Specific Advantages of using Steel Conduit vs PVC conduit
(Ưu điểm sử dụng ống thép luồn dây điện so với ống PVC)

(Published by www.steelconduit.org)

• Physical protection of conductors (Bảo vệ tốt cáp điện-dây dẫn điện)
• Minimize fire problems due to Aged Electrical Wiring Systems
(Chống cháy tốt do hệ thống cáp điện/ dây điện lão hóa theo thời gian)
• Added security and protection (Tăng tính bảo mật & bảo vệ)
• EMI shielding (Chống nhiễu điện từ)
• Non-combustibility
(Không cháy và không tạo khí độc khi cháy như ống luồn PVC. Ở Việt nam, đa số vụ cháy nhà cao tầng gây nhiều tử vong là do ngạt khí độc xuất hiện trong lúc cháy)
• Recyclablility (Green Building)
(Có khả năng tái chế và thân thiện môi trường xanh)
• Proven equipment grounding conductor (Có thể dùng chôn dưới đất)
• Adaptable to future wiring changes
(Để thay đổi hệ thống đi dây dẫn điện trong tương lai)
• High tensile strength (Chỉ được va đập cao)
• Competitive life-cycle costs (Chi phí cho vòng đời sử dụng thấp)
• Coefficient of expansion compatible with common building materials
(Hệ số dẫn nóng thép phù hợp sử dụng với vật liệu xây dựng thông dụng)
• Chemically compatible with concrete
(Tương tích với các hóa chất trong bê tông)
Most Frequently Asked Questions About Steel Conduit

(Published by www.steelconduit.org)

1. What are the differences between electrical metallic tubing (EMT), rigid steel conduit (RSC), and intermediate metal conduit (IMC)? Answer
2. What National Electrical Code® (NEC®) Articles cover IMC, RSC, and EMT? Answer
3. What Standards apply to steel conduit/tubing? Answer
4. Can RSC, IMC and EMT be direct-buried? Answer
5. Can steel raceways be installed underground as a watertight system? Answer
6. Can RMC, IMC and EMT be installed in concrete? Answer
7. Do RSC, IMC and EMT comply with the requirements of NFPA 130? Answer
8. What is the coefficient of expansion for steel conduit/EMT and why is this significant? Answer
9. What are the metric designators for steel conduit/EMT? Answer
10. What is the fire rating of steel conduit/EMT? Answer
11. Can IMC be used as a service mast? Answer
12. Does IMC provide as much physical protection as rigid? Answer
13. How do you thread IMC? Answer
14. What type of threads are cut on RSC and IMC? Answer
15. How can field-cut threads be protected against corrosion? Answer
16. Does RSC conform to IEC standards? Answer
17. Is RSC the same as schedule 40 pipe? Answer
18. Can EMT be used over 600 volts? Answer
19. Can steel conduit/tubing be used as equipment grounding conductors or do you have to use a supplementary conductor? Answer
20. Does steel conduit/tubing shield against electromagnetic interference (EMI)? Answer
21. What are the advantages of using steel conduit/tubing? Answer
22. Can EMT be used on roof-tops? Answer
23. Are special EMT fittings required for use in wet locations? Answer
24. What is the recycled content of steel conduit/tubing? Can I get LEED points for using these products in my project? Answer

1. The Steel Tube Institute Guidelines for Installing Steel Conduit/Tubing General Product Information addresses this question. Click here to link to the section containing a downloadable pdf file.

2. Raceway Articles were renumbered in the 2002 NEC®. The following list shows the Article numbers that apply to IMC, RSC, and EMT, followed by the former Article number in parentheses.

IMC NEC® Article 342 (345)
RMC NEC® Article 344 (346) Article 344 covers Rigid Metal Conduit (RMC), including rigid steel conduit (RSC).
EMT NEC® Article 358 (348)

3. The following standards cover steel conduit/tubing. The American Society for Testing Materials (ASTM) does not publish a standard whose scope specifically covers steel electrical conduit and couplings. Therefore, ASTM specifications do not apply to metal conduit for use as a metal raceway for the installation of wires and cables in accordance with the National Electrical Code®.

Electrical Metallic Tubing (EMT) is Listed to Standard for Electrical Metallic Tubing - Steel, UL 797 and produced to American National Standards Institute - ANSI C80.3

Rigid Steel Conduit - Steel (RSC) is Listed to Standard for Electrical Rigid Metal Conduit - Steel, UL 6 and produced to American National Standards Institute - ANSI C80.1
**Intermediate Metal Conduit - Steel (IMC)** is Listed to Standard for Electrical Intermediate Metal Conduit - Steel, UL 1242 and produced to American National Standards Institute - ANSI C80.6.

Additional information on the titles and designations of standards or requirements that have been used for the investigation of products in a specific category can be found in the Underwriters Laboratories Inc., General Information for Electrical Equipment Directory. The UL product category for EMT is FJMX, for RSC is DYIX, and for IMC is DYBY.

The Federal government, in an effort to reduce costs, has undertaken a process of identifying non-government and industry wide practices that have been accepted previously by the Department of Defense under the Single Process Initiative (SPI) for use in lieu of a specific military or Federal Specification or standard. This process reduces the burden of the government to product and maintain separate standards. To this end WW-C-581 standards which covered both Rigid Steel Conduit and Intermediate Metal Conduit, were cancelled and replaced by:

- WW-C-581 Class 1 Type A with Standard for Electrical Rigid Metal Conduit - Steel, UL 6
- WW-C-581 Class 2 Type A with Standard for Electrical Intermediate Metal Conduit - Steel, UL 1242

4. The 2005 National Electrical Code (NEC) allows the direct burial of all three products as noted in their respective Articles:

**RSC Section 344.10 (B) Corrosion Environments.** "RMC, elbows, couplings, 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 and judged suitable for the condition."

**IMC Section 342.10 (B) Corrosion Environments.** "IMC, elbows, couplings, 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 and judged suitable for the condition."

**EMT Section 358.10 (B) Corrosion Protection.** "Ferrous or nonferrous EMT, elbows, couplings, 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 and judged suitable for the condition."

RSC, IMC and EMT are all "protected by corrosion protection" due to the zinc coating that is applied during the manufacturing process. However, in severe corrosive environments, the designer or AHJ may decide to require additional or supplementary protection.

Underwriters Laboratories' Electrical Construction Equipment Directory contains information relating to limitations or special conditions applying to products listed by UL. The Directory states that RSC and IMC do not generally require supplementary corrosion protection when installed in soil unless: 1. Soil resistivity is less than 2000 ohm-centimeters. 2. Local experience has confirmed that the soil is extremely corrosive.

(Note: Soils producing severe corrosive effects have low electrical resistivity, expressed in ohm-centimeters. Local electric utilities commonly measure the resistivity of soils. The authority having jurisdiction (AHJ) has the authority to determine the necessity for additional protection.)

EMT in direct contact with the soil generally requires supplementary corrosion protection. However, local experience in some areas of the country has shown this to be unnecessary.

5. The National Electrical Code® considers all underground installations a "wet location".

2005 NEC®, Article 100 defines a wet location as follows:

**Wet Location.** Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as vehicle washing areas, and locations exposed to weather and
No raceway system is really "watertight", including those that are glued or have sealed joints. Normally raceways will collect condensation. The raceway is designed to allow this moisture to drain out. It is understandable that in some cases where the ground does not percolate well, the water will also seep in. This is why the conductors installed must be of a type approved for wet locations i.e. THWN or XHHW.

If the presence of water is a problem, one of the following steps may help: 1. Install a typical Quazite(TM) concrete-polymer underground open bottom junction box over a gravel sump. This can be done by excavating a hole approximately 3' X 3; filling it with 1 to 2 inch gravel and placing the Quazite(TM) box flush with the ground prior to entering the building, or at the lowest location in the conduit run. 2. Install type ECDB or equivalent drain fittings to permit the water to drain out of the conduit. These would normally be installed in all above the ground locations prior to entering each building or piece of equipment.

The 2005 NEC® permits EMT, IMC and RMC to be installed in all wet locations both inside and outside. NEC® 300.6(C) requires all metallic raceways installed indoors in a wet location to be mounted so there is at least a 1/4" inch air space between the raceway and the supporting surface to minimize the accumulation of moisture. NEC® Sectons 342 (345).10(D), 344 (346).10(D) and 358 (348).10(C) caution the installer that all hardware items such as straps, bolts, screws etc. be of a corrosion resistant material when used to support raceways in wet locations. When threadless fittings are used with RMC and IMC, they must be identified and listed for the application. Threadless fittings intended for use in wet locations are marked "Raintight" or "Wet locations" on the fitting or its smallest unit shipping container. Threadless fittings intended for embedment in poured concrete are marked "Concrete-tight" or "Concrete-tight when taped" or "Raintight" on the fittings' smallest unit shipping container. Fittings listed as "raintight" are also "Concrete-tight", but not all concrete-tight fittings are raintight. For more information, see Section 4.3, Fittings For Use With RMC, IMC, and EMT in the publication Guidelines for Installing Steel Conduit/Tubing.

6. The National Electrical Code (NEC) allows all three products to be installed in concrete, as noted in their respective Articles: (Also see NEC 300.6(A)(3).

RMC Section 344.10 (B) Corrosion Environments. "RMC, elbows, couplings, 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 and judged suitable for the condition."

IMC Section 342.10 (B) Corrosion Environments. "IMC, elbows, couplings, 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 and judged suitable for the condition."

EMT Section 358.10 (B) Corrosion Protection. "Ferrous or nonferrous EMT, elbows, couplings, 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 and judged suitable for the condition."

Rigid steel conduit, IMC and EMT are all "protected by corrosion protection" due to the zinc coating that is applied during the manufacturing process. However, in severely corrosive environments, the designer or AHJ may decide to require additional or supplementary protection. If supplementary corrosion protection is required or desired, it can be provided by a factory-applied PVC coating, a paint approved for the purpose, or tape wraps approved for the application

When steel conduit/EMT emerge from concrete into soil, we recommend that supplementary corrosion protection be applied a minimum of 4 inches on each side of the point where the conduit or EMT emerges. This LINK will take you to an individual page from the STI Installation Guide pertaining to concrete installation.

Underwriters Laboratories' Electrical Construction Equipment Directory contains information relating to limitations or special conditions applying to products listed by UL.

The UL Directory states that supplementary corrosion protection is not required on rigid steel conduit and IMC when installed in concrete.

The UL Directory states the following for EMT: "Galvanized steel electrical metallic tubing installed in concrete on grade or above generally requires no supplementary corrosion protection. Galvanized steel electrical metallic tubing in concrete slab
below grade level may require supplementary corrosion protection."

Where the concrete slab is installed on grade, it is important that the raceway be placed in between layers of rebar and above the bottom of the slab to insure full encasement. However, there are structural concerns that must be satisfied. These concerns are related to size of the conduit or tubing to be encased and the thickness of the slab.

The International Building Code (IBC) contains information in section 1906.3 concerning conduits and pipes embedded in concrete. According to the IBC Handbook, "Conduits, pipes and sleeves may be embedded in concrete, provided that the properties of the material or the size and location of embedments will not damage the concrete." (Aluminum conduit cannot be embedded in concrete unless provided with supplementary corrosion protection.) The IBC references ACI (American Concrete Institute) 318, Section 6.3 which provides guidance for safe installations under common conditions.

The Authority having Jurisdiction responsible for the structural integrity of the installation should also be consulted.

7. The requirements in NFPA 130, Section 5.4 Wiring Requirements state that "Materials manufactured for use as conduits, raceways, ducts, boxes, cabinets, equipment enclosures, and their surface finish materials shall be capable of being subjected to temperatures up to 500°C (932°F) for 1 hour and shall not support combustion under the same temperature condition."

Steel conduit is zinc-galvanized for corrosion protection. Underwriters Laboratories exposed rigid steel conduit and steel intermediate metal conduit and electrical metallic tubing to a 4 hour ASTM E119 fire test at a temperature of 2000°F. The conduit and EMT were still intact at the end of the test. This information is contained in a report Annular Space Protection of Openings Created by Penetrations of Tubular Steel Conduit – a Review of UL Special Services Investigation File NC546 Project 90NK111650, which is available from Allied Tube.

Since the melting point of zinc is around 800°F, the galvanizing may be compromised but the conduit and EMT would still be intact after the E119 fire and would not be “capable of supporting combustion”. We cannot verify the condition of the conductors within the conduit. However, Fire-resistive Circuit integrity cables can be used within conduit to obtain a 2-hour fire rating.

8. The coefficient of expansion for steel conduit/EMT is 6.5x10^-6 in./in./°F. This is significant as it relates to whether or not expansion fittings would be required in a particular application. Expansion fittings are installed where significant temperature differentials are anticipated. These temperature shifts cause materials to expand and contract and could result in the conduit being pulled apart at the joint. Expansion fittings are not normally required with steel conduit/tubing because their coefficient of expansion is identical to or similar to that of other common building materials. However, when steel conduit is installed on bridges or rooftops or as an outdoor raceway span between buildings, expansion fittings may be required. In these types of installations, there is a probability that expansion and contraction would occur, resulting from the direct heat of the sun coupled with significant temperature drops at night. Expansion characteristics of steel conduit/tubing are shown in Table 3, at 5°F to 200°F in 5°F increments. The Table also shows the length changes for steel conduit at each temperature differential. This will help determine the need for expansion fittings. For information about the use of expansion fittings, contact your fittings supplier.

9. The Trade Sizes and Metric Designator equivalents for RSC, IMC, and EMT are:

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<th>Trade Size</th>
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Note: The Trade Sizes and Metric Designators are for identification purposes only and are not actual dimensions. Product dimensions do not change.

10. No fire-rating is required since these products are defined as noncombustible by the building codes. This question is usually asked relative to the penetration of a fire-rated assembly or use in an emergency circuit, fire pump, or mass transit vehicle (see Question 4 for information on NFPA 130 "Standard for Fixed Guideway Transit and Passenger Rail Systems").

1. Penetrations
The NEC® and building codes require the sealing of openings around raceways that penetrate a fire-rated assembly. This requirement is to prevent smoke, gases and flames from migrating from one area to another. There are many listed penetration firestopping systems that can be used to seal openings; the listing instructions should be strictly followed.

Most building codes permit the openings around galvanized steel RSC, IMC and EMT in concrete or masonry to be filled with cement, mortar, or grout. However, since local codes sometimes vary, these requirements should be checked prior to installation.

2. Emergency circuits
Prior to installing these circuits, the NEC® and local or state code requirements should be reviewed. Steel raceways withstand fire (see Question 4); however, ordinary conductor insulation melts when exposed to elevated temperatures and a short circuit can be created. This is the reason for special protection of emergency and fire-pump circuits.

Methods of thermal protection include enclosing the raceways in a fire-rated enclosure, embedding them in concrete, wrapping them with 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.

The NEC does not require these thermal protection methods where conduit is installed in a fully sprinklered building.

11. Yes, according to Section 230.28 of the 2005 NEC" the only requirement is that the service mast "...shall be of adequate strength or be supported by braces or guys to withstand safely the strain imposed by the service drop."

12. Yes, even though IMC is lighter and has a thinner wall thickness than rigid, it is just as strong. This is achieved through the steel processing during manufacturing. NEC® Articles 342 (formerly article 345) for Intermediate Metal Conduit and 344 (formerly article 346) for Rigid Metal Conduit contain identical installation requirements. Both products are UL listed and have been tested under similar conditions.

13. Cutting and threading of IMC is covered extensively in the Steel Tube Institute publication Guidelines for Installing Steel Conduit/Tubing under Section 4, General Installation Practices. You can jump to that section by clicking here to download a pdf file.

14. The NEC requires that the threads of both RSC and IMC be cut with a 3/4 inch taper per foot (1 in 16) per ANSI/ASME B.1.20.1 Standards for Pipe Threads, General Purpose (Inch). This applies to both factory and field threads. This is the same taper as standard plumbing pipe.

15. Factory cut threads have corrosion protection applied at the factory. Field cut threads are required to be coated "with an approved electrically conductive, corrosion-resistant compound "where corrosion protection is necessary " (see NEC® 2005 300.6 (A). We recommend that all field cut threads be protected against corrosion where they will be installed in wet or outdoor locations. The thread surface should be protected with conductive rust resistant coating. Zinc-rich paint is a typical...
coating, but there are other conductive coatings that can be used.

Field threads should be cut one thread short. This will insure a good connection and allow the entire thread surface to be inside the coupling.

16. The Rigid Steel Conduit used in the U.S. is manufactured to UL Safety Standard No. 6 and to ANSI C80.1. There is one IEC standard entitled Extra Heavy-Duty Rigid Conduit (IEC 981) which is very similar to the Rigid Steel Conduit listed to UL 6 with the exception of some dimensional differences. At the current time, no one lists product to IEC 981.

17. The term "schedule 40" originated when ASTM A120 existed and conduit was made from this pipe. A120 was cancelled many years ago. Steel conduit is not required to meet ASTM standards. For any future information, contact steel conduit manufacturers.

18. Underwriters Laboratories Electrical Construction Equipment Directory states that EMT is listed for "installation of conductors in circuits rated above or below 600V, nominal, and in accordance with a ANSI/NFPA 70, National Electrical Code".

Part II of Article 300 (Wiring Methods) of the National Electrical Code® covers "Requirements for Over 600 Volts, Nominal". In Section 300.37 of Part II entitled "Aboveground Wiring Methods", EMT is listed as one of the permitted wiring methods.

In 1996 Underwriters Laboratories published a report of research entitled Electrical Metallic Tubing for use over 600 Volts. To view a copy of the report, click here.

19. Yes, RSC, IMC and EMT are all permitted as an equipment grounding conductor in accordance with NEC® 250.118. It is permitted to add a supplementary equipment grounding conductor sized in accordance with NEC® 250.122. This is a systems design consideration. If a supplementary equipment grounding conductor is used, it is still very important to comply with NEC® 300.10 and 300.12, since approximately 90% to 95% of the current will flow on the conduit and not in a supplementary conductor. For information on the equipment grounding capabilities of RSC, IMC and EMT, click here for a link to the section with the results of a research study performed by the Georgia Institute of Technology.

20. Yes. A copy of the study conducted by Georgia Institute of Technology titled Modeling and Evaluation of Conduit Systems for Harmonics and Electromagnetic Fields is the basis for the Grounding and ElectroMagnetic Interference (GEMI) Analysis software, which is available for downloading.

21. Steel conduit and tubing offers several advantages over alternative wiring methods:
    — EMI Shielding
    — Physical protection of conductors
    — Proven grounding capabilities
    — Low coefficient of expansion - infrequent need for expansion fittings
    — Impact resistant -high tensile strength
    — Noncombustible
    — Adaptable to future wiring changes
    — Low life-cycle costs
    — Recyclable (For more documentation click HERE)

22. There is no prohibition in the NEC®. In some installations, there may be a concern about physical damage or corrosion
This is often a judgment call by the authority having jurisdiction. The NEC® does not allow EMT to be used where "during installation or afterward, it will be subject to severe physical damage". The NEC® also requires the EMT to be "securely fastened in place" and provides requirements for supports. The AHJ may determine more supports are necessary. If the AHJ approves the installation with EMT, consideration should be given to compliance with NEC® 110.12, 300.6, 300.7(A) & (B), 352.30 (formerly 348-13), 352.12 (1) (formerly 348.5(1) and 358.10 (C) (formerly 348.6).

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### 23.

Per Article 358 in the 2002 NEC, all EMT associated fittings are required to be listed for the installation (see 358.6). In 358.42, it is stated that "Couplings and connectors used with EMT shall be made up tight. Where buried in masonry or concrete, they shall be concretetight type. Where installed in wet locations, they shall be of the raintight type." The recently-published 2005 NEC contains a change in language in 358.42 which now states: "Couplings and connectors used with EMT shall be made up tight. Where buried in masonry or concrete, they shall be concretetight type. Where installed in wet locations, they shall comply with 314.15(A)." Article 314 includes installation requirements for fittings used to join raceways and to connect raceways and cables to boxes and conduit bodies. 314.15A states that in damp or wet locations, boxes, conduit bodies, and fittings "shall be placed or equipped so as to prevent moisture from entering or accumulating within the box, conduit body, or fitting. Boxes, conduit bodies and fittings installed in wet locations shall be listed for use in wet locations."

Select this link to view UL Bulletin that includes additional information on raintight fittings. 
“Raintight” compression type EMT fittings for use in wet locations

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### 24.

Unlike other materials, steel contains recycled material and is also fully recyclable. In fact, according to the Steel Recycling Institute (SRI), steel is the world's most recycled material. All of the STINA conduit producers use recycled steel in their conduit and tubing products. Our members produce steel Electrical Metallic Tubing, Intermediate Metal Conduit, and Galvanized Rigid Conduit.

The amount of recycled material in steel conduit/tubing products depends upon the process used by our various steel suppliers. If the pipe is made from a steel coil that comes from a steel mini-mill, then the scrap or recycled content of the steel is between 95-100% because mini-mills use a technology called "electric arc furnace" (EAF) that allows them to use up to 100% scrap. If the pipe is made from a steel coil that comes from an integrated mill, then the scrap or recycled content of the steel is about 30% because integrated mills use a technology called "basic oxygen furnace" (BOF) that restricts the use of scrap steel to no more than 30%. It is important to note that economic expansion, domestically and internationally, creates additional demand that cannot be fully met by available scrap supplies.

Both the EAF and the BOF methods provide an enhanced environmental benefit. One is not environmentally superior to the other, since they are both complementary parts of the total interlocking infrastructure of steelmaking, product manufacture, scrap generation and recycling, as explained on the Steel Recycling Institute's website.

The US Green Building Council has told us that CSI 15 (Mechanical) and CSI 16 (Electrical) products are excluded from LEED points. Since steel conduit is an electrical product, it, too, is omitted. We understand, however, that our products exceed the 5% and 10% goals in LEED Version 2.1, Credits 4.1 and 4.2, regardless of which type of steel is used in the manufacturing of the product.

The additional "green" aspect of steel conduit is what the Steel Recycling Institute terms the "reclamation rate". Currently LEED only considers the recycled content of a product, not how much can be reclaimed at the end of the service life or from jobsite scrap. Steel conduit is exceptional relative to "reclamation rate." Four major factors account for this:

- The service life is very long. (There is steel rigid conduit still in use after more that sixty years.)
- Conductors can be removed and new conductors installed.
- Additional circuits can frequently be added in the same conduit.
- When the conduit is finally discarded, it is virtually totally recyclable.

You may want to review two articles by the Steel Recycling Institute (www.recycle-steel.org). The two segments are "Steel Takes LEED with Recycled Content" and "Modern Steel Production Technologies".

For more documentation click [HERE](#).