BAT Assessment

This BAT assessment was undertaken following the methodology in the following publications:

- Sector Guidance Note EPR 2.07 – How to comply with your environmental permit for: The Surface Treatment of Metals and Plastics by Electrolytic and Chemical Processes

BAT Ref	EPR Requirement	Current Arrangements
1.1 Energy Efficiency		
1	High efficiency dewatering techniques to minimise drying energy	n/a - no drying stage during the process.
2	Minimisation of water use and closed circulating water systems.	There is a closed loop chiller system to minimise water use.
3	Using spent cooling water (which is raised in temperature) for rinsing purposes	It is not feasible for water to be reused for rinsing due to quality requirements. If the product is not sufficiently degreased the anodising process will not be effective, and this relies on clean water for rinsing.
4	Automated control for DC rectifiers.	The process is run and controlled by software. It is automated and adjusted based on the parts being treated.
5	Electrolytic processes that operate under thermally stable conditions without the need for heating or cooling.	The aluminium etch heat requirements are minimal as the reaction involved in the etching process is exothermic.
6	Minimum use of fume extraction consistent with COSHH Regulations.	The air is extracted from the Sulphuric acid and Sodium Hydroxide treatment tanks via local exhaust ventilation from the top of the process tanks in the form of lip extraction and then sent into a wash box scrubber where contaminants are captured in water. The LEV system is inspected and tested 14 monthly as required by the COSHH regulations (LEV COSHH reports for 2018 and 2019 have been provided as part of this submission).

7	Inverter speed control or flow damper for fume extraction centrifugal fans.	Centrifugal fans are present within the LEVs, however, due to the age of the equipment inverter speed control is not present. COSHH reports have been provided as part of this submission to demonstrate the effective working of the site's LEV systems.
1.2 Efficient use of raw materials and water – indicative BAT		
1	Ion exchange or other treatment unit to re-circulate rinse waters.	With sulphuric acid anodising it is essential to control the amount of aluminium in solution. This is required to overcome the precipitation of aluminium sulphate. To achieve this, the simple approach is to partially discard the sulphuric acid solution on a regular basis. An alternative approach is to include an ion exchange column to remove the aluminium. This removes the need to discard sulphuric acid anodising solution and this equipment has been installed.
2	Closed loop operation with three to four stage cascade rinsing, so that drag-out can be returned upstream to balance the evaporative loss and minimise waste.	There are 2 cascades system in place: • The water goes from tank 11 to tank 10, and from tank 10 it is discharged. • The water goes from tank 16 to tank 15, and from tank 15 it is discharged.
3	Spent pickle acid for pH control in the effluent treatment facility.	Alkaline and acid collected in the dump tanks is used to regulate ph.
4	Proprietary plating electrolytes that have a low concentration of dissolved solids and operate with minimum energy requirements for heating or cooling. These should avoid cadmium where possible and should require relatively simple effluent treatment.	n/a - No plating activities
5	Minimise drag-out by maximising the drainage time of the work over the tank or in a separate drainage tank.	Rinse tanks are utilised to remove treatment chemicals with drag out times of 15 seconds (etch), 10 seconds for anodising and 5 seconds for rinse stags. The drag times are pre-programmed via the software and cannot be adjusted. The site is currently looking into options for being able to manipulate the software which would allow drag out times to be adjusted.
6	ECO-rinse tank(s) to reduce mass drag-out and subsequent rinse-water consumption.	Lotus has incorporated the concept of eco-rinsing to reduce water consumption whilst maintaining rinse quality

7	Electrochemical metals recovery technology for unreturned drag-out.	n/a - no unreturned drag out as it falls back into the vessels
8	Evaporation technology in conjunction with 3-5 stage cascade rinsing to allow closed loop operation.	n/a
9	Hydrogen peroxide in the pickling tanks to reduce NOx emission and acid consumption.	n/a
10	Low temperature processes consistent with good metal deposition rate. The use of lids on process tanks operating at 60°C and above, and hexagons or croffles should be considered for all manually operated tanks	The plant uses croffles on one tank to reduce evaporative heat loss and energy consumption. They are not required on other tanks due to the operating temperature.
11	Recycle trade effluent to less critical rinsing stages.	It is not possible to recycle water for rinsing due to quality requirements. If the product is not sufficiently degreased the anodising process will not be effective, and this relies on clean water for rinsing.
12	Proprietary cleaners that allow a lower operating temperature.	Detergents are used which are effective at a lower operating temperature
13	A low temperature biological cleaner system in place of the traditional alkaline soak cleaner for a long production life, low waste and low energy consumption	Detergents are used which are effective at a lower operating temperature
1.3 Avoidance, recovery and disposal of wastes – indicative BAT		
1	Effluent treatment facilities should be designed to process spent process fluids and recover anode metals for reuse, e.g. cadmium, copper and nickel.	All wastewater exiting the anodising facility is directed through the effluent plant before entering the foul sewer. The effluent plant has been designed to precipitate all consented metals. To ensure that the system functions correctly there are pH meters to control redox reduction and neutralisation process and a redox meter to control the redox reduction process. Daily internal monitoring of the effluent quality is performed against the requirements of the formal discharge consent. Anglian Water Services undertake routine unscheduled sampling to ensure full compliance. The effluent system incorporates a filtration unit to dewater the sludge and the sludge is stored prior to analysis and disposal by a registered waste handler.
2	Spent alkaline cleaners and acid pickles should be used for pH control in the effluent treatment facility.	Alkaline and acid collected in the dump tanks is used to regulate pH.

3	You should evaluate the use of phosphating sludge as a filler for agricultural and horticultural use.	The waste is currently sent to landfill, but the site is investigating alternative disposal routes.
4	Filter cake may have uses, and these should be investigated in preference to landfill disposal.	The waste is currently sent to landfill, but the site is investigating alternative disposal routes.
5	Filter cake presses should be operated at not less than 7 bar and preferably 10-15 bar to reduce its mass, volume and water content	The filter cake press operates at 15-17 bar
6	Consider use of a low temperature biological cleaner system in place of the traditional alkaline soak cleaner for a long production life, low waste and low energy consumption.	Detergents are used which are effective at a lower operating temperature
7	Consider use of ion exchange or other treatment unit to re-circulate rinse waters.	With sulphuric acid anodising it is essential to control the amount of aluminium in solution. This is required to overcome the precipitation of aluminium sulphate. To achieve this, the simple approach is to partially discard the sulphuric acid solution on a regular basis. An alternative approach is to include an ion exchange column to remove the aluminium. This removes the need to discard sulphuric acid anodising solution and this equipment has been installed.
8	Consider use of closed loop operation with three to four stage cascade rinsing, so that drag-out can be returned upstream to balance the evaporative loss and minimise waste.	There are 2 cascades system in place: • The water goes from tank 11 to tank 10, and from tank 10 it is discharged. • The water goes from tank 16 to tank 15, and from tank 15 it is discharged.
9	Minimise drag-out by maximising the drainage time of the work over the tank or in a separate drainage tank.	Rinse tanks are utilised to remove treatment chemicals with drag out times of 15 seconds (etch), 10 seconds for anodising and 5 seconds for rinse stages. The drag times are pre-programmed via the software and cannot be adjusted. The site is currently looking into options for being able to manipulate the software which would allow drag out times to be adjusted.
10	Use electrochemical metals recovery technology for unreturned drag-out.	No unreturned drag out as it falls back into the rinsing vessels. Metals recovery from rinse water is uneconomical. Furthermore, this is an etching process and not a plating one.
11	Use electrodialysis technology for the re-oxidation of hexavalent chromium [chromate, or Cr (VI)] degraded to trivalent chromium [Cr (III)] in chromic acid anodising electrolytes	n/a – no chromium used for the anodising process

2.2 Surface preparation Mechanical – indicative BAT		
1	You should ensure that emissions from the local exhaust ventilation do not have an adverse environmental impact.	n/a – no mechanical work prior to surface treatment e.g. linishing or rust removal
Chemical cleaning using aqueous cleaners – indicative BAT		
2	Consider use of ion exchange or other treatment unit to re-circulate rinse waters.	With sulphuric acid anodising it is essential to control the amount of aluminium in solution. This is required to overcome the precipitation of aluminium sulphate. To achieve this, the simple approach is to partially discard the sulphuric acid solution on a regular basis. An alternative approach is to include an ion exchange column to remove the aluminium. This removes the need to discard sulphuric acid anodising solution and this equipment has been installed.
3	Closed loop operation with three to four stage cascade rinsing, so that drag-out can be returned upstream, is a particularly effective way to balance the loss of water by evaporation and minimise waste of costly process chemicals.	A two-stage water rinse process is in place after the alkaline cleaning phase (see process flow within B3.002 Process Description and emissions monitoring). There are 2 cascades system in place: The water goes from tank 11 to tank 10, and from tank 10 it is discharged. The water goes from tank 16 to tank 15, and from tank 15 it is discharged. The cascade system ultimately discharges into the effluent treatment plant.
4	Where appropriate, generate turbulence by means of an eductor to provide improved cleaning, and maintain particulates in suspension so that they can be removed continuously by external filtration.	For tanks 12, 13 there is a recirculating system. Air circulation in the tanks is via eductors (direct fluid or air into tank to create agitation) which reduces the amount of mist. An aeration system exists for the rest of the tanks
5	Where appropriate, use membrane filtration to remove oil and grease, emulsions and dispersants	n/a – not appropriate for this process.
6	Where possible, maintain adequate freeboard above the cleaner level (minimum of 150 mm) to minimise entrainment of liquid and subsequent emissions to air. Extraction lip ducts should be mounted at least 50mm above the top of the tank lip angle, and you	The air is extracted from the Sulphuric acid and Sodium Hydroxide treatment tanks via local exhaust ventilation from the top of the process tanks in the form of lip extraction and then sent into a wash box scrubber where contaminants are captured in water. The tank lip ducts are located with a gap greater than 150mm between the top of the tank and the bottom of the lip duct.

	should use the minimum air flow consistent with satisfactory extraction.	
7	Where appropriate, use "hexagons" or "croffles" to reduce evaporative loss and reduce energy consumption. Use automated lids on large cleaner tanks to reduce fume extraction energy costs as well as to reduce consumption for process heating.	The plant uses croffles to reduce evaporative heat loss, energy consumption and to remove excess steam. Croffles (polypropylene balls) are used to minimise the heat loss and release of steam. Croffles are only used on one tank due to its high temperatures.
8	Consider the use of proprietary cleaners that allow a lower operating temperature.	Detergents are used which are effective at a lower operating temperature
9	Consider use of a low temperature biological cleaner system in place of the traditional alkaline soak cleaner for a long production life, low waste and low energy consumption.	Detergents are used which are effective at a lower operating temperature
Pickling – indicative BAT		
2	There should be two or three stage cascade pickling with continuous pickle acid feed and continuous discharge to the effluent treatment facility.	The installation is a 20-stage anodising facility which includes a two-stage pickling process (see process flow within B3.002 Process Description and emissions monitoring). All water discharged is fed directly to the effluent plant via discharge tanks.
3	There should be a minimum of two stages of cascade rinsing with agitation.	The main plant consists of a series of 20 holding tanks ranging in size from 7m3 and 14m3. Multiple rinse tanks are utilised to remove treatment chemicals with drag out times of 15 seconds (etch), 10 seconds for anodising and 5 seconds for rinse stages. See process flow within B3.002 Process Description and emissions monitoring.
4	Consider ion exchange or other treatment unit to re-circulate rinse waters.	With sulphuric acid anodising it is essential to control the amount of aluminium in solution. This is required to overcome the precipitation of aluminium sulphate. To achieve this, the simple approach is to partially discard the sulphuric acid solution on a regular basis. An alternative approach is to include an ion exchange column to remove the aluminium. This removes the need to discard sulphuric acid anodising solution and this equipment has been installed.
5	Consider use of spent pickle acid for pH control in the effluent treatment facility	Alkaline and acid collected in the dump tanks is used to regulate pH.
2.3 Surface treatment		

Electroplating		
2	You should give full consideration to using substances other than cadmium, chromium (VI) and other hazardous materials. Where alternatives are not available, you must provide proper controls.	n/a - no plating process
3	Maximise stages of cascade rinsing, with agitation where appropriate.	n/a - no plating process
4	Use ion exchange or other treatment units to re-circulate rinse waters.	n/a - no plating process
5	Use proprietary plating electrolytes that have a low concentration of dissolved solids and operate with minimum energy requirements for heating or cooling. These should avoid cadmium where possible and should require relatively simple effluent treatment.	n/a - no plating process
6	Replace EDTA by QUADROL in autocatalytic copper systems.	n/a - no plating process
7	Minimise drag-out by maximising the drainage time of the work over the tank or in a separate drainage tank	n/a - no plating process
8	Use ECO-rinse tank(s) to reduce mass drag-out and subsequent rinse-water consumption.	n/a - no plating process
9	Use electrochemical metals recovery technology for unreturned drag-out.	n/a - no plating process
10	Use evaporation technology in conjunction with 3-5 stage cascade rinsing to allow closed loop operation	n/a - no plating process
11	Generate turbulence by hydraulic power and eductors.	n/a - no plating process
12	Use electrodialysis technology for the re-oxidation of chromium (VI) reduced to chromium (III) in chromic acid anodising electrolytes.	n/a - no plating process
13	Use hydrogen peroxide in the pickling tanks to reduce NOx emission and acid consumption.	n/a - no plating process
14	Employ low temperature processes consistent with good metal deposition rate. You should use lids on process tanks operating at 60°C and above, and you should consider hexagons or croffles for all manually operated tanks	n/a - no plating process

15	A minimum of 4 and preferably 5 stages of cascade rinsing after chromic/sulphuric acid etch, with techniques for minimising drag-out. Consider alternatives to chromic/sulphuric acid as an etchant.	n/a - no plating process
16	Provide jig or barrel supports whilst draining for manually operated process tanks.	n/a - no plating process
17	Use continuous filtration and removal of sludge from phosphating process tanks.	n/a - no plating process
Anodising – indicative BAT		
	Rinse water economy	See section 1
	Mass drag-out reduction	See electroplating
	Energy consumption	See section 1
	Prevention of fugitive emissions to air	See section 3
	Removal of dissolved aluminium for the anodising electrolyte	All wastewater exiting the anodising facility is directed through the effluent plant before entering the foul sewer. The effluent plant has been designed to precipitate metals for removal.
	Chromium (VI) plating	n/a – no chromium (VI) used for the anodising process
2.4 Rinsing – indicative BAT		
2	Multistage cascade rinsing	There are 2 cascades system in place: 1- The water goes from tank 11 to tank 10, and from tank 10 is discharge into the drain. 2- The water goes from tank 16 to tank 15, and from tank 15 is discharge into the drain.
3	Closed loop or recirculation systems with rinse water treatment (ion exchange, reverse osmosis, electrodialysis, air swept evaporation or vacuum evaporation).	Lotus has introduced a total reverse osmosis system to remove the need for chemical regeneration.

		With sulphuric acid anodising it is essential to control the amount of aluminium in solution. This is required to overcome the precipitation of aluminium sulphate. To achieve this, the simple approach is to partially discard the sulphuric acid solution on a regular basis. An alternative approach is to include an ion exchange column to remove the aluminium. This removes the need to discard sulphuric acid anodising solution and this equipment has been installed.
4	Conductivity probes.	Regular manual conductivity tests are undertaken with portable probes twice each day.
5	Water meters on each line.	There is only 1 production line and so the mains water meter is utilised. There is minimal water use on site apart from what is used for the process.
6	Flow restrictors.	An overflow system in place that can be adjusted to restrict flow.
7	Minimised drag-out by employing a drainage time over the process tanks of at least 20 seconds for rack work and 30 seconds for barrelled work.	Holding time to avoid drag-out in the process tanks is between 15-17 seconds. Rinse tanks are utilised to remove treatment chemicals with drag out times of 15 seconds (etch), 10 seconds for anodising and 5 seconds for rinse stags. The drag times are pre-programmed via the software and cannot be adjusted. The site is currently looking into options for being able to manipulate the software which would allow drag out times to be adjusted.
8	Drag-in – drag-out tanks (ECO rinse system) to reduce mass drag-out and subsequent rinse water consumption	ECO rinse system is in place (see process flow within B3.002 Process Description and emissions monitoring). Holding time to avoid drag-out in the process tanks is between 15-17 seconds. Rinse tanks are utilised to remove treatment chemicals with drag out times of 15 seconds (etch), 10 seconds for anodising and 5 seconds for rinse stags. The drag times are pre-programmed via the software and cannot be adjusted. The site is currently looking into options for being able to manipulate the software which would allow drag out times to be adjusted.
9	Continuous filtration and removal of sludge from phosphating process tanks.	n/a

10	Recycling of trade effluent to less critical rinsing stages.	It is not feasible for water to be reused for rinsing due to quality requirements. If the product is not sufficiently degreased the anodising process will not be effective, and this relies on clean water for rinsing.
2.5 Drying – indicative BAT (consider use of following techniques to save energy)		
1	Centrifugal drying for small work	Following treatment via the tank dipping process, the parts air dry before being removed from the screw clamps for packing.
2	Providing lids for hot water tank driers.	n/a - air dry.
3	Providing a continuous bleed-off from hot-water driers as supply for the preceding cascade rinsing system, with equivalent water feed to hot water tank driers to make-up for evaporative loss and the bleed to the rinsing tanks.	n/a - air dry.
3.1 Point source emissions to water Indicative BAT (used where appropriate) Handling		
7	You should normally use buffer storage tanks to contain process fluid dumps (e.g. spent alkaline cleaners, pickles, passivates), which are preferably treated in the effluent treatment facility rather than removed by a licensed waste disposal contractor. You will usually have a dedicated storage tank for alkaline, acidic, and Cr (VI) dumps. In such cases you should be able to release the spent materials to the effluent treatment facility at a slow, controlled rate.	Dump tank underneath alkaline vessel & dump tank underneath acid vessel to allow controlled release to the effluent treatment plant.
8	For larger surface treatment operations where there are several process lines, the effluent flow will vary in accord with the number of lines in operation. You should ensure that peak loads do not exceed the capacity of the effluent treatment facility.	n/a – only one process line
9	Small effluent treatment facilities are preferably operated on a batch basis, only releasing trade effluent to the sewer after confirmation that it is within the Sewerage Undertaker's consent limits. Larger facilities may be operated on a continuous basis provided that adequate monitoring is in place.	The effluent plant is run on a batch basis. The effluent is checked before discharge for Total Suspended Solids, pH and Sulphates.

10	The effluent system should be designed so as to prevent process effluent by-passing the effluent treatment plant.	There is no possibility to by-pass the effluent treatment plant.
11	You should justify the choice and performance of the effluent treatment facility against the following objectives: • the removal of dissolved metals including basis metals, e.g. iron, aluminium, copper and zinc, and plating metals e.g. chromium, copper, nickel, lead, tin, silver, and zinc • the control of the trade effluent pH within the Sewerage Undertaker's consent limits • formal consent limits may also be set for suspended solids, oil and grease, sulphate, detergents, COD, and cyanide • your permit may also set limits on the discharge.	All wastewater exiting the anodising facility is directed through the effluent plant before entering the foul sewer. The effluent plant has been designed to precipitate all consented metals and the chemistry of the precipitation is common knowledge. To ensure that the system functions correctly there are pH meters to control redox reduction and neutralisation process and a redox meter to control the redox reduction process. Daily internal monitoring of the effluent quality is performed against the requirements of the formal discharge consent. Equally Anglian Water Services undertake routine unscheduled sampling to ensure full compliance. The effluent system incorporates a filtration unit to dewater the sludge and the sludge is stored prior to analysis and disposal by a registered waste handler.
Primary treatment		
12	Whether multistage cascade or rinse water re-circulation with ion-exchange (or other treatment unit) is used for water conservation, the primary stage of effluent treatment is the precipitation of the dissolved metals from the effluent. Any Cr (VI) present, must first be reduced to the trivalent state in a turbulent tank reactor. Any effluent stream containing cyanide requires a cyanide oxidation step, again in a turbulent tank reactor. The dissolved metals in the combined effluent stream are then precipitated in a turbulent tank reactor by adjusting the pH within the range 6-10 depending on the metals present. Mixing in circular tank reactors is preferably promoted by slow speed propellor or turbine agitation and wall baffles. PID control rather than on-off control systems for dosing chemicals may improve pH stability.	All chemical waste generated by the two finishing plants is contained in the rinse water. This water is passed directly to the effluent plant for treatment, precipitation of the metals and pH correction prior to entering the foul sewer. The precipitate is removed using a desludging system which generates a filter cake. This filter cake is stored in a bulk container prior to disposal via a registered Waste Contractor. The filter cake has been analysed and classified as non-hazardous.
13	The next step is the separation of the precipitate in a void tank settler or a lamellar clarifier, often with chemical pre-treatment (e.g. polyelectrolytes, inorganic coagulants and bentonite) to enhance the removal of colloidal solids, and/or to reduce the settlement time. Settling equipment works best with a steady continuous flow. Pumping tanks should preferably be fitted with a level sensing device with a proportional output that is used to	Pumping tanks are fitted with a level sensing device with a proportional output that is used to control the flow. Sludge is ultimately turned into filter cake.

	control the flow. The settled sludge containing 2-3% solids is periodically discharged to a secondary settlement tank where the solids level is allowed to attain a level of around 8%.	
14	The sludge is then filtered in a high-pressure batch filter press for further water removal. The discharged filter cake containing 20-30% solids is removed by a licensed waste disposal contractor to landfill. The filtrate is recycled to the precipitation reactor. Filter press pumps providing an operational pressure of 10-15 bar will increase the solids content of the filter cake to 35-40%.	A filter cake press exists prior to discharge to remove the solids from the discharge water. The resulting filter cake solid waste is removed from site to landfill as non-hazardous waste.
15	The clean water flow from the settler/clarifier is usually discharged directly to the foul sewer as trade effluent.	The clean water is pumped out back into the effluent treatment plan before ultimately going to foul sewer.
Secondary / tertiary treatment		
16	Filtration to remove fine suspended solids to achieve trade effluent consent limits for metals of 1-3mg/l is common.	All wastewater exiting the anodising facility is directed through the effluent plant before entering the foul sewer. The effluent plant has been designed to precipitate all consented metals.
17	Trade effluent, whether filtered or not, may be recycled to the less critical rinsing steps and thus reduce input water usage by up to 30%.	n/a – reusing the water in this way would have an adverse effect on the quality of the process and so is not a viable option.
18	Where multistage cascade rinsing is in place, the effluent flow may be very low. “End of pipe” treatment with such techniques as activated carbon, bone charcoal, selective cationic ion-exchange, membrane filtration technology, and reverse osmosis may be considered, thus enabling a further reduction in water usage.	There is no end of pipe treatment in place on the rinsing tanks. Flow of fresh water into the rinsing tanks is reduced when production volumes are low and increased when production volumes are higher. This reduces overall water use in the rinsing stages.
3.2 Point source emissions to air – indicative BAT		
1	If you use local exhaust ventilation (LEV) to control harmful substances, you should use the minimum extraction rates that enable COSHH requirements to be met; and where possible extraction should not be used at all, as described above	The air is extracted from the Sulphuric acid and Sodium Hydroxide treatment tanks via local exhaust ventilation from the top of the process tanks in the form of lip extraction and then sent into a wash box scrubber where contaminants are captured in water. The resulting emission from the stacks is predominantly water mist with <0.04mg/m3 Sodium Hydroxide and <0.10mg/m3 Sulphuric Acid respectively (see Redwings Emissions Report). The LEV system is inspected and tested 14 monthly as

		required by the COSHH regulations (LEV COSHH reports for 2018 and 2019 have been provided as part of this submission).
2	Process tank lip ducts should be located with at least a 50mm gap between the top of the tank and the bottom of the lip duct.	The tank lip ducts are located with a gap greater than 50mm between the top of the tank and the bottom of the lip duct.
3	Fume extraction through the upper sides of process tanks is not recommended.	Fume extraction through the upper side of process tanks is not present
4	A mist eliminator should be installed in the suction side of the extraction fan, with mist eliminator drainage and washings being discharged to the effluent treatment facility.	There is a wash water box/scrubber in the extraction system for the alkaline and acid tanks.
3.3 Fugitive emissions to air – indicative BAT		
2	A simple water scrubber should be fitted to the vent outlet of hydrochloric acid tonnage storage vessels (for use during filling operations).	There is a wash water box/scrubber in the extraction system for the alkaline and acid tanks.
3	You should regularly clean fume extraction ducting and mist eliminators.	Fume extraction ducting and mist eliminators are cleaned once a month