supplied by user*	1.52
Phosphoric acid, (75 %)	supplied by user*	1.58

* The current product qualities respectively -specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

2.2 Composition

Degreaser Salt SLOTOCLEAN AK 91	borates, polyphosphate (complexing compounds), tensides; free from silicon and NaOH

2.3 Requirements for a 100 litre bath

Product name	**AN**	**SG**	**Quantity**	
Degreaser Salt SLOTOCLEAN AK 91	020091	--	3.5	kg
Degreaser additive depends on application, refer to TDS BATH 02300-E				

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2.4 Make up sequence for a 100 litre bath

All tanks and equipment to be used should be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add the required quantity of Degreaser Salt SLOTOCLEAN AK 91 and dissolve
- add the required quantity of degreaser additive
- make up to final volume with preferably deionised water
- mix thoroughly

The degreaser is ready for use when the operating temperature has been reached.

2.5 Concentrations- and operating conditions

2.5.1 for the removal of processing oils and drawing compounds

	Range	Optimum	
Degreaser Salt SLOTOCLEAN AK 91	25 - 35	30	g/l
Treatment time	2 - 10	--	min.
Temperature range	50 - 80	--	°C
pH value	approx. 8.2	--	
Ultra sound	--	--	

2.5.2 for the removal of pigmented drawing compounds and grinding pastes

	Range	Optimum	
Degreaser Salt SLOTOCLEAN AK 91	25 - 35	30	g/l
Degreaser additive depends on application, refer to TDS BATH 02300-E			
Treatment time	1 - 5	--	min.
Temperature range	70 - 85	--	°C
pH value	approx. 8.2	--	
Ultra sound	--	> 8	W/l

raise pH value ↑: Sodium hydroxide, 50 % (765 g/l aqueous)
decrease pH-Wert ↓: phosphoric acid, (75 %)

3.0 PROCESS SEQUENCE

Our service department or technical field service would be pleased to provide you information on suitable process sequences respectively methods.

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4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

The water quality used for make-up and continuous replenishment of the evaporation losses is essential to obtain good degreasing results. Therefore we strictly recommend the use of deionised- or partly desalted water. Tap water may only be used if the hardness degree does not exceed 6° dH. Using hard water results in precipitation of the active components of Degreaser SLOTOCLEAN AK 90.
This'll therefore necessarily result in unusable cleaning results !

4.1 Degreaser Salt SLOTOCLEAN AK 91

Degreaser Salt SLOTOCLEAN AK 91 contains all the components necessary for the operation of the degreaser. The content of Degreaser Salt SLOTOCLEAN AK 91 can be determined by acidimetric titration. Correction is made to nominal value according to the difference determined by titration. We're pleased to provide a suitable analysis description upon request.

4.2 Degreaser additives

Degreaser Salt SLOTOCLEAN AK 91 already contains tensides. But the cleaning effect can be enhanced by the use of suitable cleaning additives. Degreaser additives are only consumed by drag-out. A determination of the concentration isn't possible with justifiable methods. They're replenished either during replenishment of Degreaser Salt SLOTOCLEAN AK 91 proportionately or with decreasing effect.

4.3 Cloud point

When the operating temperature reaches a certain point - the cloud point - degreaser additives start to oil out and effectiveness diminishes. This is indicated by cloud formation in the electrolyte. Maximum operating temperature is defined by the cloud point.
The cloud point depends on quality and type of degreaser additive, as well as on the salt content of the solution. The salt content results from the degreaser salt added and the carbonate that forms during operation. The higher the salt content, the lower is the cloud point.

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Company according to
DIN EN ISO 9001: 2008
DIN EN ISO 14001: 2004

4.4 pH value

The optimum pH value 8.2 should be maintained in the degreasing system (Degreaser Salt SLOTOCLEAN AK 91 with cleaning enhancer suitable for ultrasound) especially when removing grinding paste or similar products. (The pH value is measured at 20 °C).

pH value < 8.0	The solubility of the surfactants decreases. Degreaser solution turns cloudy. Cleaning effect deteriorates.
pH value > 8.7	Depending on temperature and immersion time there's the risk, that e.g. brass for example starts more or less tarnishing. Pigment removal decreases.

Corrections of the ph value if necessary

raise pH value ↑: sodium hydroxide, 50 % (765 g/l aqueous)
decrease pH-Wert ↓: phosphoric acid, (75 %)

5.0 TROUBLE SHOOTING

No information available at present.

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6.0 EFFLUENT

Legal regulations must be observed for disposal of the Degreaser SLOTOCLEAN AK 90. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Resulting rinse waters must be batch detoxified. Therefore the pH must be adjusted to approx. 2 with diluted acid, e.g. with technical hydrochloric acid, (10 %). After the addition of 5 g/l technical calcium chloride ($CaCl_2 \times H_2O$) the pH is increased to pH 9 with technical sodium hydroxide solution. After metal precipitation and flocculation it's filtered.

7.0 SAFETY

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The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

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Schloetter
Plating Technology

OPERATING DATA
SLOTETCH 584
MICRO ETCH

SLOTETCH 584 is a micro etch specifically designed for the pre-treatment of printed circuit boards, integrated circuit lead frames, copper and Alloy 42 base materials.

SLOTETCH 584 is equally suited for use both in PTH and pattern plating stages of PCB manufacture.

SLOTETCH 584:
- gives a consistent etch rate.
- has a long life.
- is easily maintained.
- is economical to use.

Important :
Please read these instructions carefully and follow recommendations given.
We reserve the right to make technical changes as necessary.
In the interests of safety, please pay attention to the R- and S- phrases on the drum label.
The shelf life of the additives is generally 18 months.
The date of production is taken from the first part of the batch-number which shows the year and month. The final four figures are the specific batch code.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	Polypropylene tank or liner.
Extraction:	Advisable.
Agitation:	Air and work movement at 0.6 m/min.
Heating/Cooling:	Porcelain or PTFE heaters with thermostat.

2.0 MAKE UP AND OPERATING RANGES)

2.1 Requirements for a 100 litre bath

Product name	Product no.	SG	Quantity			
			PTH	Pattern Plating	Nickel-Iron Alloys	
Slotech 584	019004		6 - 10	3 - 6	6.0	kg
Sulphuric Acid	163030	1.84	1.0	1.0	1.0	ltrs

2.2 Procedure for make up of a 100 litre bath

1. Fill the cleaned process tank to 90% of its final volume with deionised water.
2. Stir in the required amount of sulphuric acid followed by the Slotech 584 Salt.
3. Mix until the salt is completely dissolved and make up to final volume with deionised water.
4. Ensure the temperature is 20 - 30°C before use.

2.3 Concentrations and operating conditions

	PTH		Pattern Plating		Nickel-Iron Alloys		
		Optimum		Optimum		Optimum	
Slotech 584:	60 - 100	60	30 - 60	30	50 - 70	60	g/l
Sulphuric Acid:	5 - 20	10	5 - 20	10	10 - 20	10	ml/l
Copper:	< 8		< 12		-		g/l
Nickel-Iron:	-		-		< 10		g/l
Temperature:	20 - 30	25	20 - 30	25	20 - 30	25	°C
Immersion time:	60 - 180	120	20 - 60	40	30 - 90	60	secs
Etch rates - with air agitation: without air agitation:	 0.9 - 1.3 0.6 - 1.0	 1.0 0.7	 0.7 - 1.0 0.3 - 0.7	 0.7 0.3	 - 0.3 - 0.6	 0.45	 µm/min µm/min

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2.4 Consumption of bath constituents

2.4.1 PTH

Based on an etch rate of 1.0 µm/min, and an immersion time of 2 minutes:	Slotetch 584	=	95 g/m²

2.4.2 Pattern Plating

Based on an etch rate of 0.7 µm/min, and an immersion time of 40 seconds:	Slotetch 584	=	22 g/m²

2.4.3 Nickel-Iron Alloys

Based on an etch rate of 0.45 µm/min, and an immersion time of 60 seconds:	Slotetch 584	=	40 g/m²
	Sulphuric acid	=	7 ml/m²

3.0 MAINTENANCE

SLOTETCH 584 salt should be added on a regular basis to maintain a constant concentration and hence a stable etch rate.

PTH applications	- replenishment should be made after a throughput of	5 m²/100 litres
Pattern plating applications	- replenishment should be made after a throughput of	20 m²/100 litres
Nickel-Iron alloys	- replenishment should be made after a throughput of	10 m²/100 litres

The concentration of Slotetch 584 salt must be confirmed by regular analysis.

The bath should be renewed when the copper content reaches 8 g/l for PTH, or 12 g/l for pattern plating applications, and in the case of nickel-iron alloys at 10 g/l metal. These levels would normally be expected after a throughput of 50 m²/100 litres, 290 m²/100 litres and 140 m²/100 litres respectively.

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4.0 ANALYSIS PROCEDURE

4.1 Copper

Reagents and Equipment

1. 100 vol. hydrogen peroxide
2. Hexamine buffer - (Dissolve 170 g hexamine in 900 ml deionised water, adjust pH to 5.9 - 6.1 with 30% sulphuric acid, then make up to 1 litre with deionised water).
3. Xylenol orange indicator - (Mix 1 g xylenol orange with 100 g sodium chloride using a mortar and pestle).
4. 0.05 M EDTA.
5. 0.05 M zinc sulphate.
6. 5 ml pipette
7. 250 ml conical flask
8. Hotplate
9. Fume cupboard
10. 50 ml measuring cylinder
11. 50 ml burette

Procedure

1. Pipette 5 ml of solution into a 250 ml conical flask.
2. Add 10 ml hydrogen peroxide.
3. Boil for 2 - 3 minutes (in a fume cupboard) and then cool.
4. Add 80 ml deionised water.
5. Add exactly 20 ml 0.05 M EDTA.
6. Add 30 ml hexamine buffer.
7. Add 2 spatula tips of xylenol orange indicator.
8. Titrate with 0.05 M zinc sulphate from green to a violet endpoint.

Calculation

(20 - titre) x 0.635 = g/l Copper.

4.2 Copper - alternative method (not as precise as 4.1)

Reagents and Equipment

1. Ammonia SG 0.88
2. Murexide indicator (Mix 1 g ammonium purpurate with 100 g sodium chloride using a mortar and pestle)
3. 0.05 M EDTA
4. 5 ml pipette
5. 250 ml conical flask
6. 50 ml burette.

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Procedure

1. Pipette 5 ml of solution into a 250 ml conical flask.
2. Add 150 ml deionised water.
3. Carefully add ammonia until the solution turns deep blue.
4. Add a spatula tip of murexide indicator.
5. Titrate with 0.05 M EDTA to a violet endpoint.

Calculation

Titre x 0.635 = g/l Copper.

4.3 Nickel-Iron (composition of alloy is required)

Reagents and Equipment

1. 100 vol hydrogen peroxide
2. Hexamine buffer - (Dissolve 170 g hexamine in 900 ml deionised water, adjust pH to 5.9 - 6.1 with 30% sulphuric acid, then make up to 1 litre with deionised water)
3. Xylenol Orange indicator -(Mix 1 g xylenol orange with 100 g sodium chloride using a mortar and pestle)
4. 0.05 M EDTA
5. 0.05 m zinc sulphate
6. 100 g/l ammonium fluoride solution
7. 5 ml pipette
8. 250 ml conical flask
9. Hotplate
10. Fume cupboard
11. 50 ml measuring cylinder
12. 2 x 50 ml burette

Procedure

1. Pipette 5 ml of solution into a 250 ml conical flask.
2. Add 10 ml hydrogen peroxide.
3. Boil for 2 - 3 minutes (in a fume cupboard) and then cool.
4. Add 25 ml ammonium fluoride solution.
5. Add 50 ml deionised water.
6. Add exactly 20 ml 0.05 M EDTA (let volume used = A)
7. Add 30 ml hexamine buffer.
8. Add 2 spatula tips of xylenol orange indicator.
9. Titrate with 0.05 M zinc sulphate from a green/yellow to a red-brown endpoint. (Let titre = B).

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Calculation

$$\frac{\frac{C}{100} \quad (58.71 \times 55.85)}{(F \times 58.71) + (N \times 55.85)} = \text{g/l total metal (Fe + Ni)}$$

where C = A ml 0.05 M EDTA - B ml 0.05 M zinc sulphate
F = % Fe in alloy ÷ 100
N = % Ni in alloy ÷ 100

4.4 Nickel-Iron alternative method (not as precise as 4.3)

Reagents and Equipment

1. Ammonia SG 0.88
2. Murexide indicator (Mix 1 g ammonium purpurate with 100 g sodium chloride using a mortar and pestle).
3. 100 g/l Ammonium fluoride solution
4. 0.05 M EDTA
5. 5 ml pipette
6. 250 ml conical flask
7. 50 ml burette
8. 50 ml measuring cylinder

Procedure

1. Pipette 5 ml of solution into a 250 ml conical flask.
2. Add 25 ml ammonium fluoride solution.
3. Add 125 ml deionised water.
4. Carefully add ammonia until the solution turns purple.
5. Add a spatula tip of murexide, the colour should turn to a yellow/brown.
6. Titrate with 0.05 M EDTA to a violet endpoint.

Calculation

$$\frac{\frac{Titre}{100} \quad (58.71 \times 55.85)}{(F \times 58.71) + (N \times 55.85)} = \text{g/l total metal (Fe + Ni)}$$

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4.5 Oxidant : Slotetch 584 Salt

Reagents and Equipment

1. 30% sulphuric acid
2. Potassium iodide salt
3. 5% sodium hydrogen carbonate
4. 0.1 M sodium thiosulphate
5. Starch or iodine indicator
6. 5 ml pipette
7. 250 ml stoppered flask
8. 25 ml measuring cylinder
9. 50 ml burette

Procedure

1. Pipette 5 ml of solution into a 250 ml stoppered flask.
2. Add 20 ml 30% sulphuric acid.
3. Add 10 ml 5% sodium hydrogen carbonate solution.
4. Add approx 3 g potassium iodide.
5. Stopper the flask and leave in the dark for 20 minutes.
6. Titrate with 0.1 M sodium thiosulphate to a straw yellow colour.
7. Add a spatula tip of iodine indicator (or starch). Solution should turn dark blue/violet.
8. Continue titrating to a colourless endpoint.

Calculation

For Copper Etches -

(Titre - [0.7868 x copper content (g/l)]) x 3.33 = g/l Slotetch 584.

For Nickel-Iron Etches -

(Titre x 3.33) - (2.981 x M) = g/l Slotetch 584

where M = g/l total metal x F
F = % Fe in alloy ÷ 100

4.6 Sulphuric Acid (Only for Copper Etches)

Reagents and Equipment

1. Methyl orange indicator (1 g/l in water)
2. 1.0 M sodium hydroxide
3. 25 ml pipette
4. 250 ml conical flask
5. 50 ml burette

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Procedure

1. Pipette 25 ml of solution into a 250 ml conical flask.
2. Add 75 ml deionised water.
3. Add 4 - 6 drops methyl orange indicator.
4. Titrate with 1.0 M sodium hydroxide from red to a yellow endpoint.

Calculation

Titre x 1.1 = ml/l sulphuric acid.

4.7 Etch Rate

Equipment

1. Copper or nickel-iron panel as appropriate (~ 0.25 dm^2)
2. Acid cleaner
3. Drier
4. Analytical balance
5. Stop watch / timer

Procedure

1. Take a small copper or nickel-iron panel as appropriate for the application of the etch, of known surface area, eg 0.25 dm^2. Let surface = A dm^2.
2. Prepare the panel as follows:
   a. For copper: Immerse in acid cleaner (ie S20, Slotosit C10, Buz R) for 3 minutes at room temperature.
      For nickel-iron: Immerse in 50% v/v sulphuric acid (made fresh each time) for 1 - 1½ minutes at 60°C.
   b. Water wash.
   c. Hot air dry.
3. Accurately weigh the cleaned panel, accuracy + / - 1 mg. Let weight = W1 mg.
4. Immerse the cleaned panel in the Slotetch 584 Etch for a known time, eg 3 minutes. Let time = t minutes.
5. After removing from the solution wash thoroughly with water and then dry.
6. Reweigh the panel, accuracy + / - 1 mg. Let weight = W2 mg.

Calculation

$$\frac{W1 - W2}{A \times t \times D} = \text{micron / minute etch rate}$$

where

$$D = 89.3 \quad \text{for copper}$$

$$D = \frac{(89 \times N) + [78.6 \times F]}{100} \quad \text{for nickel-iron}$$

N = % Ni in alloy

F = % Fe in alloy

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5.0 EFFLUENT

SLOTETCH 584 does not contain complexing agents, but will contain metals (copper or nickel and iron) through use. Rinse waters can be directly neutralised with sodium hydroxide or sodium carbonate. Spent solutions should be diluted prior to neutralisation.

If you require any further toxicological or ecological information related to the disposal of this product, please refer to the individual safety data sheets.

6.0 SAFETY

The solution contains an oxidising agent and is an irritant.

When handling the solution protective clothing, gloves and goggles should be worn. Splashes on the skin or eyes should be washed out with water for 10 - 15 minutes. If irritation becomes apparent seek medical advice.

The hazards of the working solution may differ from those of its components. A risk assessment should be carried out as required by current regulations using information given in the individual safety data sheets.

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Bright Tin
CULMO 1

Bright Tin CULMO 1 is a sulphuric acid based electrolyte which is mainly applied for printed circuit boards manufacturing, electro-technical component finishing - also in barrel application -, and in the field of household accessories as well.

Bright Tin CULMO 1 deposits fully bright tin coatings in an extremely wide range of throwing power. High stability and easy maintenance are the features of this bright tin electrolyte.

Bright tin layers of any thickness are deposited from Bright Tin CULMO 1. Even thin layers are bright, and the brightness still improves with increasing layer thickness due to the good levelling quality. The tin deposits from Bright Tin CULMO 1 are resistant towards fingerprints to a great extent and also solderability is still excellent after prolonged storage periods.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important:
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the TRGS 510 must be followed.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data Sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	rubber-lined steel, polypropylene or PVC
Local Exhaust Ventilation:	not required
Part/Electrolyte Agitation:	**Printed Circuit Boards (PCBs):** work piece movement from and to the anodes, at a rate of 0.5 - 0.8 m/min, stroke length approx. 30 mm **Rack application:** parallel to the anodes, at a rate of 3 - 4 m/min, stroke length approx. 50 - 70 mm **Barrel application:** barrel rotation 4 - 6 rpm
Filtration:	continuous, 2 - 3 turnovers per hour
Anodes:	pure tin, min. 99.90 %, preferably 99.93 % according to DIN EN 610; higher impurities would increase the formation of anode sludge
Anode bags:	polypropylene fabric
Cooling:	plastic coated steel pipes, thin-walled plastic pipes or stainless steel 1.4571

NB
Titanium should not be used for cooling coils or anode hooks. Plastic coated anode hooks are especially recommended for tin electrolytes.

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product name	**Article no. (AN)**	**SG**
Sulphuric acid, conc. (96 %) chem. pure	supplied by user*	1.84
Tin Salt SU	100000	--
Starter CULMO 1 (for new make-up see point **4.3**)	101501	1.03
Brightener CULMO 2	101502	1.00
Additive CULMO AN 11 1	101508	1.03
Additive CULMO IRA 1	101507	1.00
Corrector ACR (see point **4.6**)	100019	1.00

***** The current product qualities respectively -specifications recommended by us can be found on the internet at www.schloetter.com/downloads.

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2.2 Requirements for a 100 litre bath

2.2.1 when used as barrel application

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	10	ltr.
Tin Salt SU	100000	--	3	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.2.2 when used as rack application (high current densities)

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	6.5	ltr.
Tin Salt SU	100000	--	6	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.2.3 when used for the processing of PCBs

Product name	AN	SG	Quantity	
Sulphuric acid, conc. (96 %) chem. pure	--	1.84	10	ltr.
Tin Salt SU	100000	--	4	kg
Starter CULMO 1	101501	1.03	3	ltr.

2.3 Make-up sequence for a 100 litre bath

All tanks and equipment to be used should be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add the required quantity of sulphuric acid, conc. (96 %) chem. pure while stirring constantly; observe safety measures!
- add the required quantity of Tin Salt SU while stirring vigorously and dissolve completely
- cool to operating temperature
- add the required quantity of Starter CULMO 1
- mix well
- make up to final volume with deionised water
- mix thoroughly
-

The electrolyte is ready for use when the operating temperature has been reached.

NB
When making-up the electrolyte, it has to be taken into consideration that the temperature of the solution raises quickly by the exothermic reaction which forms by the addition sulphuric acid, conc. (96 %) chem. pure. If the sulphuric acid is added too quickly, an intensive heat can develop which causes spattering of the corrosive liquid.
It's absolutely necessary to observe the safety measures applicable to make-up and handling (protective clothing, goggles, rubber gloves).

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2.4 Concentrations and operating conditions

2.4.1 when used as barrel application

	Range	Optimum	
Tin(II)		15	g/l
Free sulphuric acid	85 - 108 160 - 200	100 185	ml/l g/l
Starter CULMO 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	min. 0.6	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

2.4.2 when used as rack application (high current densities)

	Range	Optimum	
Tin(II)		15	g/l
Free sulphuric acid		65 120	ml/l g/l
Starter CULMO AT 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	2 - 4	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

2.4.3 when used for the processing of PCBs

	Range	Optimum	
Tin(II)		20	g/l
Free sulphuric acid		100 185	ml/l g/l
Starter CULMO AT 1	25 - 35	30	ml/l
Temperature range	10 - 25	18	°C
Cathodic current density	1.5 - 2	--	A/dm²
Anodic current density	< 2.5	--	A/dm²
Deposition rate at 2 A/dm²	approx. 1.0		µm/min.

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2.5 Consumption and replenishment

Consumption of the additives is mainly due to drag-out.

Approximate values for replenishment:

Additive	Replenishment / Consumption
Brightener CULMO 2	approx. 2.5 l/10 kAh

Depending in the local drag-out losses the following replenishment is required:

Additive	Replenishment / Consumption
Additive CULMO AN 11	approx. 4 ml/m² surface throughput
Additive CULMO IRA 1	approx. 1 ml/m² surface throughput

2.6 Deposit characteristics

Hardness of the tin deposit: 20 - 30 $HV_{0.05}$

3.0 PROCESS SEQUENCE

Our technical field service or service department will be pleased to provide you with detailed information on suitable process sequences respectively methods upon request.

3.1 Pre-treatment

Steel or copper parts are pre-treated as usual followed by dipping into diluted sulphuric acid and then transferred into Bright Tin CULMO 1. Please note that hydrochloric acid solutions may not be used in the pre-treatment process. Chloride contamination ≥ 0.3 g/l lead to irreparable disturbances in the form of matt tin deposition that starts in the low current density range.

Non-ferrous metal alloys containing zinc cannot be tin plated directly, since zinc would diffuse from the base material into the tin layer above even at room temperature. Therefore a 3 - 5 µm intermediate copper- or nickel layer as diffusion barrier should be plated. Therefore an intermediate copper- or nickel layer is applied as a diffusion barrier. Intermediate copper layers should be deposited from acidic- or cyanide high performance electrolytes. The adhesion of the tin layers would decrease if intermediate copper layers are deposited from additive-free cyanide pre-copper electrolytes.

Printed circuit boards is rinsed immediately after the electroplated copper deposition, followed by dipping into sulphuric acid, conc. (96 %) chem. pure (50 ml/l) and then transferred into Bright Tin CULMO 1. The copper layer may be precautionary activated in an aqueous sodium peroxodisulfate solution (100 g/l of sodium peroxodisulfate solution, 30 ml/l of sulphuric acid). Then it's carefully rinsed and also dipped into diluted sulphuric acid and immediately tin plated.

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3.2 Process sequences

Base material steel	Base material copper	Printed Circuit Boards (PCBs)
• immersion degreasing • rinsing • pickling in HCl diluted 1:1 • rinsing throughly • electrolytic degreasing, anodically • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating in Bright Tin CULMO 1 • rinsing • drying	• immersion degreasing • rinsing • electrolytic degreasing, anodically • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating Bright Tin CULMO 1 • rinsing • drying	• through hole plating • pattern plating • acid cleaner • rinsing • micro-etch • rinsing • acid dipping in **sulphuric acid**, (10 %) • copper plating in a sulfuric copper electrolyte • rinsing • acid dipping in **sulphuric acid**, (10 %) • rinsing • tin plating in Bright Tin CULMO 1 • rinsing • drying

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4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Tin

The tin content depends on the electrolyte application and should range between 10 and 30 g/l. The optimum for barrel parts is 15 g/l and for parts with difficult surface geometry or PCBs at 20 g/l.
If high demand is set on deposition speed, current densities of up to 4 A/dm² can be plated with a tin content of 30 g/l, but it would however impair the metal distribution. Lack of tin is replenished with Tin Salt SU (50 % tin).

4.2 Sulphuric acid

The sulphuric acid concentration should not fall below 85 ml/l or 160 g/l, except for the "rack high current density - version". As optimum concentration 100 ml/l respectively 185 g/l and max. 108 ml/l respectively 200 g/l are recommended. A higher concentration of sulfuric acid leads to disturbances caused by anode passivation and must therefore be avoided. In the high current density version with 30 g/l tin the optimum content of sulphuric acid is approx. 65 ml/l respectively 120 g/l. Lack of acid is replenished with sulphuric acid, conc. (96 %) chem. pure acid only.

4.3 Starter CULMO 1

Starter CULMO 1 is only used for make-up of a new electrolyte and contains all components required for deposition. The concentration should be 25 - 35 ml/l. The single components Brightener CULMO 2, Additive CULMO IRA 1 and Additive CULMO AN 11 1 are used for replenishment during electrolyte operation.

4.4 Brightener CULMO 2

Brightener CULMO 2 is responsible for the good brightness over the entire current density range. Lack of Brightener CULMO 2 starts with decreasing brightness in the low current density range. Lack of Brightener CULMO 2 can first of all be recognized by a decrease of brightness in the low current density area. At parts with a large surface, processed with low electrolyte agitation, the lack of brightener can be recognized by matt zones. Then, additions of 1 - 2 ml/l Brightener CULMO 2 are required.

First of all, excess dosing of Brightener CULMO 2 leads in areas with a favourable electrolyte flow (breakthroughs) to a matt-, partly stepped tin deposition with a brownish discolouration. In an extreme case the deposition will be completely inhibited. At parts with a large surface excess dosing is recognized by burnings in the high current density range. In this case the tin deposition is matt with a brownish discoloration. Excess dosing can be compensated (see point **4.5**) by the addition of the Additives CULMO AN 11 1 and IRA 1.
The continuous consumption of Brightener CULMO 2 is at a operating temperature of approx. 20 °C about 2.5 l/10 kAh. At a higher temperature an increased consumption must be expected.

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4.5 Additives CULMO IRA 1 and AN 11 1

The Additives CULMO IRA 1 and CULMO AN 11 1, are only indirectly involved in the brightening effect of the electrolyte. Both additives are consumed due to drag-out losses. Normally, 4 ml of Additive CULMO AN 11 1 and 1 ml of Additives CULMO IRA 1 must be added per m² surface throughput.

Lack of the Additives CULMO IRA 1 and CULMO AN 11 1 cause almost the same faulty depositions as described for excess dosing of Brightener CULMO 2 (see point **4.4).** Incremental additions of a total of 3 ml/l Additives CULMO IRA 1 followed by up to 20 ml/l of Additive CULMO AN 11 1 are may be required. If accidentally too much of the Additives CULMO IRA 1 and CULMO AN 11 1 is dosed, then this will result in decreasing brightness of the deposited tin coatings but can be corrected by an addition of 1 - 2 ml/l Starter CULMO 1. Although the alternating correction may be repeated but leads to an uneconomical and unnecessary raise of the total organic concentration and in some cases soldering problems cannot be excluded.

4.6 Corrector ACR

Corrector ACR contains an auxiliary brightener component which is partly included in Additive CULMO IRA 1. The required component concentration is maintained by continuous replenishment of Additive CULMO IRA 1. However, depending on the local working conditions, a lack can occur (see point **4.5**).
We recommend an addition of Corrector ACR if despite of an addition of 1 - 2 ml/l Additive CULMO IRA 1 the problem with step plating cannot be solved and so the deposition not be improved.
Additions with Corrector ACR should be performed in increments of 1 up to max. 5 ml/l.

4.7 Bright tin plating in barrel plants

In barrel application sufficient rectifier capacity must be available during plating. The current density should be > 0.6 A/dm² and the anode surface must be in such a dimension that the anodic current density does not exceed 2.5 A/dm². Too small anode surfaces lead to anode passivation and to oxidation of Sn(II) to Sn(IV). Combining rack and barrel application is not recommended since different operating conditions would require different dosing quantities of the additives which would result in bath instability.

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5.0 TROUBLE SHOOTING

5.1 Fault finding chart

Fault	Cause	Correction
step plating	extremely high concentration of Brightener CULMO 2	add 1 - 2 ml/l of Additive CULMO IRA 1 **and/or** 5 ml/l of CULMO AN 11 1; repeat the addition if required
dark rings around boreholes		work the electrolyte through for maybe 1 - 2 h/2 A/dm²
total inhibition of the tin deposition (no deposition around boreholes, no deposition on a large area		
frosted deposition around boreholes		
strong hydrogen formation at the cathode		
formation of pores in the high current density range	minor excess dosing of Brightener CULMO 2	add 1 - 2 ml/l of Additive CULMO IRA 1 **and/or** 5 ml/l of Additive CULMO AN 11 1
matt deposition in the low current density range	lack of Brightener CULMO 2	addition 1 - 2 ml/l of Brightener CULMO 2
	electrolyte temperature is too high	decrease the temperature to e.g. 15 °C
	tin content too high	dilute the electrolyte to optimum
	chloride contamination	it can be tried to correct chloride contaminations up to approx. 300 mg/l by incremental additions of 1 ml/l ; Brightener CULMO 2; at contaminations > 300 mg/l the electrolyte must be replaced by a new make-up
hazy or milky matt deposition in the entire current density range	lack of Brightener CULMO 2	incremental additions of 1 ml/l Brightener CULMO 2

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Fault	Cause	Correction
white-grey coating on the anodes	the anodic current density is too high (> 2,5 A/dm²)	increase the anode surface
the anodes are passive		
pitting, uneven erosion of the anode	sulphuric acid content too high	analyse the electrolyte and adjust to optimum
	poor flow conditions in the plating tank	improve the electrolyte exchange at the anode, e.g. by cleaning of the anode bags

6.0 EFFLUENT

Legal regulations must be observed for disposal of the Bright Tin CULMO 1. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Bright Tin CULMO 1 doesn't contain complexing agents. The rinse waters resulting from Bright Tin CULMO 1 are acidic and contain dissolved tin(II) sulphate as well as Sn(IV)-compounds (metastannic acid) as suspended particles. Resulting rinse waters must therefore be neutralised to insoluble tin hydrate and sedimented. The sedimentation, depending on the effluent plant, must if necessary be supported by a flocculant.

7.0 SAFETY

Reasonable care is required when handling chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.
EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Bright Tin CULMO 1 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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Antitarnish
ALS 30

Antitarnish ALS 30 is an acid based process (pH value approx. 1 - 2) for post-treatment of tin or tin-lead plated components. A liquid concentrate is used for make-up.

Antitarnish ALS 30 is non-foaming and can be used for rack-, barrel-, and reel-to-reel application.

The treatment of bright tin- or tin alloy layers in Antitarnish ALS 30 prevents discolouration during heat treatment > 200 °C and therefore improves the long term solderability.

Antitarnish ALS 30 is AOX-free.

The information in this data sheet is based on laboratory as well as practical experience. Figures quoted for operating limits and replenishment quantities are for guidance only. Actual values necessary will depend on the components being plated (material and geometry), their application and plating plant conditions.

Important :
Please read this instruction carefully prior to the use of the process and carefully follow all the parameters that have a direct influence on the operation. We reserve the right to make technical changes. In the interest of safety, please pay attention to the hazard warnings on the labels of the containers. The minimum shelf life of the products is included on the labels and is also available in the appropriate Quality Assurance (QA03).
The current IMDS number of the layer deposited from the process is available on the internet at www.schloetter.com/downloads.
For the storage of chemical products the HSG71 is suggested as guidance.
If the additives used in this process contain a SVHC-substance, then this will be specified in the corresponding Material Safety Data sheet, section 15.

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1.0 TECHNICAL INFORMATION AND EQUIPMENT REQUIREMENTS

Tanks:	rubber-lined steel, stainless steel
Local Exhaust Ventilation:	required
Part-/Electrolyte Agitation:	stirring device
Heating/Cooling:	heating made of stainless steel and controlled by thermostat

2.0 MAKE-UP AND OPERATING CONDITIONS

2.1 Product names

List of products required		
Product names	**Article no. (AN)**	**SG**
Antitarnish Concentrate ALS 31	120031	1.16

2.2 Requirements for a 100 litre bath

Product name	AN	SG	Quantity	Optimum	
Antitarnish Concentrate ALS 31	120031	1.16	7.5 - 15	10	ltr.

2.3 Make-up sequence for a 100 litre bath

New, but also unused tanks, filtration equipment etc. or tanks and equipment must be thoroughly cleaned prior to use.

- fill 70 litres of deionised water into the tank
- add 10 litres of Antitarnish Concentrate ALS 31
- make up to final volume with deionised water
- mix thoroughly

When the operating temperature is reached the antitarnish is ready for use.

NB
The water quality is very important for an optimum way of operating Antitarnish ALS 30. We recommend the use of deionised water since tap water from a hardness degree of 6 °dH may lead to a precipitation of Antitarnish ALS 30 components.

2.4 Concentrations and operating ranges

	Range	Optimum	
Antitarnish Concentrate ALS 31	75 - 150	100	ml/l
Treatment time	> 5	30	sec.
Temperature range	20 - 60	30	°C
pH value (at 20 °C)	1.0 - 2.0	--	

raise ↑ pH value: shouldn't be necessary
decrease ↓ pH value: with Antitarnish Concentrate ALS 31

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2.5 Consumption

Consumption of the additives is mainly due to drag-out.

3.0 PROCESS SEQUENCE

Our service department or technical field service would be pleased to provide you information on suitable process sequences respectively methods.

3.1 Process sequence

- plating with tin or tin-lead
- rinsing
- Antitarnish ALS 30
- rinsing
- drying

4.0 MAINTENANCE AND FUNCTION OF THE INDIVIDUAL BATH COMPONENTS

4.1 Antitarnish Concentrate ALS 31

Antitarnish Concentrate ALS 31 contains all the necessary components required for the operation of the degreaser.

The Antitarnish Concentrate ALS 31 may be determined by alkalimetric titration and replenished according to analysis results. We're pleased to provide you with suitable analysis description upon request.

4.2 pH value

The pH should be measured at regular intervals at a temperature of 20 °C. The optimum pH value is between 1.0 and 2.0.

5.0 TROUBLE SHOOTING

No information available at present.

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6.0 EFFLUENT

Legal regulations must be observed for disposal of the Antitarnish ALS 30. Different regulations normally apply for the additives and the ready-made electrolyte. Please refer to section **13** of the appropriate Material Safety Data Sheet for disposal code and recommendations.

The following detoxification sequence is only considered to be an aid:

Antitarnish ALS 30 doesn't contain complexing agents so a simple neutralisation for the treatment of resulting rinse waters is sufficient.

7.0 SAFETY

Reasonable care is required when handling Schlötter chemical products. Only personnel specially trained on working with chemicals should be deployed with their handling.

EC Material Safety Data Sheets must be made available to all personnel dealing with the chemicals to ensure they have all required information about product composition, hazards identification, first-aid measures, handling and storage, exposure controls, toxicological and ecological information, etc. It is required to ensure the supply and use of suitable protective clothing and -equipment.

The user must verify the designated purpose of the electrolyte. Previous experience has shown that not all metal surfaces are suitable for a trouble-free electroplating.

The above mentioned data are made according to our best knowledge. Consistent operation of the working solution requires appropriate maintenance. Antitarnish ALS 30 is a process of Dr.-Ing. Max Schlötter GmbH & Co KG. It can only be operated with the products described in this technical data sheet. Use of other chemicals (also partly) will impair quality and invalidates our service- and quality commitments (quality assurance).

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