

TECHNICAL BULLETIN 1 2/2022

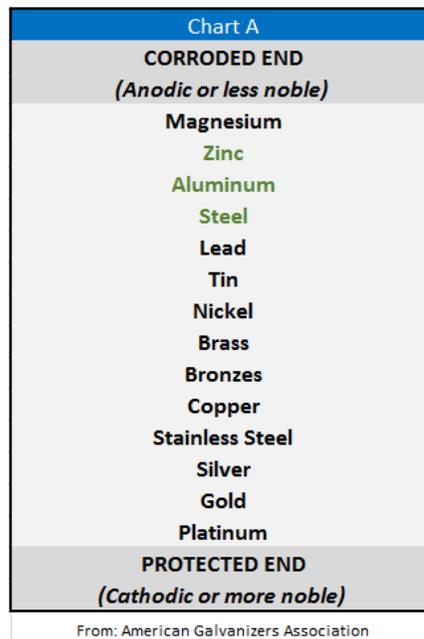
## Corrosion Protection & Dissimilar Metals in Conduit Usage

Penn Aluminum Conduit & EMT often receives inquiries regarding the acceptable application practices of Aluminum conduit products on the jobsite. As the trend in the Electrical Construction Industry of transitioning from galvanized steel conduit products to Aluminum conduit products based on the many benefits (including cost and safety) continues, questions regarding the usage of Aluminum in specific environmental locations and the acceptability of readily available fittings for EMT are important to answer.

An understanding of the corrosion protection requirements of conduit product standards and of the National Electrical Code® (NEC) together with guidelines on the use of supplementary corrosion protection will help understand the acceptability of Aluminum conduit usage in most electrical construction applications.

### Corrosion Prevention

The performance of a material in the various environmental conditions found in electrical construction is controlled by a number of factors including the potential and resistance between anodic and cathodic areas (Chart A), dust, harsh chemicals, the pH of the environment, temperature and humidity. Appropriate product selection and control of environmental factors can reduce the likelihood and minimize the rate of corrosion.



**The Galvanic Series**  
The closer the metals are together on the chart means less difference in galvanic potential.

Corrosive environments, such as concrete and soil, can be corrosive to certain materials. (Chart B) Harsh chemicals can have an effect on both metal and nonmetallic conduit. The NEC allows the use of rigid aluminum conduit and EMT in concrete or direct buried *“where provided with approved supplementary corrosion protection.”* This means that additional protection meeting the requirements of the Authority Having Jurisdiction (AHJ) is required.

| Chart B                                    |                         |                      |
|--|-------------------------|----------------------|
| UL GUIDELINES Corrosion Protection SUMMARY |                         |                      |
| In Concrete:                               | Required                | Optional             |
| Steel Rigid Conduit                        |                         | X                    |
| Intermediate Metal Conduit                 |                         | X                    |
| Aluminum Rigid Conduit                     | X                       |                      |
| Steel EMT                                  | Below grade<br>may need | On or above<br>grade |
| Aluminum EMT                               | X                       |                      |
| <b>In Soil</b>                             |                         |                      |
| Steel Rigid Conduit                        |                         | X                    |
| Intermediate Metal Conduit                 |                         |                      |
| Rigid Aluminum Conduit                     | X                       |                      |
| Steel EMT                                  | Generally<br>required   |                      |
| Aluminum EMT                               | X                       |                      |

From: Soares Book on Grounding

Aluminum, by nature, is a very non-corrosive material in most environments. Unlike steel, Aluminum forms a natural protective layer which protects against corrosion. This protective layer may present itself as light-colored or white on the surface of the Aluminum rigid conduit or EMT.

Per the UL 6A Standard for Safety for Aluminum Electrical Rigid Metal Conduit, *“Electrical rigid metal conduit made of aluminum does not require a protective coating. When intended for use in concrete, for direct burial, or for use in severely corrosive environments, aluminum conduit shall be provided with a protective coating.”* (UL 6A 5.3.1)

The Standard for Safety for Electrical Metallic Tubing (EMT), UL 797A, states that *“Aluminum electrical metallic tubing does not require a protective coating. Exception: Aluminum electrical metallic tubing intended for use in concrete, for direct burial, or for use in severely corrosive environments, shall be provided with a protective coating.”* (UL 797A 5.1)

There are a variety of acceptable coatings available, including PVC, epoxy and tapes, that are intended to provide the supplemental corrosion protection for severe environments.

## Dissimilar Metals

The question of whether readily available steel (galvanized) or zinc fittings for EMT are acceptable for use with Aluminum EMT is common. Due to the proximity of these metals with Aluminum in the Galvanic Series, the combination of these components does not present an issue. (See Chart A)

The NEC advises that where practicable, dissimilar metals shall be avoided.

However, steel fittings and enclosures are allowed to be used with Aluminum rigid conduit and EMT and vice versa *where not subject to severe corrosive influences*. This allowance is noted in NEC Handbook, Section 358.14.

Chart C shows galvanic corrosion potential between common construction metals.

Note that galvanic action is insignificant between Aluminum and steel or zinc.

| Chart C   |          |       |        |        |                  |            |      |                 |      |
|---|----------|-------|--------|--------|------------------|------------|------|-----------------|------|
| Dissimilar Metals   |          |       |        |        |                  |            |      |                 |      |
| Galvanic corrosion potential between common construction metals |          |       |        |        |                  |            |      |                 |      |
|   | Aluminum | Brass | Bronze | Copper | Galvanized Steel | Iron/Steel | Lead | Stainless Steel | Zinc |
| Aluminum  |          | 1     | 1      | 1      | 3                | 2          | 2    |                 | 3    |
| Copper  | 1        | 2     | 2      |        | 2                | 1          | 2    |                 | 1    |
| Galvanized Steel (zinc)   | 3        | 2     | 2      | 2      | 3                | 3          |      |                 | 3    |
| Lead  | 2        | 2     | 2      | 2      | 3                | 3          |      |                 | 3    |
| Stainless Steel*  |          |       |        |        |                  |            |      |                 |      |
| Zinc  | 3        | 1     | 1      | 1      | 3                | 1          | 3    |                 |      |

**1. Galvanic action will occur with direct contact.**  
**2. Galvanic action may occur.**  
**3. Galvanic action is insignificant between these metals.**  
 \* Stainless steel conduit and EMT shall only be used with stainless steel fittings and approved accessories, outlet boxes and enclosures. If stainless steel is used with galvanized steel or aluminum, galvanic corrosion can occur. In galvanic corrosion, the more noble metal is protected and becomes the cathode and the weaker alloy will become the anode and corrode at an accelerated rate. Since stainless steel is more noble than either aluminum or galvanized steel, it would become the anode and will cause the other metals to corrode at an accelerated rate.

From: NEMA Bulletin No. 96

Resources: National Electrical Manufacturers Association, Bulletin No. 96, Rev2 – 03/15/18  
National Electrical Code Handbook, 2020 Edition

Please contact Penn Aluminum Conduit & EMT at [ConduitSales@pennaluminum.com](mailto:ConduitSales@pennaluminum.com) with any additional questions.



**Penn Aluminum Conduit & EMT**  
Proudly Serving America's Heartland

