WELDING V/S BOLTING

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The old technology required anodizing line to weld aluminum cathodes to what we call a header-bar. For years this was accepted as the correct way to provide aluminum cathodes in an anodizing tank. The thought was that it sealed the connection between the cathode and the header-bar giving good electrical conductivity for the life of the cathode. The disadvantage was when cathodes needed to be replaced the system would need to be removed and the cathode cut out and replaced/rewelded. This could be a real burden on an already stretched maintenance department or costly to have an outside contractor do the job. Bolting had a bad reputation because of how it was done. Not the least of which is the contact area of the cathode to the header-bar which is a very important component in a cathode system. Now here are some of the facts about welding cathodes or any metal. Remember contact area is the important factor. When welding two plates of metal of any material the edge down to 1/4" - 1/2" is the only area which makes guaranteed contact. The areas beyond the weld, specifically in the case of welding a plate of 4"x4", will expand and bow outward, creating a void and thusly stopping contact between the two surfaces that are welded. In addition, by welding, heat is built up in the aluminum and changes the temper designation -T6 of the aluminum to an unknown or dead soft material. This can cause the aluminum to be susceptible to attack from the sulfuric acid in the bath.

The bad reputation bolting has gotten is from less than well thought out bolting installations. Remember we are looking for good and consistent contact. The contact comes from clean and adequate contact area. Running 2000 amps through an area that is 1x1" held together with 1 bolt will cause localized heating and the formation of oxide that will further reduce contact area. By using a 1x4" header bar to bolt on to and a wide 6063T6 cathode this problem is avoided. To increase contact area using a very good bolt pattern across the 4x4 area also helps to maintain good contact. Using 316l stainless fasteners or Titanium will also add years of service to the system. Since aluminum threads can be stripped easily or eroded by the fumes off the anodizing tank, through hole with washers, nuts and lock washers will ensure replacement does not run into a snag of threaded holes being stripped. As an added precaution using a conductive sealant between the header-bar and cathode is assure additional good contact.

So here is the list of things to keep in mind when designing an aluminum cathode system:

1. Make sure you have adequate contact area between cathode and header-bar

See illustration A

- 2. Use a bolt pattern that maximizes the pressure on all areas of the connection
- 3. Use 316L stainless or Titanium bolts
- 4. Do not tap the holes, drill straight through and use nuts and lock washers.
- 5. Use a thin conductive sealant film between cathode and header-bar
- 6. Try to use the best alloy 6063T6 for the complete system

7. See illustration B & C



А



В

C alloy 6063T6 v/s 5000 alloy

Table 1. Weight Loss over Time

Days Exposed	6063 Alloy Weight	6063 Alloy Weight Loss %	% Sulfuric Acid (v/v)	5000 Series Alloy weight	5000 Series Weight Loss %	% Sulfuric Acid
0	88.4033 g	0%	12.9% (225 g/L)	62.2532 g	0%	12.9%
12 days	87.8161 g	0.66%	12.8%	58.7676 g	5.6%	10.8%
22 days	87.0005 g	1.6%	11.8% ¹	55.6696 g	10.6%	8.4% ¹
39 days	85.6494 g	3.1%	12.0% ²	50.1080 g	19.5%	10.1% ³
62 days	83.2935 g	5.8%	10.4% ^{1, 4}	42.7474 g	31.3%	9.2% ^{1, 5}
81 days	80.4747 g	9.0%	10.7	41.7639 g ⁶	32.9%	7.6%

- 1- Sulfuric Acid Addition was made to raise levels back to 12.5%
- 2 Dissolved aluminum content was found to be 6.6 g/L
- 3 Dissolved aluminum content was found to be 21.6 g/L
- 4 Dissolved aluminum content was found to be 11.9 g/L
- 5 Dissolved aluminum content was found to be 37.8 g/L