

Lifting Magnets and Magnetic Separators manufactured in India have been traditionally wound with Fibreglass or Nomex covered Aluminium or Copper Wire or Strip. This covering material keeps the turns insulated. However, these insulating materials absorb moisture and deteriorate from heat, shock and age. They eventually break down causing a costly burn out of the Magnet Coil.

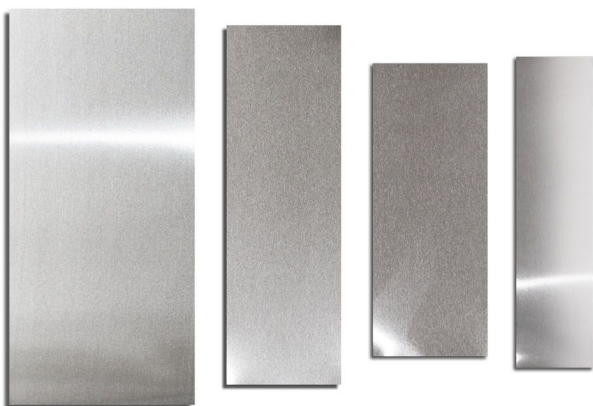
Furthermore, Copper tends to oxidise at high temperatures and may fail beyond 220°C. This is virtually impossible for Anodised Aluminium Strip as THERE IS NO INTERTURN INSULATING MATERIAL WHEN ANODISED ALUMINIUM IS USED AS THE CONDUCTOR. Effectively, it can be considered as superior to Class C insulation (220°C final temperature).

ANODISED ALUMINUM FOR ELECTRO MAGNETS

European manufacturers have been using Anodised Aluminum Strip for Lifting Magnet and Magnetic Separators for over 50 years.

Elektromag has been importing Anodised Aluminium Strip from Germany since 2006 and winding the Magnet Coils in India. Elektromag has already supplied a few hundred Electro Magnets with Anodised Aluminium Coils over the last 10 years. However, as the landed cost of imported Anodised Aluminium was very high, many customers, though aware of the advantages, were reluctant to pay the large price difference.

Now, in April 2017, Elektromag has commissioned its own Continuous Coil Anodising Line at Vapi in Gujarat, India, with technology acquired from Germany, to enable the Magnets to be more affordable.



THE ANODISING PROCESS

The Anodising Process is an electrolytic process which results in the surface of the Aluminium Strip being converted to a layer of Aluminium Oxide which firmly adheres to the metal surface and forms a nearly homogeneous bond with the Aluminium. This oxide layer functions as an electrical insulator with insulating properties dependent on the oxide layer thickness. The oxide layer thickness is controlled during the Anodising process so as to meet the desired insulation level which would be adequate for the inter-turn voltage. For example, if the inter-turn Voltage is 1V, then the insulating level would be in excess of 100V.

The Al_2O_3 (aluminium oxide) layer has high wear and abrasion resistance. It has a melting point of approximately 2000°C which exceeds the melting point of 658°C of the base Aluminium metal. Thus, effectively the oxide layer would have refractory properties and a Coil made from Anodised Aluminium Conductor could insulate till it melts.

ELEKTROFOL - The Perfect Coil



Edge Preparation

Prior to Anodising, the Slit Aluminium Strip is subjected to a special edge preparation process. In this process, any remaining burr, after the slitting cycle, is removed and the edges are rounded to an appropriate radius.

ELEKTROFOL MAGNET COILS

Technical Advantages

► Superior Heat Dissipation

Coils made of Anodised Aluminium Strip dissipate heat much faster since every single turn is itself part of the heat emitting exterior surface. In a conventional fibreglass or nomex covered and varnished wire coil, the dissipation of heat from the Coil centre

is significantly obstructed. The poor thermal conductivity of the inter-turn insulation as well as air inclusions results in heat build-up that may ultimately destroy the Coil. Particularly in Oil Cooled Electromagnet Coils wound with Anodised Aluminium Strip, every single coil turn is directly exposed to oil cooling. On the other hand, in Wire Wound Coils, inside turns do not come into contact with the Oil. Hence the cooling is uneven, resulting in hot spots within the inner layers of the coil.

Technical Advantages of Elektrofol Magnet Coil

► Lower Operating Temperature

The thermal conductivity and heat emission capacity of the oxide insulating layer are far superior to that of wire covered with conventional insulating material. As a result, a Coil made from Anodised Aluminium Strip builds up much less heat under load. The cooler Coil will have a longer life and superior magnet power.



Coil with Conventional Fibreglass covered conductor

► No inter-turn Insulation needed - Superior Space Factor

The space factor for a coil made with Anodised Aluminum Strip is 0.85 or higher where as that for conventional fibreglass or nomex insulated coils is in the range of 0.5-0.65. This is because the individual turns of an Anodised Aluminium Strip Coil are firmly in contact with each other and there are virtually no air filled interspaces. As the interlayer voltage is equal to the inter-turn voltage,



there is no need for interlayer insulation as required in wire coils. Such insulation layers are significantly thicker. For example, the Aluminium Oxide layer is typically 1- 6 microns. So it is much thinner than fibreglass covering which is around 220 microns.

► Ideal for High Temperature Service

As the Aluminium Oxide Insulation layer will not melt below 2000°C and Aluminium has a melting point of 658°C, Anodised Aluminium Coils can survive temperatures of up to 500°C for extended duration. By contrast conventionally insulated Aluminium or Copper Wires have a maximum temperature limitation of 180°C - 220°C if Class 'H' or Class 'C' insulating materials are used.

Technical Advantages of Elektrofol Magnet Coil

Typically, in Lifting Magnet applications a Coil made of Anodised Aluminium has a far better chance of survival in the following possible circumstances.

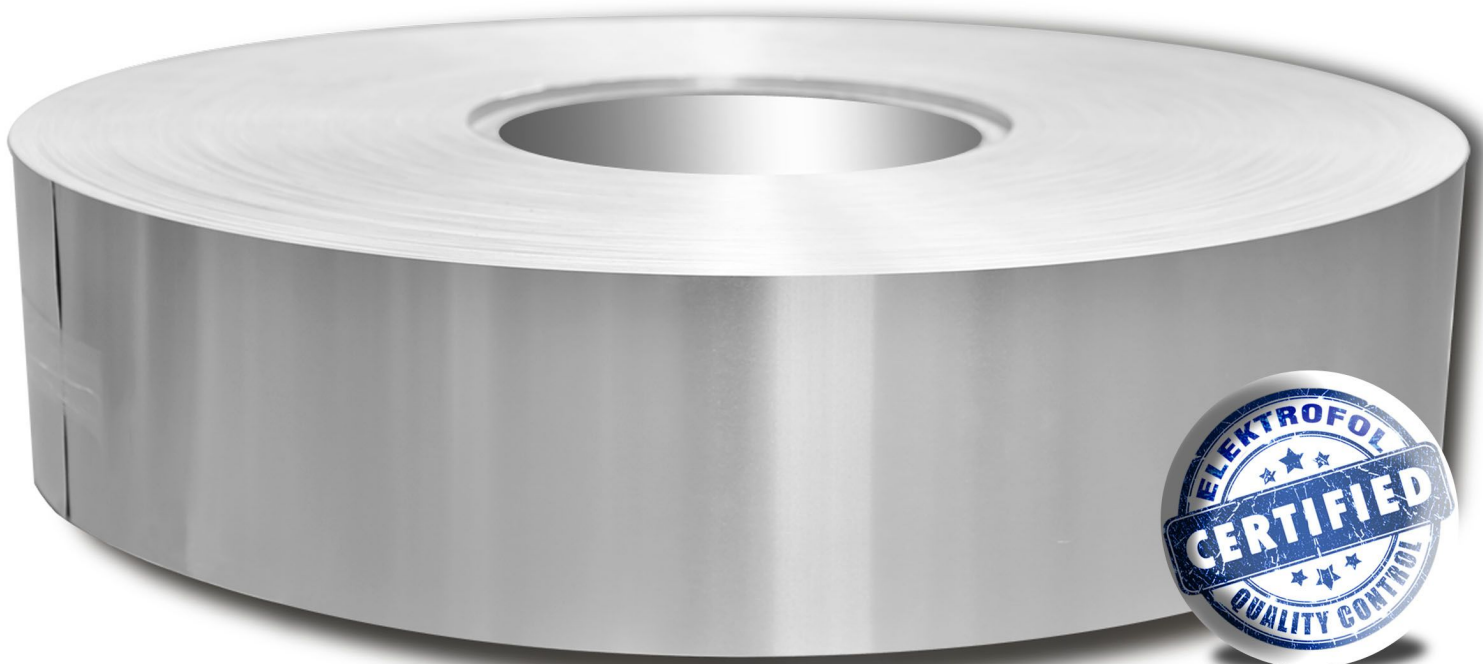
- i.** If rated duty cycle of 60%/10 min or 75%/10 min is exceeded repeatedly.
- ii.** When continuously handling hot materials such as Billets at 600°C temperature in concast plants.
- iii.** If Magnet is accidentally left "ON" continuously for a few hours.
- iv.** If used occasionally for Direct Furnace Charging.

► QUALITY ASSURANCE

The ELEKTROFOL Anodising Line is equipped with state-of-the-art equipment and trained manpower to ensure quality check at all stages, from incoming raw materials to finished product.

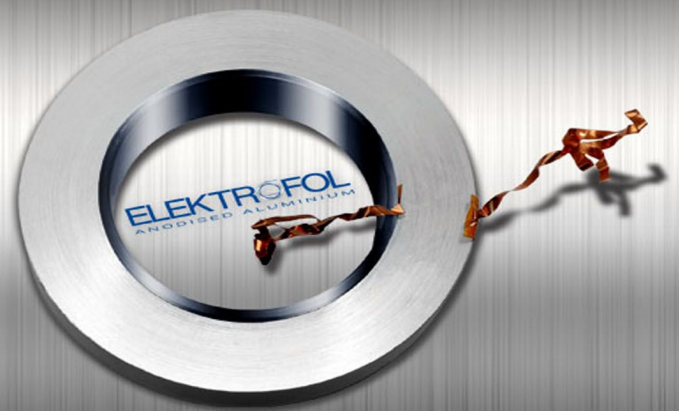
Test Equipment includes all necessary Mechanical, Electrical and Chemical testing instrumentation.

Tests include Dimensional checks, Conductivity measurement, Resistance measurement, Film Coating Thickness measurement, Breakdown Voltage Tests, Chemical Analysis to ensure consistency of Anodising and other Baths, etc.



Technical Advantages of Elektrofol Magnet Coil

ELEKTROFOL
ANODISED ALUMINIUM COIL



► COIL WINDING EXPERTISE

The Magnet Coils are wound on special purpose Coil Winding Machines imported from Germany. Coil jointing and Flexible Copper Lead terminations are carried out using state-of-the-art Cold pressure joining, Ultrasonic welding Machines and Techniques acquired from Germany.

SUMMARY OF ADVANTAGES OF ELEKTROFOL

- ✓ Highest space factor allows compact construction.
- ✓ Highest heat dissipation.
- ✓ Lower temperature rise
- ✓ Light weight
- ✓ Highest thermal stability due to excellent heat transfer of ELEKTROFOL Coils.
- ✓ Lower hot spots.

- ✓ Lower operating temperature allows more current flow.
- ✓ More current flow results in stronger Magnets.
- ✓ Result – higher average all day lifting capacity in Scrap Handling Magnets, more kg of scrap lifted per KW of Power consumed.
Or
- ✓ Higher Gauss Value in Magnetic Separators.
- ✓ ELEKTROFOL enables optimisation of Magnet Design – Magnet Dimension, Weight and Power Consumption.
- ✓ Best Energy efficiency.

CONCLUSION

In view of all the above Technical Factors, it should be apparent that, under normal working conditions, Elektromag Magnets with ELEKTROFOL Anodised Aluminium Coils will have the longest life compared to any other winding material.

The Magnets will be much cheaper and lighter than Copper wound Magnets. The lighter weight will result in less wear and tear on crane components. They may be a little more expensive than Magnets with conventional Aluminium Coils, but their much longer life will easily compensate for the premium paid over the lifetime of the product.

Effectively, they will need repairs much less frequently than conventional copper wound or aluminium wound magnets.

Over the lifetime, they will be the CHEAPEST Magnets you can buy.



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