DC Busbar Systems
for high current applications
Introduction

Working with our Sister Company and main production unit, MSS India Pvt Ltd, MSS Products supply turnkey high current DC busbar system projects for clients around the world.

High Current DC Busbar Systems are used in many diverse applications. However, the main uses are in electrochemical applications where there is a requirement for high DC currents, these would typically be:

**Base metal refining for metals such as:**
- Copper
- Zinc
- Nickel
- Cobalt

**Chlorine refining for products such as:**
- Chlorine Dioxide
- Caustic Soda
- Bleaching Agents
MSS Products works with refinery operating companies or Engineering, Procurement and Construction (EPC) companies, to design and engineer busbar systems that will deliver the optimum electrical performance for a given refinery.

This can be done from basic operating parameters and plant layout drawings from the client. MSS Products will then produce a series of performance calculations, ensuring the installed busbar system will achieve this once operational. Once the performance specification is agreed, the layout and detailed drawings can then proceed. Initial layout drawings are approved and the operating specification agreed. MSS Products would then produce the necessary manufacturing drawings.

MSS Products success is based on a strong portfolio of world-class technologies, robust industry expertise and innovative personnel. To stay at the forefront of the industry, continuous development with in-house R&D is key to the maintenance of our equipment solutions offer, for mineral and chlorine processing applications. We are constantly actively seeking new applications and/or developing existing ideas for metal processing, offering significant growth opportunities.

MSS Products supplies the mining industry with sustainable mineral processing solutions, from undertaking engineering studies to designing and supplying equipment for complete electrowinning tankhouses. Our comprehensive offering allows for the efficient and profitable treatment of base metal ore types such as copper, zinc, nickel and cobalt. With over 40 years experience in designing, manufacturing and supplying of DC busbar systems, we have the knowledge as well as the established R&D resources to continuously improve and develop new technologies.

MSS Products assists clients in their decision making process, from the pre-feasibility stage of the project to the commissioning of a refinery. With our extensive experience and knowledge of most economic procedures, our company is dedicated to providing highly technical and complex solutions to the mining/mineral processing and chlorine refining industry.

**MSS Products can work closely with clients in the following areas:**

- Tankhouse Design
- Budgeting Proposals
- Feasibility Studies
- Project Management
- Refurbishment/Expansion Programs
- Electrical/Thermal/Efficiency Studies
- On-site evaluations of Tankhouse performance
In the early 2000's the refined production of copper saw a substantial amount of growth from a total refined copper production of just over 17 million tonnes to just over 20 million tonnes by 2005, a growth of 18% in capacity. A significant proportion of this growth was through the development of electrowinning refining capacity, as opposed to the more traditional electro-refining process. MSS Products was therefore able to develop designs that were ideal for the higher DC currents required for the electrowinning processes being developed at that time.

MSS Products work with customers on specific process issues to do with plant operation and develop products such as electrowinning shorting frames, which are able to increase plant operational performance by reducing plant downtime.

MSS Products expanded into the nickel refining industry and has subsequently worked on some of the largest electrolytic nickel refineries that have been commissioned globally in recent years.

These projects have utilised the latest technologies to refine nickel sulphide concentrates via the hydrometallurgical process. It is essential for close control of this process and to monitor the performance of anodes and cathodes, which require the refining cells to be grouped in pairs creating the need for a very specialised DC busbar system connecting the pairs of cells together.

MSS Products offer clients all of the important aspects to the busbar system including the machined cell top busbars, machined apron busbars, flexible linking busbars, riser bars and specialist by-pass frames.

Our in-depth knowledge of the design and supply of DC busbar systems provides a major benefit to our zinc refinery customers, where DC currents can run at over 200 kA. With such high operating current, it is essential that zinc refinery busbar systems are designed correctly, using optimum materials and a robust support structure. MSS Products has many years of experience in using of both copper and aluminium materials within DC busbars for zinc electrowinning tankhouses.

The demand for MSS Products supplied electrolytic zinc tankhouse equipment has increased significantly over the last few years, assisted by the increase in global demand for zinc used in processes such as galvanizing of steel.

MSS Products is one of the longest established and most experienced companies involved in the design, manufacture and supply of DC electrical systems for use in the chlorine refining industry.

Our busbar systems were originally used on flowing mercury cathode refineries in the 1970s. We were also at the forefront of the industry changeover from mercury electrolysis to clean electrolyser technology, with the introduction of diaphragm, mono-polar and latterly bi-polar electrolysers.

MSS Products has had successful installations across the globe with chloralkali, sodium hydroxide and chlorine dioxide installations in countries such as: Australia, Indonesia, Canada, Brazil, China, Mexico, USA and the U.K. We have also successfully installed DC systems for the pulp and paper industry.
MSS Products design and manufacture a range of unique Endcell and Intercell Busbars for zinc electrowinning SX/EW applications.

**MSS Products**

- Watercooled Busbar
- Intercell & Endcell
- Shorting Frames
- Flexible Busbars
- DC Switches

**Materials**

- MSS Products use high quality Extruded and drawn hollow copper sections
- No cast copper is used
- Manufacturing standard is to EN 13605
- Copper grade Cu-ETP (C11000)
- Lengths can be manufactured up to 12 Meters
- Excellent straightness over length of bar
- Option for lead plating of bars

**Machining**

- The anode and cathode slots in the Equipotential busbars are machined in the busbars with a very high degree of accuracy
- MSS Products has recently invested in new CNC Machine tools to maintain a high level of accuracy in machining over lengths up to 12 Meters
- Bespoke CNC Machine tools allows a very high throughput of busbars
**Intercell and Endcell**

MSS Products design and manufacture a range of unique intercell and endcell busbars for electro-refining and electrowinning applications.

### Intercell Busbars

The aim of the Intercell busbar is to transfer the DC current efficiently between each cell in the circuit.

The size of the Intercell busbar is dependent on the current capacity required, the height requirement of the electrodes from the cell-top, the physical size of the supporting cell wall and length of the refining cells.

The Intercell busbars can be designed to accommodate different hanger bar configurations for the electrodes. Electrode hanger bars can either be of a symmetric or asymmetric design, leading to the required corresponding format for the intercell busbars and associated cell-top furniture.

To offer the most efficient electrical performance, the intercell busbars are produced as one continuous copper extrusion to ASTM B187 Grade UNS C11000. This will give a conductivity well in excess of the minimum requirement as detailed in the standard, ensuring a low electrical resistance between the cells and minimising any power losses.

The busbars can also be machined with slots to take the anode and cathode hanger bars or can be an un-machined plain extrusion with the hanger bars simply resting on the busbar. In addition, an auxiliary current equalisation busbars can be added to ensure an even current distribution across each intercell arrangement.

### Endcell Busbars

MSS Products endcell busbars, also known as ‘Apron Busbars’, are designed to have a number of key functions:

- To connect with the multiple riser busbars, which are transmitting the current up from the main trunk busbars
- To provide an effective connection and current distribution system for the DC electrical current coming from the main trunk busbar system to the tankhouse electrodes
- For electrowinning applications, they provide a location for the tankhouse shorting frame, which will position the anode/cathode contact of the shorting frame on the endcell busbar

### Shorting Frames

MSS Products design and manufacture a unique range of shorting frames, sometimes called Jumper frames, for electrowinning refineries of base metals such as Copper, Nickel and Zinc.

Shorting frames are used to allow the current flowing through the cell line to by-pass one or two cells, these cells can then be worked on for maintenance.

Our shorting frames are designed from laminations of copper plate busbars, formed into a rectangle. The busbars are sized allowing a current density of between 1.3 – 1.5 Amps per mm sq, depending on the prevailing ambient temperature. The size of the shorting frame is relative to the size of the cells. The frame will usually be around the same length as the cells, but slightly wider than one cell in the case of a single cell frame, or two cells in the case of a double cell frame, as the frame must make contact with the anode and cathodes in the adjacent cells to the cell being shorted out. In addition, the frame must also be wide enough to allow for the removal of the anodes and cathodes while the frame is in place.

MSS Products shorting frames are designed with individual spring loaded contact pins pitched at the same distance as the spacing of the anode and cathode hanger bars. This is so each Hanger bar makes contact with its own contact pin on the frame. This ensures that all the hanger bars make an effective contact with the frame, with the spring loaded contact pins making an allowance for any height variation in the hanger bars. The spring loaded contact pins are electrically connected to the shorting frame through special laminated or braided copper connectors.

For certain electrowinning refineries it may be preferable to fit the shorting frame with high current air or vacuum switches. This will allow the shorting frame to be positioned on the cell line without any reduction in operating current, which is usually the case with un-switched shorting frames.
Flexible Busbars

MSS Products designs and manufactures specialist high DC current flexibles for use in electro-refining and electrowinning applications.

There are a number of flexibles produced:

- Busbar System Expansion Flexibles
- Transformer / Rectifier connection flexibles
- Connection flexibles to DC Isolation switches
- Intercell and endcell electrolyser connection flexibles

Expansion Flexibles

The purpose of fitting expansion flexibles are twofold: firstly they help with tolerances on installation allowing some movement as the busbar system is installed, secondly and the primary reason is that the expansion flexibles allow for a certain amount of linear expansion and contraction in the busbar system, caused by thermal cycling as the ambient and operating temperatures rise and fall inside the tankhouse.

The expansion flexibles are bolted into the busbar system, are usually around a length of 1.2 Metres and sized at the same overall dimensions as the individual busbar laminations. The flexibles are made up from a number of thin high conductivity Cu-ETP copper strips and consolidated into a solid mass at the ends. This will therefore give the same current density as the solid busbars with an improved lower temperature rise than the busbar due to the increased surface area offered by the laminated copper strips in each flexible.

Transformer/Rectifier Connection Flexibles

It is essential to connect the solid busbars of the positive and negative busbar feeders to the connection tabs on the T/R unit through a series of flexible connections. The aim of these flexibles is to avoid any possibility of the solid busbars stressing the connections on the T/R unit. These stresses can be caused through thermal expansion of the busbar system, misalignment of the busbar system on assembly or small vibrations from within the T/R unit.

The T/R connection flexibles are usually designed to be more flexible than the Expansion flexibles, with a thickness made up from multiple laminations of thin high conductivity Cu-ETP copper strips. This is the same as the solid busbar but at around a half or a third of the width, you would have twice or three times as many T/R flexibles compared to the number of solid busbars.

The current density of the T/R connection flexibles is usually a little higher than that for the main busbar system, but this is compensated by a lower temperature rise due to the increased surface area of the flexibles provided by the multiple lamination design. Copper plates are ‘shaved’ during the mill manufacturing process, to remove any excessive surface oxides and to give a good surface finish suitable for the electrical contact faces of the busbars.

DC Switches

MSS Products has been involved in the supply of high current DC switches for nearly 20 years and we can supply switches for plants operating from 10kA up to 230kA.

Our switches are predominantly of a vacuum contact design which gives a safe, reliable and long-term performance in harsh copper tankhouse environments.

The switches can be custom designed, to meet the individual needs of any busbar system.

The switches can either have manual, electronic or pneumatic controls, as well as including drip covers and current monitoring systems.

MSS Products can supply switches for both ON-load or NO-load breaking conditions.
Installation and maintenance

Following the completion and delivery of the DC Busbar system to site, an essential part of a successful project is the installation process and follow on system maintenance.

As part of the project documentation package, MSS will produce a detailed Installation Operation and Maintenance manual (IOM). The IOM will provide a detailed step by step guide for the on-site installation team to follow. This installation process would be supervised by the MSS site installation supervision team.

Following the successful installation and commissioning of the busbar system, it is essential that we pass on to our customers the necessary skills for effective maintenance by supplying the required manuals and the provision of maintenance training courses.

With regards to this training, after the completion of the on-site installation phase MSS will undertake a number of maintenance seminars for key site personnel. These seminars are designed to help the various operational and process staff to understand the importance of regular busbar system maintenance and housekeeping over the lifetime of the refinery.