



BIRNS Penetrators: Frequently Asked Questions

- Can BIRNS supply Penetrators to accommodate LAN connections inside a SAT system?
- What is Low-Smoke cable? Why is it required?
- Does the penetrator screw into the pressure vessel from the outside or inside?
- What are the maximum lengths of cable available inboard and outboard?
- Are "24 Conductor" and "12 pair" the same thing?

1. Can BIRNS supply Penetrators to accommodate LAN connections inside a SAT system?

LAN connections are probably 8P8C connectors (also known as RJ45); these have 8 conductors and are typically used with UTP (unshielded twisted pair) cable in computer networking. STP (aka TSP, i.e. shielded twisted pair) cable is probably superior. Either way, a minimum of 4 twisted pairs of wire is required. The standard penetrator construction is good when made with appropriate cable.

We have several appropriate cable stocks:

- o 52A-126 (20 AWG/4 TSP, LSZH/LSZH)
- o 52A-130 (20 AWG/8 TSP, LSZH/EPDM)
- o 52A-135 (16 AWG/4 TSP, CPE/FREP, OAS)
- o 52A-151 (16 AWG/8 TSP, CPE/FREP, OAS)
- o 52A-153 (18 AWG/8 TSP, LSZH/XLPE, OAS)

Note: "LSZH" = Low Smoke Zero Halogen, and "OAS" = Overall Shield (i.e. an overall shield around all of the individual TSP's).

2. What is Low-Smoke zero halogen cable? Why is it required?

Low smoke zero halogen ("LSZH") is a type of cable jacketing composed of compounds that emit limited smoke and no halogens when exposed to high sources of heat. Because LSZH cable reduces the amount of toxic and corrosive gases emitted during combustion, some authorities require LSZH for use in PVHOs.

Halogens are a group of highly reactive elements including fluorine, chlorine, bromine, iodine and astatine. Chlorine and fluorine are extensively used in compounds for insulating and jacketing electrical wire and cable. Many common materials like PVC, Hypalon[®], Neoprene[®], and FEP and PTFE Teflon[®] contain significant amounts of these halogens. PVC, for example, contains 29% chlorine by weight; CPE 19% chlorine by weight; and Teflon has 76% fluorine by weight. Halogenated compounds are normally very stable, but when they burn the halogens separate and form toxic and extremely dangerous gasses. These halogenated gasses



are dangerous because they form acid when they contact water. The chlorine from PVC makes hydrochloric acid and the fluorine from Teflon makes hydrofluoric acid, both of which are extremely corrosive. The water source used to form these acids can be moisture in the eyes, throat and lungs of individuals with whom it comes in contact, as well as fire sprinkler systems and even humidity in the air. Thus, fires involving the combustion of halogenated materials can cause serious harm or even death to humans. (During combustion, cables containing halogens also produce significantly higher levels of carbon monoxide (CO), a dangerous and potentially lethal gas.)

ABS (American Bureau of Shipping) follows the USCG (United States Coast Guard) requirements for cables on manned submersibles defined in USCG NVIC 5-93 Chapter 7(B), which states that *"...because of the confined area of the submersible, any amount of smoke may be extremely asphyxiating, irritating to the eyes, and could cause panic or disorientation among the passengers. For this reason, all power and lighting cable must be low smoke, low/zero halogen cables."* DNV (Det Norske Veritas) also requires the use of LSZH cable in PVHOs.

BIRNS produces PVHO penetrators using LSZH, Neoprene, Hypalon (CSPE) and PUR (polyurethane) cable stock in accordance with our customers' instructions.

3. Does the penetrator screw into the pressure vessel from the outside or inside?

Generally, chambers' inboard pressure is equal to or higher than outside ambient pressure. During decompression, the chamber is pressurized (often with HeliOx or other mixed gases in which normal air's nitrogen is replaced with helium), so the resulting direction of pressure is outward. Penetrators for decompression/deck chambers are usually screwed into the chamber from the outside (the right-angle portion of the cable lies flat against the chamber).

Diving bells' inboard pressure is usually (but not always) higher than outside ambient pressure. Penetrators for bells are usually-- but not always-- screwed into the chamber from the outside.

BIRNS penetrators are tested bidirectionally: we apply high-pressure helium to the inboard side, and, during a different part of the test, we apply multiple cycles of high-pressure saltwater to the outboard side. Unless it is specified otherwise by our customer, we understand the "outboard side" to be the side with the large 90-degree overmold (the side with the larger thread diameters).

The definition of the "inboard" side can be quite important, because when the customer requires LSZH (Low-Smoke Zero Halogen) cable, we put it on the inboard side.



4. **What are the maximum lengths of cable available inboard and outboard?**

The cable lengths are limited by the constraints of our pressure testing system. On the penetrator's outboard side, we can provide cable lengths up to 3m (10 feet) long. On special orders, we can provide cable lengths up to 4.5m (15 feet) long (at additional cost). If you need longer cable outboard, we can splice on any length of cable.

Inboard, we can provide unbroken cable runs up to 18m (60 feet).

5. **Are "24 Conductor" and "12 pair" the same thing?**

"24 Conductor" usually means 24 straight (i.e. untwisted) wires in the cable. "12 pair" (or "12 TP" or "12 TSP" or "12 STP") means 12 pairs of 2 conductors each. In a pair the two conductors are twisted around each other to minimize losses and electrical interference. However, they can also be used as two separate conductors if desired.