



222 W Central Ave. PO BOX 72260, Roselle, IL 60172
630-529-2920 FAX 630-529-0482
www.electriflex.com

Shielded Conduit Protects Against RFI/EMI

Three kinds of shielding provide maximum choice

Introduction

Many applications require shielding effectiveness from RFI and EMI interference. Stray voltage, current, and high frequency noise can damage circuits, interrupt performance, and initiate potentially dangerous actions. Shielding reduces these potential problems. Shielded conduit, especially where flexibility is required, provides a significant solution for the engineer.

Electri-Flex Company manufactures a broad line of conduits that are designed to protect sensitive circuits from outside interference in a variety of applications. These applications are found in aerospace, communications, and many other industries where commercial off the shelf (COTS) products are acceptable. This paper discusses three different conduit types that are designed for high-performance shielding applications. They are Braided Shield; Interlocked Bronze Strip Inner Core; and Interlocked Bronze Strip with Braided Shield, and can be classified as "good," "better," and "best" solutions to provide effective shielding from RFI and EMI interference.

Markets and Applications

Electri-Flex Company's shielded conduit types may be used in a variety of markets and applications.

For example, markets such as industrial, HVAC, and utilities – especially water and wastewater– use variable speed drives. Also called variable frequency drives, these devices are extremely susceptible to radio frequency interference. Using shielded flexible conduit from the drive controller to the motor eliminates the potential for hazardous interference in the operation of the drive. Flexible shielded conduit is also often used in building automation applications such as dampers, blower motors, and electronic controllers.

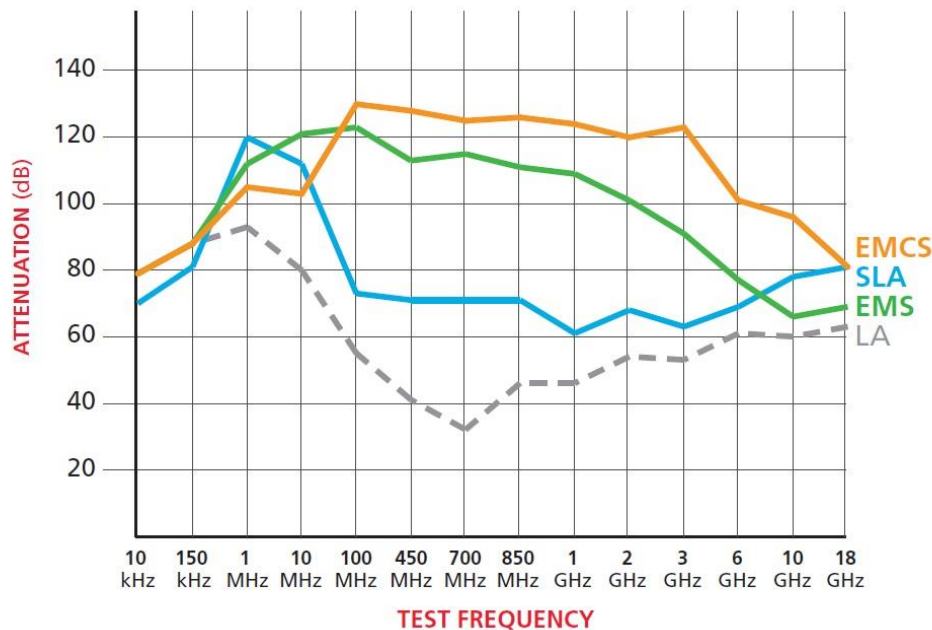
Flexible shielded conduit is very often used in data center wiring to keep power wiring from interfering with signal and data lines, and, for similar applications, in test and measurement. Flexible shielded conduit is used in transportation and in aerospace, where space is at a premium and the flexibility is an advantage, such as in trains, subways, and both military and civilian aircraft.

The use of flexible shielded conduit is also superior to the use of shielded cable because the conduit's construction protects from damage to the jacket and inner conductors of the cable.

Shielding Effectiveness as a Selection Criterion

Shielding Effectiveness

The graph below depicts a general comparative shielding effectiveness (attenuation in dBs) of all three types of SHIELD-FLEX conduit. The dotted line indicates a comparison to standard unshielded liquidtight flexible conduit Type LA. The spectrum of test frequency is from 10 kHz to 10 MHz Electric Field, to 100 MHz to 1 GHz Planewave Field and 2 GHz to 18 GHz Microwave Field. Tests were performed per MIL-STD-285 and in general accordance with IEEE 299. 1" trade size conduit was tested using standard liquidtight fittings from Thomas & Betts Series 5300. Results are based on controlled laboratory conditions and may vary in actual field installed conditions.



This chart shows the relative effectiveness of shielding for the three types of Shield-Flex flexible shielded conduit under discussion. The baseline is the shielding capability of standard unshielded flexible conduit, where Electri-Flex Company's Lquatite conduit type LA was used. Note that the shielding effectiveness curves are different among the three types of flexible shielded conduit. This permits the engineer to select the conduit type with the best noise reduction for either egress or ingress at the point of maximum potential interference.

Braided Shield—Good

Braided shield conduit, such as Electri-Flex Company's Lquatite Shield-Flex Type SLA, consists of an inner core of interlocked steel, with a tinned, braided shield over it, and covered by a polymer (PVC) jacket. This type of flexible

shielded conduit is UL listed, offers a wide temperature range, has excellent chemical resistance, and is suitable for use in some hazardous areas. The conduit can be used as an equipment grounding conductor in most cases and accepts standard metallic liquid-tight connectors. Type SLA flexible conduit has a working temperature range of -30° to 80° C dry / 60° C wet/ 70° C oil.



Referring to the chart of Shielding Effectiveness above, braided shield conduit has a high reduction level of RFI and EMI in the lower frequency ranges, from 150 kHz to 10 MHz, with a rather sharp roll off at higher frequencies. These characteristics should be considered when choosing the shielded conduit type. Braided shielded flexible conduit Type SLA should be considered the "good" option.

Interlocked Bronze Strip Inner Core—Better

Another type of flexible shielded conduit, such as Electri-Flex Company's Shield-Flex Type EMS, does not have a braided shield, but is instead made with an interlocking bronze strip inner core that provides the RFI and EMI shielding. This flexible shielded conduit can be used over a wide temperature range, and its PVC jacket material has excellent chemical resistance. This type of flexible shielded conduit also accepts standard metallic liquid-tight connectors.



Interlocked bronze strip inner core flexible shielded conduit has a wider shielding effectiveness than the Type SLA braided flexible shielded steel conduit. Its effectiveness has a more gradual roll off until the higher frequencies are reached, approximately from 150 khz to 6 Mhz. Type EMS conduit has a working temperature range of -55° to 105° C and would be considered the “better” option.

Interlocked Bronze Strip with Braided Shield—Best

This flexible shielded conduit, like Electri-Flex Company's Shield-Flex Type EMCS, has the same type of interlocked bronze strip inner core as the previously discussed type EMS, but, in addition, has the same type of tinned braided shielding as the Type SLA conduit above. It has a very wide operating temperature range and excellent chemical compatibility because of the PVC jacket. It, too, is compatible with standard liquid-tight conduit connections. Type EMCS conduit has a working temperature range of -55° to 105° C. Interlocked bronze strip inner core flexible conduit with a braided shield has the best shielding effectiveness of the three types of conduit compared in the chart above, all the way from 10 kHz to 18 GHz.



Type EMCS flexible shielded conduit should be considered the “best” engineering option, especially for applications in which effective reduction of high frequency RFI and EMI are critical.

Halogen-Free Jackets

There are applications where there is a need for low smoke and low flame-spread materials of construction. These applications require zero halogen conduit jacketing instead of the PVC jacket material used in the three conduit types under discussion. These applications include confined spaces, such as tunnels and subways, and in areas where the public could be exposed to hazardous smoke and off-gassing from PVC in the event of fire. These areas include not only subway tunnels, but also subway and railroad rolling stock, airplanes, elevators, and other confined spaces.

These three types of flexible shielded conduit can also be obtained in “halogen-free” jacketing material, polyurethane. Electri-Flex Company adds HF to the conduit type designation, HFSLA, HFEMS, HFEMCS, to denote this variation.

Both polyvinyl chloride (PVC) and polyurethane (PU) have wide chemical resistance. For specific chemical resistance, please see [the Chemical Resistance Guide on the Electri-Flex Company website](#).

Conclusion

Using flexible shielded conduit provides a widely applicable solution to the problem of noise and interference from stray voltages and current. When you need high-performance EMI/RFI shielding, these three conduit types provide the performance you need across a wide frequency range and the quality you must demand in flexible shielded conduit.