NECA 102

Standard for Installing Aluminum Rigid Metal Conduit

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(This foreword is not a part of the standard)

Foreword

National Electrical Installation Standards® are designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services. They define a minimum baseline of quality and workmanship for installing electrical products and systems. *NEIS*® are intended to be referenced in contract documents for electrical construction projects. The following language is recommended:

Aluminum rigid metal conduit (RMC) shall be installed in accordance with NECA 102, *Standard for Installing Aluminum Rigid Metal Conduit.*

Use of *NEIS* is voluntary, and the National Electrical Contractors Association assumes no obligation or liability to users of this publication. Existence of a standard shall not preclude any member or non-member of NECA from specifying or using alternate construction methods permitted by applicable regulations.

The installation and maintenance practices recommended by this publication are intended to comply with the edition of the National Electrical Code (NEC) in effect at the time of publication. It is the responsibility of users of this standard to comply with state and local electrical codes when installing electrical products and systems.

Suggestions for revisions and improvements to this standard are welcome. They should be addressed to:

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1. Scope

1.1 Products and Applications Included

This standard describes installation procedures for aluminum rigid metal conduit, including aluminum RMC with a supplementary PVC coating.

1.2 Products and Applications Excluded

This publication does not cover other types of aluminum raceways.

1.3 Regulatory and Other Requirements

a) All information in this publication is intended to conform to the National Electrical Code (ANSI/NFPA 70). Installers should always follow the NEC, applicable state and local codes, manufacturer's instructions, and contract documents when installing metallic raceway systems.

b) Only qualified persons familiar with the construction and installation of aluminum raceways should perform the work described in this publication.

c) General requirements for installing electrical products and systems are described in NECA 1-2000, *Standard Practices for Good Workmanship in Electrical Contracting* (ANSI). Other *National Electrical Installation Standards* provide additional guidance for installing particular types of electrical products and systems. A complete list of *NEIS* is provided in Annex A.

2. Definitions

Alternate corrosion protection. A coating(s), other than the standard aluminum oxide layer, that provides a superior level of corrosion resistance on the exterior of the conduit.

Bend. A curvature of the conduit made so the raceway will fit a specific geometric location. This can be a factory elbow or a field bend of the raceway.

Coupling, standard. A threaded, straight-tapped means of joining two pieces of aluminum rigid metal conduit.

Fitting, threadless. A fitting without threads that secures aluminum rigid metal conduit to another piece of equipment (threadless connector) or to an adjoining length of conduit (threadless coupling).

Primary coating. Corrosion protection coating required by the product listing standard.

Supplementary coating. A coating other than the primary coating applied to listed aluminum rigid metal conduit either at the factory or in the field to provide additional corrosion protection where needed.

3. General Product Information

3.1 Product Description

NEC 344.10 permits aluminum rigid metal conduit (RMC) to be installed in all environments. It has no temperature limitations and can be used indoors, outdoors, underground, concealed or exposed. Aluminum RMC with supplemental protective coatings may have temperature or other limitations; consult manufacturers' listings and markings. *(NOTE: For installation in concrete or directly buried in soil, supplementary corrosion protection is required. See 4.7.)*

3.1.1 Trade Sizes

Aluminum RMC is a listed threaded metal raceway of circular cross-section, that comes with a factory-installed threaded coupling on one end. The nominal finished length with coupling is 10 feet.

Aluminum RMC is available in trade sizes 1/2 through 6. Threaded ends are covered by color-coded thread protectors, which also aid in size recognition:

- BLUE thread protectors: "full inch" trade sizes 1, 2, 3, 4, 5, 6.
- BLACK thread protectors: "half inch" trade sizes 1/2, 1-1/2, 2-1/2, 3-1/2.
- RED thread protectors: "quarter inch" trade sizes 3/4, 1-1/4.

(See Table 1 for Metric Trade Size Designators.)

3.1.2 Materials

Aluminum RMC has a protective coating of aluminum oxide. This oxide layer protects the conduit and its contents from a variety of corrosive factors, such as the outdoor environment and corrosive chemicals. Other types of supplemental coatings may be applied where additional corrosion protection is required. *(NOTE: Contact manufacturers with product-specific questions).*

Aluminum RMC is manufactured with a PVC coating for installation in highly corrosive atmospheres. See section 7 for special installation practices and tools required when working with PVC-coated conduit.

3.2 Manufactured Elbows

a) Elbows are bent sections of conduit, threaded on each end. Factory-made elbows in both standard and special radius are readily available for all sizes of aluminum rigid RMC. Elbows with integral couplings are available in trade sizes 1/2 through 4.

b) Physical dimensions of factory-made elbows for aluminum rigid metal conduit vary from one manufacturer to the next. To avoid problems, always measure carefully when roughing-in conduit runs. When ordering aluminum RMC factory elbows, it is necessary to specify the manufacturer, trade size, and angle of bend.

c) Special large-radius elbows (often referred to as "sweeps") can be custom-ordered. They are used to solve particular installation problems such as easier wire pulling, installing conduit in limited or geometrically difficult spaces, providing a specific stub-up length, or enhancing protection of communications or fiber optic cables during pulls.

3.3 Nipples

Factory-made aluminum rigid metal conduit nipples are threaded on both ends. Listed nipples are available in all trade sizes, in lengths up to 24 inches.

3.4 Couplings

Factory-made couplings for aluminum RMC are available in all trade sizes. Integral couplings are available on trade sizes 1/2 through 4. These integral couplings permit joints to be made up by turning the outside coupling rather than the conduit.

3.5 PVC-Coated Aluminum Rigid Conduit

This product is described in Section 7, along with special installation practices.

4. General Installation Practices

4.1 Cutting and Threading Aluminum RMC

(NOTE: Although coupling threads are straight-tapped, conduit threads are tapered.)

4.1.1 Cutting Aluminum RMC

a) Cut the conduit to length with a saw or roll cutter. Be careful to make a straight cut or the die will cut crooked threads.

b) To cut conduit using a wheel-and-roll cutter, revolve the cutter completely around the pipe (Figure 1). Tighten the handle about one-quarter turn after each rotation and repeat this procedure until the conduit is cut through.

c) After cutting, ream the interior and remove sharp edges from the exterior (Figure 2). *(NOTE: Reaming the conduit after threading will stretch or oval the end of the conduit.)*

4.1.2 Setting Up the Dies

Perform field threading in accordance with the following procedures, unless manufacturer's instructions differ. Follow the manufacturer's operating and safety instructions when operating threading equipment.

a) Use a standard National Pipe Thread (NPT) die with a taper of 3/4 inch per foot, as defined in ANSI/ASME B120.1.

b) Dies must be sharp to produce full, clean threads; worn dies produce ragged, torn threads, or threads which are not cut deep enough.

c) To adjust dies, loosen the screws or locking collar that hold the cutting dies in the head. When the screws or collar are loosened, the dies should move freely away from the head.

d) Screw the die head onto the threaded portion of a factory-threaded nipple or factory-threaded conduit until the die fits the factory thread (Figure 3). If the die head has an adjusting lever, set the head to cut a slightly oversized thread.

(NOTE: This is ordinarily one thread short of being flush with the face of a thread gauge, when the gauge is hand tight. This is within the tolerance limits which allow the thread to be one thread short or long of being flush with the gauge face.)

e) Tighten the screws or locking collar so that the dies are tightly held in the head.

f) Remove the set-up piece of threaded conduit. The die is ready for use.

4.1.3 Threading Aluminum RMC

a) To start a universal die head, press it against the conduit end with one hand and turn the stock with the other. With a drop head die, the stock remains stationary and the head rotates. After the dies have engaged for a thread or two, they will feed along the conduit without pressure.

b) Stop the cutting as soon as the die has taken hold and apply thread cutting oil freely to the dies and the area to be threaded. Keeping dies flooded with a good grade of cutting oil lubricates the conduit and produces smoother threads by reducing friction and heat. Using insufficient cutting oil can cause ragged threads.

c) Cut one thread short of the end of the chaser.

d) Back the die head off and clean the chips from the thread, using a brass brush (Figure 4). Do not use brushes with steel bristles on aluminum conduit threads.

4.2 Bending Aluminum RMC

While many sizes of factory elbows are manufactured, the variety of electrical installations makes field-bending necessary. Make bends after conduit is threaded.

4.2.1 General Information

a) Follow the bender manufacturer's operating and safety instructions when operating equipment. The bender, its components, and accessories must be matched to the conduit type and size being bent because of the forces being applied. When using a power bender, make sure that pins are in the proper pin holes for the size of conduit being bent.

b) Accurately measure and mark the conduit with a thin line that goes completely around the conduit. This assures the mark is visible if the conduit needs to be rotated.

c) Make radius measurements to the centerline of the bend.

d) Slight overbending may be necessary to compensate for springback.

e) Trade sizes 1/2, 3/4, and 1 can be bent with a hand-type bender. Trade sizes 1-1/4 and 1-1/2 require a power bender or a mechanical ratchet-type bender. Bend trade sizes 2 and larger on a power bender. (*NOTE: Benders recommended for a larger size range may also be capable of bending some sizes below their primary range.)*

f) Do not place ends of aluminum RMC in the hook or bending shoe of the bender, because thread damage and end-flattening will occur.

4.2.2 Using Hand Benders

a) Some hand benders do not have degree markings. Degrees of bend must be measured on the inner surface of the conduit that fits into the groove of the bender.

b) When using a hand bender, choose a solid, flat surface. Pin the conduit firmly to the surface with steady foot pressure sufficient to keep the conduit and bender marks aligned, and the conduit nestled in the groove, throughout the full arc of the bend (Figure 5).

4.2.3 Using EMT Benders

Aluminum RMC can often be bent using benders designed for electrical metallic tubing (EMT). If the manufacturer's instructions do not prohibit using the equipment with aluminum RMC, use an EMT shoe one trade size larger than the conduit to be bent (to bend trade size 3/4 PVC-coated aluminum RMC, use a trade size 1 EMT bender). This produces a slightly larger radius than using a bender designed for rigid metal conduit.

4.3 Joining Aluminum RMC with Integral Couplings

a) Make up couplings hand-tight, and then tighten them with wrenches once it is certain that threads are properly engaged. Wrench-tightening should not exceed three additional threads. *(NOTE: Never use extension handles on a wrench to make up a tight joint. ONLY use extension handles to dismantle a stubborn joint in an existing conduit installation.)*

b) A simple rule regarding the use of tools is to select the right type and the right size. Table 2 specifies the proper size wrench for each conduit size trade.

c) Apply a conductive coating to field-cut threads to ensure continuity and ease of joining. *(NOTE: Two commonly-used brands are Noalox and Kopr-Shield.)*

4.4 Installing Fittings on Aluminum Rigid Metal Conduit

Before installing a fitting on aluminum RMC, review the packaging labels or manufacturer's literature to ensure that the fitting is listed for this use.

4.4.1 Threaded Fittings

a) Avoid excessive force when tightening threaded fittings, both between conduits and at threaded box entries. Generally, the correct force is hand-tight plus one full turn with a wrench. At least three full threads should be engaged.

b) Conduit bodies typically have an integral bushing that provides a smooth surface for conductors when pulled. This bushing is not a conduit end-stop. It isn't necessary that aluminum RMC be inserted flush against this bushing to assure a secure joint.

c) Do not use conduit bushings to secure threaded aluminum RMC to a box or enclosure. Always install a locknut between a conduit bushing and the inside of the box or enclosure.

4.4.2 Threadless Fittings

a) Threadless fittings intended for use in wet locations are marked "Raintight" or "Wet locations" on the fitting or its smallest unit shipping container. Many raintight fitting designs come with a gasket or sealing ring that must be installed between the fitting and a box.

b) Threadless fittings intended for use in industrial settings involving sprayed mineral oils and coolants are marked "Liquidtight" on the fitting or its smallest unit shipping container.

c) Threadless fittings must not be used with threaded aluminum RMC unless specifically permitted by the fitting manufacturer. Follow these instructions to install threadless fittings on aluminum RMC:

1) The end of the conduit must be cut squarely, be free of internal and external burrs, and have a circular cross-section.

2) The end of the conduit to be inserted into the fitting must be free from dirt, grease, or other foreign matter.

3) The end of the conduit must be inserted against the threadless fitting's end stop.

4.4.3 Expansion Fittings

a) Install expansion fittings in runs of aluminum RMC where significant temperature differentials are anticipated. When conduit is installed as long outdoor spans, the direct heat of the sun coupled with significant temperature drops at night create a need to use expansion fittings.

b) Table 3 shows length changes for Rigid Aluminum Conduit at selected temperature differentials. Degree-feet are the length of the conduit run in feet multiplied by the temperature rise in degrees Fahrenheit (F°). A good general rule is to use an expansion joint whenever the degree-feet of a conduit run exceeds 10,000.

c) See 5.2 for bonding considerations.

4.4.4 Attaching Aluminum RMC to Boxes and Enclosures

Properly align the conduits, fittings, and knockouts to provide secure mechanical and electrical connections. Allow sufficient conduit length to complete engagement of the conduit and fittings at entries to boxes and enclosures.

4.5 Supporting Aluminum Rigid Metal Conduit

a) Support and securely fasten aluminum RMC in place in accordance with NEC requirements. In general, aluminum RMC must be securely fastened at least every 10 feet, and within 3 feet of boxes, enclosures, and other conduit terminations. The following supporting and fastening methods are recommended:

b) *Masonry surfaces, plaster, drywall or wood framing members:* One-hole straps, two-hole straps, conduit hangers, or similar products intended for the purpose, securely fastened with appropriate hardware. Aluminum RMC in trade sizes 1/2 through 1 is permitted to be supported by nail-straps in wood framing members.

c) *Raceways mounted on metal framing members:* One-hole straps, two-hole straps, conduit hangers or similar products intended for the purpose, fastened with metal screws or rivets. When using clamp-on supports that are not of the hammer-on or press-on type, add screws, rivets, beam clamps, or similar means for extra support.

d) *Openings in metal or wood studs:* These openings can be used to support aluminum RMC where they are no more than 10 feet apart. Fasten conduits at all termination points. Where a conduit transitions to vertical (for example, to run up to a switch box), secure it to the stud and within 3 feet of the termination.

e) *Raceways suspended below ceilings; or suspended from structural members such as beams, columns, or purlins:* Use lay-in pipe hangers supported by threaded rod which is fastened in place by beam clamps or similar devices. Strut-type channel can also be used.

f) *Suspended (dropped) ceiling cavities:* In cavities above fire-rated suspended ceilings, conduits cannot be supported by the ceiling system wires unless tested as part of the fire-rated assembly. The conduit installer must provide a separate support system, identified for supporting raceways, and these conduit support wires must be secured at both ends. In cavities above non-fire-rated ceilings, the ceiling system wires can be used to support aluminum RMC when this is permitted by the manufacturer's instructions.

g) *Groups of raceways:* Mount on strut-type channels, and secure in place with strut-type channel straps identified for the particular channel and raceway type. Channels must be fastened in place by means suitable to the mounting surface.

h) *New concrete pours:* Place approved channel inserts into the concrete pour. Aluminum RMC will be mounted to the channels later in the construction process.

i) *Structural steel members:* Where aluminum RMC is mounted inside the web of I-beams, column-mount supports can be used to support the conduit.

4.6 Firestopping and Fireblocking

4.6.1 Penetrating Fire-Rated Walls, Floors, and Ceilings

Aluminum rigid metal conduit is noncombustible. Use listed firestopping systems to fill the penetrations through fire-rated partitions around the raceways, when required by building codes or the project specifications.

4.6.2 Penetrating Non-Fire-Rated Partitions

Fill openings in non-fire-rated assemblies with noncombustible materials, to prevent unwanted passage of air and sound. This is called fireblocking. Listed firestopping systems are not required for non-fire-rated partitions unless specified by building codes or the project specifications.

4.6.3 Thermal Protection of Aluminum RMC Used for Emergency Circuits

a) The National Electrical Code requires special fire protection for branch circuits supplying emergency systems and fire-pumps. Aluminum raceways withstand fire; however, ordinary conductor insulation melts when exposed to elevated temperatures.

b) Methods of thermal protection include putting the raceways in a fire-rated enclosure (horizontal or vertical), using a listed wrap system for protection from fire (sometimes called Electrical Circuit Protection System or Thermal Barrier Protection for Electrical Components), and using conductors specifically rated to maintain the circuit.

c) Fire protection wraps can affect the temperature of the conductors, and conductor ampacity may need to be derated It is also important to determine that the support system is protected and will withstand the fire exposure.

d) The NEC does not require these thermal protection methods where conduit is installed in buildings with full sprinkler protection. Consult local codes or the authority having jurisdiction to determine if there are other applicable building code requirements.

4.7 Corrosion Protection for Special Applications

4.7.1 Direct Burial

When aluminum rigid metal conduit is installed in soil, apply supplementary corrosion protection such as bitumastic (asphaltic) paint or tape wrap.

4.7.2 In Concrete

Where installed in concrete slabs, aluminum RMC and associated fittings require supplementary corrosion protection. Examples of protection include bitumastic paint and tape wrap. See the conduit manufacturer's guide for corrosion protection recommendations.

4.7.3 Supplementary Protection Methods

Where supplementary corrosion protection is required, use one of the following methods. The authority having jurisdiction must pre-approve the method selected.

a) Coatings approved for the purpose, such as bitumastic paint. Apply paint in two coats unless specifically approved for one coat.

b) Tape wraps approved for application. Wraps must overlap to cover the entire surface of the aluminum rigid metal conduit and all associated fittings.

5. Grounding

Aluminum rigid metal conduit is recognized by NEC 250.118 as an equipment grounding conductor. Raceways must be installed with secure joints to provide both mechanical and electrical continuity.

Threads must be free of corrosion and impurities to insure electrical continuity of the assembled conduit system. Leave plastic thread protectors on the conduit until installation. Wipe field-cut threads with a clean cloth to remove excess oil, prior to screwing conduits and fittings together.

NEC 250.97 requires that raceways containing feeders and branch circuits operating over 250 volts to ground be bonded. Do one or more of the following:

1. Use listed fittings.

2. Use two locknuts one inside and one outside of boxes and cabinets.

3. Use fittings with shoulders that seat firmly against the box or cabinet, with one locknut on the inside of boxes and cabinets.

4. Remove paint in locknut areas to assure a continuous ground path. Repaint or cover any exposed area after installation is completed.

5.1 Bonding Service Raceways

When aluminum rigid metal conduit is installed as a service raceway terminating at service equipment, the NEC requires special considerations.

NEC 250.97 does not permit 5. standard locknuts to be used on raceways containing 480Y/277-volt conductors, when the raceway is terminated at concentric or eccentric knockouts.

5.2 Expansion Fittings

Expansion fittings used with aluminum RMC must be listed for grounding, and shall be made electrically continuous by having equipment bonding jumpers installed around them.

6. Specific Installation Requirements

6.1 All Raceways

a) Install all exposed conduits parallel or perpendicular to walls and ceilings, where possible.

b) The minimum size of home run conduits concealed by building finishes should be trade size 3/4. This does not apply to conduits installed in suspended ceiling cavities.

c) The minimum size raceways in industrial occupancies should be trade size 3/4. Raceways for control wiring may be trade size 1/2.

d) All conductors, neutrals, and equipment grounding conductors of the same circuit must be contained within the same raceway. *(NOTE: This is extremely important in alternating current applications.)*

e) The raceway system must be installed complete, including tightening of joints, from termination point to termination point, prior to the installation of conductors.

6.2 Conduits for Communications Circuits

a) Conduits for low voltage or communications circuits shall terminate in boxes, enclosures, or wireways, except as permitted in (c) below.

b) When spare conduits are installed for future use, install pull wires and plug the conduits to prevent the entrance of debris.

c) Stub raceways for communications circuits are permitted in suspended ceiling cavities, basements, or similar utility spaces, rather than running conduits unbroken from outlet to outlet. When installing stub-ins, provide a connector,

bushing, or other fitting at the end of the conduit to protect cable insulation from abrasion. Install pull wires and plug the conduits.

6.3 Verifying the Installation

All aluminum rigid metal conduit systems must be electrically continuous, to provide a grounding path as described in Section 5. Continuity tests can be conducted after installation of all conduits, boxes, and fittings, are permitted; they shall be made between the service panel (or other distribution equipment) and the last outlet in each branch circuit.

7. PVC-Coated Aluminum Rigid Metal Conduit (RMC)

PVC-coated aluminum RMC is generally installed as a system, using fittings, supports, boxes, and conduit bodies that are also PVC-coated. Follow manufacturers' instructions when installing PVC-coated products and systems.

7.1 Tools

To minimize installation damage to PVC coatings, use tools specially designed for PVC-coated conduit or standard tools that have been appropriately modified for installing PVC-coated conduit. Standard tools that have not been modified could damage the coatings and shall not be used to install PVC-coated conduit. For repairing damage to PVC coatings, see 7.6.

7.2 Clamping (Vising) PVC-Coated Conduit

Some manufacturers offer modified jaws for use in standard vises to protect the coating. When using either a "jaw type" or a "chain type" vise, the PVC-coated conduit can also be protected by half-shell clamps. These are available as a manufactured clamp or can be made in the field from aluminum rigid metal conduit as describe in 7.2.1.

7.2.1 Clamping Sleeves Made from Aluminum RMC

a) Cut two 6-inch pieces of standard (non-PVC) aluminum rigid metal conduit, one trade size larger than the PVC-coated conduit to be clamped.

b) Use a band saw to cut each 6-inch conduit sections lengthwise. Make the cut slightly off-center. This creates two half shells from each 6-inch piece of conduit, one smaller than the other. Discard the larger pieces.

c) Remove burrs from sharp edges of the two smaller pieces. Use these field-fabricated half-shell clamps to protect PVC-coated conduit in the vise. Properly-made clamping sleeves will have a gap between the two pieces when positioned on the conduit.

d) *Alternate protection method:* Where tools necessary to make half-shell clamps are not available, protect the PVC coating in the vise by wrapping the area to be clamped with sandpaper, emery cloth, or cardboard. The coarse side of emery cloth or sandpaper should face the PVC coating. *(NOTE: This is the least desirable method and should be avoided by planning ahead.)*

7.3 Cutting and Threading PVC-Co ated Conduit

Follow manufacturers' instructions when cutting and threading PVC-coated aluminum RMC. The following provides general guidance.

7.3.1 Cutting and Reaming

Cutting with a hacksaw or bandsaw is the preferred method. However, a roller cutter is acceptable if the following precautions are followed:

a) Do not use rotating machines with jaws that cut through the PVC coating.

b) Long strips of metal or PVC from the threading can foul the die head and collapse the conduit. To avoid this and permit removal of the PVC coating in small pieces, make a series of knife cuts along the conduit, through the PVC coating, in the area to be threaded. The thread protector can be used as a length guide.

c) Following the cutting operation, use a reamer to remove rough edges.

7.3.2 Threading (manual and motorized)

a) If PVC-coated conduit is cut with a hacksaw or band saw, and a hand threader is used, trim the coating with a knife at an angle all the way around the conduit before threading. This is sometimes called a pencil cut or bevel cut; it enables the die teeth on the threader to engage the conduit. Follow the instructions in 7.2.1 for clamping PVC-coated aluminum RMC, and ensure that conduit is securely held in the vise.

b) A standard threading die head must be modified (machined) for use with PVC-coated conduit. To make this modification, bore the guide sleeve to allow the coated conduit to enter the die. The inside diameter must be increased by 110 mils (0.11 inch).

c) *IMPORTANT:* Do not remove PVC coating from aluminum RMC to allow use of standard non-machined die heads.

7.4 Bending PVC-Coated Aluminum Rigid Metal Conduit

Manufactured elbows are available in a variety of radii. For field-bending, do the following:

7.4.1 Hand-bending Small Conduit Sizes

To bend PVC-coated conduit, use an EMT bender one trade size larger than the conduit being bent. This is to avoid damaging the coating. For example, to bend trade size 3/4 PVC-coated conduit, use a trade size 1 EMT bender.

7.4.2 Power Bending

a) A bender made specifically to bend PVC-coated rigid metal conduit is preferred. Otherwise, for trade sizes 1 2 through 1-1/2, use an electric bender with EMT shoes one size larger than the PVC-coated conduit .

b) Do not use lubricant on bending shoes.

c) Trade sizes 2 and larger should be bent using a hydraulic bender.

7.4.3 Hydraulic Benders

a) Most manufacturers of hydraulic benders offer special shoes for PVC-coated conduit. Use these special shoes when possible.

b) Regular shoes can be used if modified to allow for the coating thickness. Some installers do this by grinding or milling the sides. *(NOTE: This approach is not recommended as it can create a safety hazard.)*

7.5 Installing PVC-Coated Aluminum Rigid Metal Conduit

7.5.1 Pipe Wrenches and Pliers

a) PVC-coated conduit requires special wrenches to protect the coating. Pipe wrenches specially designed with fine teeth are available for use with PVC-coated conduit. Strap wrenches can also be used. Slip-joint pliers of the Channel-Lock™ type, specially equipped with wide jaws, are also available to protect the coating.

b) Wrench sizes for PVC-coated conduit are the same as with conventional aluminum RMC. However, wrench jaws must be specially designed for use with PVC-coated conduit. If these special wrenches are not available, use a strap wrench instead, to avoid damaging the conduit.

c) Do not use ordinary slip-joint pliers or standard pipe wrenches with PVC-coated aluminum rigid metal conduit.

7.5.2 PVC Sleeves on Couplings and Fittings

a) Sleeves are provided on PVC-coated aluminum RMC couplings and fittings, to insure continuous coating. Sleeves must not be cut off or split. Trimming is permitted where the length of the sleeve exceeds the available space. In cases where two sleeves meet, trim each sleeve trim equally so the two sleeves butt together.

b) To make sleeves softer in cold weather applications, soak the coupling or fitting in warm water.

c) To make installation easier, apply silicon spray to the inside of the sleeve.

7.5.3 Threadless Fittings

Threadless fittings must not be used with PVC-coated aluminum rigid metal conduit.

7.5.4 Thread Engagement

a) Apply a conductive coating to field-cut threads to ensure continuity and ease of joining. *(NOTE: Two commonly-used brands are Noalox and Kopr-Shield.)*

b) Since conduit and coupling threads are not visible because they are covered by PVC sleeves, take extra care when assembling raceways and fittings to be sure that the threads are fully engaged and made up wrench-tight.

7.6 Patching Damaged Areas of PVC Coatings

Even when following recommended practices, the protective PVC coating is sometimes damaged during conduit installation. This destroys the corrosion protection. Patch damaged areas using touch-up compound in accordance with the raceway manufacturer's instructions.

7.7 Equipment Grounding and Bonding with PVC-Coated Conduit

General considerations for grounding and bonding are covered in Section 5. When expansion joints are installed in PVC-coated conduit systems, it is recommended that an external bonding jumper be used to maintain mechanical and electrical continuity.

Generally, this requires removing a portion of the PVC coating from the conduit where the jumper will be attached, installing the jumper, then repairing the surrounding PVC coating as described in 7.6.

Table 1: Metric Trade Size Designators For Rigid Aluminum Conduit

English	Metric
½	16
¾	21
1	27
1 ¼	35
1 ½	41
2	53
2 ½	63
3	78
3 ½	91
4	103
5	129
6	155

Table 2: Proper Wrench Sizes for Installing Aluminum Rigid Metal Conduit

Conduit Trade Size	Wrench Size
½	12”
¾ through 1 ¼	14”
1 ½	18”
2 – 2 ½	24”
3 – 4	36”
5-6	48”

Table 3: Expansion Characteristics of Aluminum Rigid Metal Conduit

Coefficient of Thermal Expansion = 13.0 x 10^{-6} in/in/°F

Temperature Change in Degrees F	*Length Change* In Inches per 100 feet of Aluminum Conduit	Temperature Change in Degrees F	*Length Change* In Inches per 100 feet of Aluminum Conduit	Temperature Change in Degrees F	*Length Change* In Inches per 100 feet of Aluminum Conduit	Temperature Change in Degrees F	*Length Change* In Inches per 100 feet of Aluminum Conduit
5	0.08	55	0.86	105	1.64	155	2.42

10	0.16	60	0.94	110	1.72	160	2.50
15	0.23	65	1.01	115	1.79	165	2.57
20	0.31	70	1.09	120	1.87	170	2.65
25	0.39	75	1.17	125	1.95	175	2.73
30	0.47	80	1.25	130	2.03	180	2.81
35	0.55	85	1.33	135	2.11	185	2.89
40	0.62	90	1.40	140	2.18	190	2.96
45	0.70	95	1.48	145	2.26	195	3.04
50	0.78	100	1.56	150	2.34	200	3.12

Figure 1: Cutting Aluminum RMC with a Roll Cutter

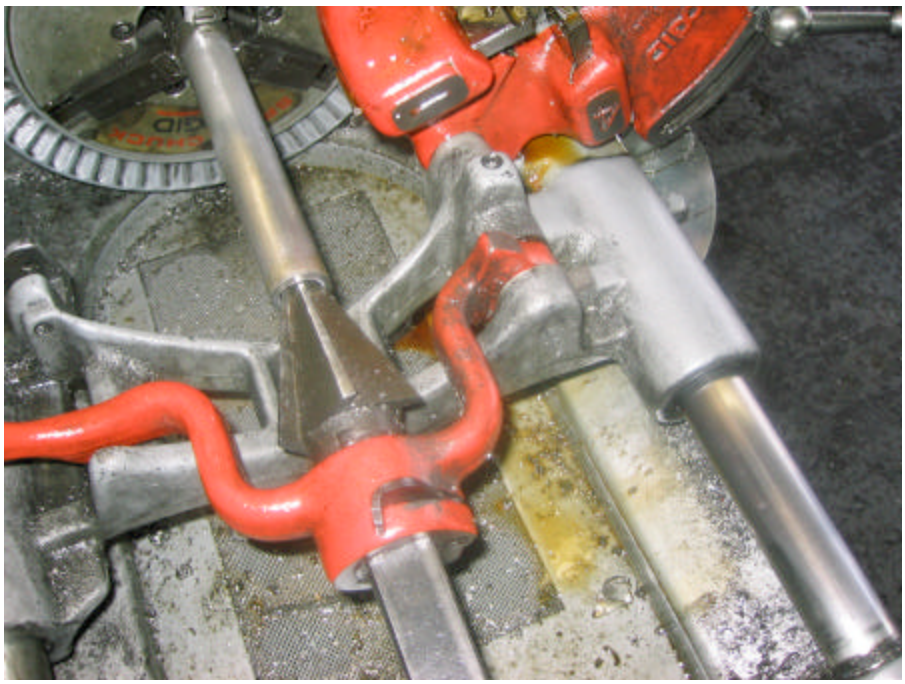

Figure 2: Reaming Freshly-Cut Aluminum RMC

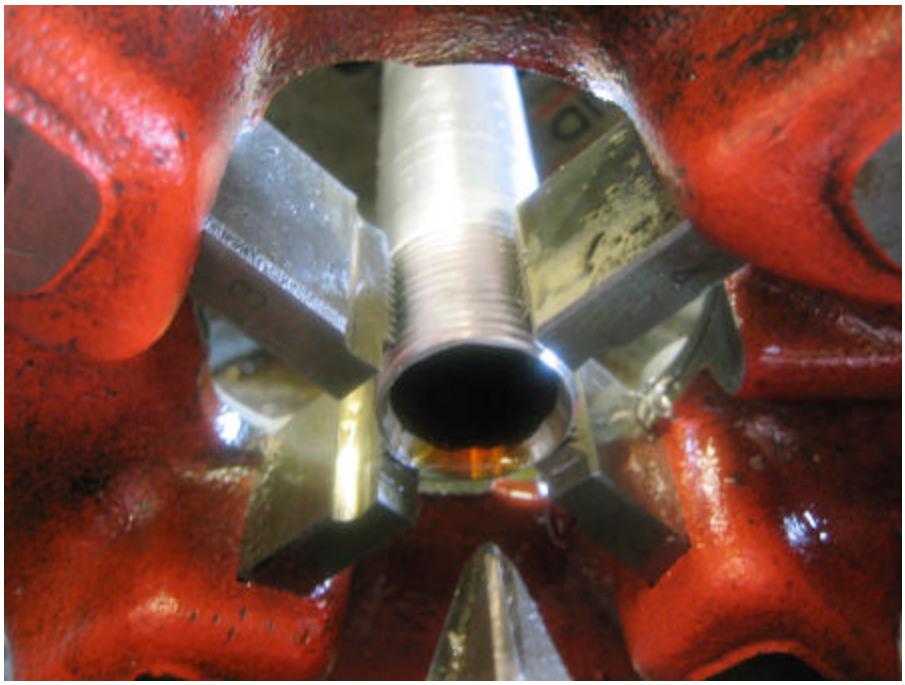

Figure 3: Setting Up Dies to Thread Aluminum RMC

Figure 4: Brushing Chips from the Threads of Aluminum RMC

Figure 5: Using a Hand Bender with Aluminum RMC

(This annex is not a part of the standard)

Annex A: Reference Standards

This publication, when used in conjunction with the National Electrical Code and manufacturers' literature, provides sufficient information to install nonmetallic raceways. The following publications may also provide useful information:

National Fire Protection Association
Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
(617) 770-3000 tel
(617) 770-3500 fax
www.nfpa.org

ANSI/NFPA 70-2002, *National Electrical Code*

American Society of Mechanical Engineers
345 East 47th Street
New York, NY
(800) 843-2763 tel
(973) 882-1717 fax
www.asme.org

ANSI/ASME B 120.1-1983, *Standard for Pipe Threads*

National Electrical Contractors Association
3 Bethesda Metro Center Suite 1100
Bethesda, MD 20814
(301) 215-4504
(301) 215-4500 Fax
orderdesk@necanet.org
www.neca-neis.org

Current *National Electrical Installation Standards*® Published by NECA

NECA 1-2000, *Standard Practices for Good Workmanship in Electrical Contracting* (ANSI)

NECA 100-1999, *Symbols for Electrical Construction Drawings* (ANSI)

NECA 101-2001, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*

NECA/NEMA 105-2002, *Recommended Practice for Installing Metal Cable Trays* (ANSI)

NECA 111-2003, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* (ANSI)

NECA 104-2000, *Recommended Practice for Installing Aluminum Building Wire and Cable* (ANSI)

NECA 202-2001, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* (ANSI)

NECA 230-2003, Standard for Selecting, Installing, and Maintaining Electric Motors and Motor Controllers (ANSI)

NECA/FOA 301-1997, *Standard for Installing and Testing Fiber Optic Cables*

NECA 305-2001, *Standard for Fire Alarm Systems Job Practices* (ANSI)

NECA 400-1998, *Recommended Practice for Installing and Maintaining Switchboards* (ANSI)

NECA 402-2001, *Recommended Practice for Installing and Maintaining Motor Control Centers* (ANSI)

NECA/EGSA 404-2000, *Recommended Practice for Installing Generator Sets* (ANSI)

NECA 405-2001, *Recommended Practice for Installing and Commissioning Interconnected Generation Systems* (ANSI)

NECA 406-2003, *Recommended Practice for Installing Residential Generator Sets* (ANSI)

NECA 407-2002, *Recommended Practice for Installing and Maintaining Panelboards* (ANSI)

NECA/IESNA 500-1998, *Recommended Practice for Installing Indoor Commercial Lighting Systems* (ANSI)

NECA/IESNA 501-2000, *Recommended Practice for Installing Exterior Lighting* Systems (ANSI)

NECA/IESNA 502-1999, *Recommended Practice for Installing Industrial Lighting Systems* (ANSI)

NECA/BICSI 568-2001, *Standard for Installing Commercial Building Telecommunications Cabling* (ANSI)

NECA/MACSCB 600-2003, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* (ANSI)