STAINLESS STEEL CONDUIT VS. PIPE
AVOID NON-COMPLIANCE

Atkore™
Calbrite

Stainless Steel Conduit is used for routing and protecting electrical wires that run in exposed locations in a variety of washdown and harsh environment applications. Because of its widely known and widely accepted performance attributes, it is specified in corrosive applications that exceed the limitations of traditional conduit systems and stainless steel pipe. Stainless steel conduit provides a safe and easy-to-install electrical raceway and satisfies the strictest mandates for plant cleanliness by various state agencies and hundreds of common regulatory requirements. It's performance over time has contributed to it being referenced in numerous electrical codes and standards and has been determined that its role results in a safe compliant raceway system.

Rigid Conduit **IMC** **EMT**

Stainless steel conduit is available in three versions, reliable rigid conduit, versatile Intermediate Metallic Conduit (IMC) and light weight Electrical Metallic Tubing (EMT) . As mentioned above, stainless steel conduit is used for routing and protecting electrical wires in a variety of harsh environment applications. Type 304 and 316 UL-listed stainless steel conduit performance meets and exceeds the current requirements for wash down and harsh/ corrosive environments in applications including Chemical, Food & Beverage, Pharmaceutical, Power Plants, Power Generation, Pulp & Paper, Shipbuilding & Marine, Transportation, Infrastructure, Water and Wastewater.

CHEMICAL	304 Stainless Steel	316 Stainless Steel	Aluminum	PVC	Galvanized Zinc Steel
Ammonia Nitrate	Excellent	Excellent	Fair	Good	N/A
Calcium Chloride	Good	Good	Severe Effect	Excellent	Fair
Chlorine (Dry)	Excellent	Excellent	Fair	Severe Effect	N/A
Kerosene	Excellent	Excellent	Excellent	Fair	Good
Oils: Fuel (1, 2, 3, 5A, 5B, 6	Excellent	Excellent	Fair	Excellent	Severe Effect
Petroleum	Excellent	Excellent	Severe Effect	Fair	N/A
Phosphorus	Excellent	Excellent	Good	Severe Effect	Severe Effect
Sea Water	Excellent	Excellent	Good	Excellent	N/A
Soap Solutions	Excellent	Excellent	Fair	Good	Good
Water, Fresh	Excellent	Excellent	Good	Excellent	Good

Stainless Steel Conduit Superior Performance

Stainless Steel Pipe on the other hand, is used for transporting fluids or gases in applications including Oil & Gas, Nuclear Power, Liquefied Natural Gas, Desalination and Mining.

So where does the confusion begin regarding when to use stainless steel conduit and when to use stainless steel pipe in an electrical raceway installation? There should be no confusion. Anyone who believes that it is an acceptable practice to substitute welded stainless steel pipe for stainless steel conduit or authorizes/approves the use of welded stainless steel pipe to lower cost or avoid project delays is participating in the installation of a non-compliant system and is inviting danger.

Stainless steel pipe:

- is not tested to and does not meet UL standards
- must be welded or cut and threaded onsite resulting in higher labor costs
- can damage wire and cables when being pulled
- does not protect the wire from elevated temperatures and removal of the jacket
- is not polished, its coarse and dull finish can create additional harboring points which are difficult to identify during visual inspections
- is not sold with couplings; plumbing couplings are non-UL listed and are manufactured with tapered threads, creating major gaps and potential snags when pulling wire
- welds do not last forever

Apart from the physical and connection differences between conduit and welded pipe, improper use and installation of stainless steel pipe can cause lack of electrical code compliance and potential safety issues. That's why these codes, standards and rules were developed for stainless steel conduit in these applications, ensuring that it is safe to pull cable or wire.

Facility Raceways Must Meet Code

All stainless steel electrical conduit goes through rigorous tests and approval processes to be authorized for installation in any environment.

As mentioned previously, stainless steel pipe **is designed** to transport liquid or gas. It was never intended or designed to be part of a secure raceway system installation. Since it is not tested or approved for crush/impact resistance in electrical applications, continuity and bad welds can expose wire and cables in wet/corrosive environments. Use of welded stainless steel pipe in an electrical raceway system **IS NOT COMPLIANT** with the National Electrical Code, ASTM, ASME, UL, cUL, or CSA. In addition, stainless steel pipe I**S NOT DESIGNED or MANUFACTURED** to the strict guidelines set by the industry standards of UL and ANSI and therefore, does not meet the approval of the NEC.

The National Electrical Code

Electrical Inspections for the Combination Inspector (IAEI Magazine Blog September 2013)

Article 300 section 18 of the National Electrical Code specifically states that metal raceways cannot be supported, terminated or connected by welding to the raceway. This section is broken down into two parts. First, in (A) we have Complete Runs, and the requirement here is that raceways, other than busways, or exposed raceways having hinged covers, shall be installed as a complete run between outlet, junction, or splicing points prior to the installation of conductors. If you ever get on site and see someone threading conductors through pieces of raceway, please remember this section of the code. If the conductors can't be pulled through a completed raceway installation, there is another problem which should be solved. Examples might be oversized conductors in the raceway, too many bends in the run, or other conditions that shouldn't exist in a good code-compliant installation. The second section of 300.18 deals with Welding. Metal raceways shall not be supported, terminated or connected using a welding process unless specifically designed for welding. To date, I haven't seen a system designed to be welded. However, that doesn't mean I haven't seen it attempted, as can be seen the photo below.

It should be pretty obvious that welding would cause rough, possibly sharp obstructions to the interior of the raceway, which would then cause damage to the conductors when they are being installed within the raceway system.

Occupational Safety and Health Administration
1910.305 - Wiring methods, components, and equipment for general use. 1910.305(b)(1)(iii)(C)
A fitting is provided on each end of the raceway to protect the cable from abrasion, and the fittings remain accessible after the installation.

National Electrical Installation Standards (NEIS) –
trademark of National Electrical Contractors Association

Standard for Installing Steel Conduit
Grounding, Bonding & Specific Installation Requirements
4.4 Support of steel conduit/tubing
Support and securely fasten all raceways in place in accordance with NEC requirements.
4.4.1 Supporting
Follow all Code requirements for spacing of supports and frequency of securing RMC, IMC and EMT. The requirement to securely fasten raceways within the specified distance from each "termination point" includes, but is not limited to, outlet and junction boxes, device boxes, cabinets, and conduit bodies. Each raceway shall be so secured. Do not omit any supports.

NOTE: Proper support and secure fastening protects the raceway joint during maintenance in the area of the raceway; this will help ensure a continuous ground path. Good workmanship in this area improves safety for the installer, other workers, and the public.

4.7. Equipment Grounding Using Steel Conduit
4.7.1 Steel conduit as an equipment grounding conductor
Steel RMC, IMC and EMT are recognized by the NEC as equipment grounding conductors. Using a supplemental equipment grounding conductor in the form of a copper, aluminum, or copper-clad aluminum conductor in addition to the raceway is a design decision, except where the NEC requires it in some specific installations such as patient care areas in NEC 517.13. Steel conduit is the main equipment grounding conductor regardless of whether a supplemental equipment grounding conductor is installed. In the event of a fault, the raceway will carry most of the current and therefore must be continuous. For this reason, each raceway must be installed securely and with tight joints to provide mechanical and electrical continuity.

4.7.2 Continuity of grounding path
The NEC states that the path to ground in circuits, equipment and metal enclosures for conductors shall be permanent and continuous. Complying with guidelines in the Fittings section 4.3 and Support section 4.4 is the major factor in maintaining electrical continuity. Using less than the NEC required supports or failing to properly tighten joints can cause discontinuity in a raceway system, which would result in the failure to carry a ground fault. Good installation workmanship is critical.

4.7.6 Bonding
Bonding is used to provide electrical continuity so that overcurrent devices will operate and shock hazards will not be present. This is the "finishing touch" for a metallic raceway system and close attention is to be paid to detail. All fittings, lugs, etc., shall be securely made up.

Bonding around steel raceway joints/couplings is not necessary when EMT, IMC, and RMC are properly made up as recommended in this installation guideline. A secure joint provides excellent low impedance continuity. Bonding is not required because this joint already meets the NEC definition of bonding.

5. Specific Installation Requirements
5.1 General
NOTE: This is extremely important in alternating current (AC) applications.
The conduit/tubing system shall be installed complete, including tightening of joints, from termination point to termination point prior to the installation of conductors.

No Greater Risk than Electrical Safety Gone Wrong

The risks and violations add up quickly when welded stainless steel pipe is incorporated into the installation of a raceway system. It not only violates the NEC, but it causes significant safety risks. The dimensional and structural flaws often found in welded pipe can damage the wire when being pulled, as there are no requirements covering the smoothness of internal weld beads. Therefore, the biggest reason not to use welded stainless steel pipe instead of conduit is SAFETY. Welding stainless steel pipe is highly toxic and exposes the welder and people nearby to carcinogenic Chromium VI fumes.

Welding this material requires proper protection equipment and professional ventilation of the fumes and gases at the source. You don't typically find these ventilation precautions in place during a raceway installation.

Stainless steel pipe interior and exterior surfaces often contain metal trimmings, hard scale, burrs, sharp edges sharp projections or other imperfections which can damage wire or cable insulation during pulling.
It is also very difficult to inspect whether a weld is completely sealed. If the raceway is installed in a washdown environment, it is possible for liquid to enter and short out any exposed damaged wire.

If a raceway system requires more cable due to the addition of a new machine, and welded pipe has been introduced into the system, then the system has been welded shut. This would add up to more cutting and welding, more cost, more violations and more risk of exposed wire. This would all be avoided by the use of UL-listed fittings in conjunction with the stainless steel conduit.

Why Invite the Danger?

We've discussed the structural differences, lack of certification compliance, code violations, safety, and performance issues involving the use of welded stainless steel pipe in electrical raceway systems.
The appeal of lower cost stainless steel pipe is not even a consideration when establishing a secure and safe electrical raceway. With all the benefits of an Atkore/Calbrite Stainless Steel Conduit System, there is no reason to risk an installation with welded pipe.

There's no need to risk safety or compliance with unsafe materials and processes. Atkore's family of 304 and 316 stainless steel conduit provides the most options in performance, ease of installation and affordability.