PENN ALUMINUM CONDUIT & EMT
A Marmon / Berkshire Hathaway Company

1117 North Second Street - Murphysboro, IL 62966 USA - Tel: 618.684.2146 - www.pennconduit.com

TECHNICAL BULLETIN 2 2/2022

Aluminum & Galvanized Steel Rigid Conduit & EMT Usage

A current trend in the Electrical Construction Industry is the transition from using galvanized steel to Aluminum rigid conduit and electrical metallic tubing (EMT). This transition is being driven by the numerous benefits Aluminum conduit products provide compared to equivalent galvanized steel products. These benefits include:

- Lower Cost of Components
- Improved Efficiency on the Jobsite (Lower Total Installed Cost)
- Safety (Aluminum weighs 1/3 that of steel and dissipates heat)
- Corrosion Resistant Alloy
- Non-sparking metal (eliminating a hazard in explosive atmospheres)
- Sustainability (100% recyclable & made from recycled Aluminum)

As more projects and electricians recognize the opportunity for increased profitability and enhanced safety presented by using Aluminum Rigid Conduit and Aluminum EMT, Penn Aluminum receives inquiries related to the acceptable usage of our Aluminum products in the field.

The answer to these inquires is that Aluminum may be used in nearly all electrical construction locations where galvanized steel conduit products have historically been used, with few exceptions. These exceptions are clearly identified in UL, ANSI and National Electrical Code (NEC/NFPA) standards, articles and specifications.

Penn Aluminum Rigid Conduit can be used indoors or outdoors. It is approved for dry or wet locations where determined suitable for the environment.

Penn Aluminum EMT is used most commonly in dry interior spaces, but it is permitted to be used in damp locations with corrosion-resistant hardware and rain-tight fittings.

Underwriters Laboratories (UL)

also American National Standards Institute (ANSI)

RIGID METAL CONDUIT (RMC)

UL authorizes the listing and use of the UL mark for Electrical Rigid Metal Conduit in two Standards for Safety.

UL6 Standard for Safety - Electrical Rigid Metal Conduit – Steel

UL6A Standard for Safety - Electrical Rigid Metal Conduit – Aluminum and Stainless Steel

In Section 3, Definitions, of each of these Standards, Electrical Rigid Metal Conduit is defined the same except for referencing the difference in material.

"Electrical Rigid Metal Conduit – steel (ERMC-S) or aluminum (ERMC-A) – A threadable steel (or aluminum) raceway of circular cross-section designed for the physical protection and routing of wire conductors and use as an equipment grounding conductor when installed utilizing appropriate fittings.

All measurable dimensions relating to the conduit tube or pipe, couplings, elbows and nipples are identical between these two UL standards.

Due to the difference in weight (Aluminum being 1/3 the weight of steel), the standards reflect this variance in the same Table 5.2 *Length and Weight of Finished Conduit*, but the lengths by trade sizes shown are the same.

Section 5 – Construction

Section 5 of both the UL6 and UL6A standards present the requirements for all of the conduit products covered.

Due to the fact that the steel tube used for rigid conduit is a product that is welded and susceptible to corrosion, a good portion of this section in the UL6 standard details the weld bead limitations and protective coating (normally zinc galvanization) requirements (5.3).

Penn Aluminum Rigid Conduit is manufactured using aluminum extrusion technology that does not create the weld bead that is of concern in the UL6 standard for rolled-and-welded steel tube.

The UL6A Standard references a maximum copper content percentage of no more than 0.40% in the alloy of the Aluminum used in the construction of the tube. This content percentage is not a concern due to the design specified 6061 series recycled Aluminum alloy Penn Aluminum uses for production of our RMC products.

Aluminum is a corrosion resistant material. Section 5.3 of the UL6A standard directly states that *Electrical rigid metal conduit made of aluminum does not require a protective coating.* Though protective coatings for Rigid Aluminum Conduit are not required as they are with steel, the standard does allow the use of protective coatings to be employed.

The specific locations or applications that do require Rigid Aluminum Conduit to have a protective coating are when intended for use in concrete, for direct burial (soil), or for use in severely corrosive environments. (5.3.1)

Beyond this statement, there are no additional references in either UL standard that would differentiate in application or usage location between galvanized steel rigid conduit and Penn Aluminum uncoated Aluminum Rigid Metal Conduit.

NOTE - The NFPA National Electrical Code addresses the allowable usage of both Rigid Metal Conduit and Electrical Metallic Tubing in Hazardous Locations which will be explained below.

PENN ALUMINUM CONDUIT & EMT
A Marmon / Berkshire Hathaway Company

1117 North Second Street - Murphysboro, IL 62966 USA - Tel: 618.684.2146 - www.pennconduit.com

ELECTRICAL METALLIC TUBING (EMT)

UL authorizes the listing and use of the UL mark for Electrical Metallic Tubing (EMT) in two Standards for Safety.

UL797 Standard for Safety - Electrical Metallic Tubing – Steel

UL797A Standard for Safety - Electrical Metallic Tubing – Aluminum and Stainless Steel

As with the Standards for Rigid Metal Conduit, the differences between these UL requirements are specifically related to the weld line of steel EMT and the protective coating(s) required to provide corrosion protection to the steel.

All dimensional specifications for galvanized steel and Penn Aluminum EMT are the same for each trade size. As with the Rigid Metal Conduit standards, there is a difference between the UL797 Steel and UL797A Aluminum standards related to the lesser weight of Penn Aluminum EMT.

The UL797A Standard references a maximum copper content percentage of no more than 0.40% in the alloy of the Aluminum used in the construction of the tube. As with the RMC, this content percentage is not a concern due to the design specified 6061 series recycled Aluminum alloy Penn Aluminum uses for production of its EMT products.

Section 5 of UL797A states simply that Aluminum electrical metallic tubing does not require a protective coating. This is due to the corrosion resistant nature of Aluminum.

The specific locations or applications that do require Rigid Aluminum Conduit to have a protective coating are when intended for use in concrete, for direct burial (soil), or for use in severely corrosive environments. (5.1)

Beyond this statement, there are no additional references in either UL standard that would differentiate in application or usage location between galvanized steel rigid conduit and Penn Aluminum uncoated Aluminum Rigid Metal Conduit.

NOTE - The NFPA National Electrical Code addresses the allowable usage of both Rigid Metal Conduit and Electrical Metallic Tubing in Hazardous Locations which will be explained below.

PENN ALUMINUM CONDUIT & EMT
A Marmon / Berkshire Hathaway Company

1117 North Second Street - Murphysboro, IL 62966 USA - Tel: 618.684.2146 - www.pennconduit.com

National Fire Protection Association (NFPA)nn National Electrical Code 2017

ARTICLE 344 - RIGID METAL CONDUIT: TYPE RMC

Part I identifies the scope of Article 344 covering the use, installation and construction specifications for rigid metal conduit (RMC) and associated fittings.

It also defines Rigid Metal Conduit as a threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for the use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings.

Part II details the Installation of RMC and in 344.10 provides for Uses Permitted.

(A) Atmospheric Conditions and Occupancies

(1) Galvanized Steel and Stainless Steel RMC shall be permitted under all atmospheric conditions and occupancies.

(3) Aluminum RMC shall be permitted to be installed where approved for the environment. Rigid aluminum conduit encased in concrete or in direct contact with the earth shall be provided with approved supplementary corrosion protection.

(B) Corrosive Environments

(1) Galvanized Steel, Stainless Steel, and Red Brass RMC, Elbows Couplings and Fittings shall be permitted to be installed in concrete, direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection approved for the condition.

(2) Supplementary Protection of Aluminum RMC. Aluminum RMC shall be provided with approved supplementary corrosion protection where encased in concrete or in direct contact with the earth.

Part III recognizes the Construction Specifications of RMC

344.100 states that RMC shall be made of one of the following:

(1) Steel with protective coating
(2) Aluminum
(3) Red brass
(4) Stainless steel

PENN ALUMINUM CONDUIT & EMT
A Marmon / Berkshire Hathaway Company

1117 North Second Street - Murphysboro, IL 62966 USA - Tel: 618.684.2146 - www.pennconduit.com

ARTICLE 358 - Electrical Metallic Tubing: Type EMT

Part I identifies the scope of Article 358 covering the use, installation and construction specifications for electrical metallic tubing (EMT) and associated fittings.

It also defines EMT as an unthreaded thinwall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings.

Part II details the Installation of EMT and in 344.10 provides for Uses Permitted.

(A) Exposed and Concealed. The use of EMT shall be permitted for both exposed and concealed work for the following:
  (1) In concrete, in direct contact with the earth or in areas of severe corrosive influences where installed in accordance with 358.10(B)

  (2) In dry, damp, and wet locations

  (3) In any hazardous (classified) location as permitted by other articles in this code

(B) Corrosive Environments
  (1) Galvanized Steel and Stainless Steel EMT, Elbows, and Fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection approved as suitable for the condition.
  (2) Supplementary Protection for Aluminum EMT. Aluminum EMT shall be provided with approved supplementary corrosion protection where encased in concrete or in direct contact with the earth.

In section 358.12, the Article identifies the conditions under which EMT (Steel or Aluminum) shall not be used.

(1) Where subject to severe physical damage
(2) For the support of luminaires or other equipment except conduit bodies no larger than the largest trade size of the tubing.

DISSIMILAR METALS

Section 358.14 provides for the use of dissimilar metals when using Aluminum EMT.

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action. Aluminum fittings and enclosures shall be permitted to be used with galvanized steel EMT, and galvanized steel fittings and enclosures shall be permitted to be used with aluminum EMT where not subject to severe corrosive influences.

Stainless steel EMT shall only be used with stainless steel fittings and approved accessories, outlet boxes and enclosures.

Part III of Article 358 recognizes the Construction Specifications of EMT.

358.100 states that EMT shall be made of one of the following:

(1) Steel with protective coating
(2) Aluminum
(3) Stainless steel

ARTICLE 500 - HAZARDOUS (Classified) LOCATIONS, CLASSES I, II, III, DIVISIONS 1 AND 2

Chapter 5 of the National Electrical Code covers the requirements for electrical and electronic equipment and wiring for all voltages through detailed “Classes” and “Divisions” in Hazardous Locations in Articles 500 through 504. *(There are exceptions and additional Articles for specific or unique hazards.)*

Article 501 – Class I Locations

Locations where fire or explosion hazards may exist due to flammable gases or vapors or flammable liquids.

Part II Wiring

501.10 Wiring Methods. Wiring methods shall comply with 501.10 (A) or (B)

(A) Class I, Division 1
(1) General. In class I, Division 1 locations, the wiring method (a) through (f) shall be permitted:
(a) **Threaded rigid metal conduit (RMC)** or threaded steel intermediate metal conduit.

(B) Class I, Division 2
(1) General. In Class I, Division 2 locations, all wiring methods permitted in 501.10 (A) and the following wiring methods shall be permitted:
(1) **Rigid metal conduit (RMC)** and intermediate metal conduit (IMC) with listed threadless fittings.

Article 502 – Class II Locations

Locations where fire or explosion hazards may exist due to combustible dust.

Part II Wiring

502.10 Wiring Methods. Wiring methods shall comply with 501.10 (A) or (B)

(A) Class II, Division 1
(1) General. In Class II, Division 1 locations, the wiring methods in (1) through (5) shall be permitted:
(1) Threaded rigid metal conduit (RMC) or threaded steel intermediate metal conduit.

(B) Class II, Division 2
(1) General. In Class II, Division 2 locations, the following wiring methods shall be permitted:
(1) All wiring methods permitted in 502.10(A).
(2) **Rigid metal conduit (RMC)**, intermediate metal conduit (IMC), **electrical metallic tubing (EMT)**, dustttight wireways.

Article 503 – Class III Locations

Locations where fire or explosion hazards may exist due to ignitable fibers/flyings.

Part II. Wiring

503.10 Wiring Methods. Wiring methods shall comply with 503.10(A) or (B).

(A) Class III, Division 1
(1) General In Class III, Division 1 locations, the wiring method shall be in accordance with (1) through (5):
(1) **Rigid metal conduit (RMC)**, Type PVC conduit, Type RTRC conduit, intermediate metal conduit, **electrical metallic tubing (EMT)**, dusttight wireways, or Type MC or MI cable with listed termination fittings.

(B) Class III, Division 2
In Class III, Division 2 locations, the wiring method shall comply with 503.10(A).

Flammability

Aluminum alloys are used in numerous applications including building construction, transportation, home appliances, and offshore structures. This widespread use raises the question of ‘Will Aluminum burn?’

Aluminum, just as steel, is a non-combustible material in the form of extruded Rigid Metal Conduit or EMT. Aluminum will melt when the temperature exceeds the melting point, it does not burn. This

melting point is in the range of 1,100-1,220˚ F (600-660˚C). At these temperatures, the aluminum surface can be seen to melt, but it does not burn.

Since Rigid Metal Conduit and EMT are considered non-combustible by the building codes, they do not have fire ratings.

HEAT DISSIPATION

The thermal conductivity of Aluminum is around four times that of steel and its specific heat twice that of steel. This means that heat is conducted away faster and a greater heat input is necessary to bring the same mass of aluminum to a given temperature, compared to steel.

Where an aluminum structure is exposed to the heat of a fire, the relatively high thermal conductivity enables the heat to be rapidly conducted away from the exposed area. This helps to reduce the hot spots where significant localized property loss could occur, extending the period of service.

Resources:
UL Standards UL6, UL6A, UL797 and UL797A
ANSI Standard C80.15-2015
NEC Code 2017
Aluminum Federation, Aluminum and Fire, Fact Sheet 11

Please contact Penn Aluminum Conduit & EMT at ConduitSales@pennaluminum.com with any additional questions.