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FIBER-OPTICS

March 7, 2005 - Traditionally, all information in vehicles traveled along wire paths from one point to another whereas in today's vehicles, some information is being sent using light signals contained in fiber-optic cables.

This article will discuss where fiber-optic cables are used on a vehicle, and what repairs are possible.

Using Fiber-Optics

often controlled by fiber-optics. These systems include entertainment devices, GPS, onboard telephone, and some side impact sensors. Some of the vehicle makers using fiber-optics include Audi, BMW, Jaguar, Mercedes-Benz, Saab, and Volvo.

Pro's and Con's To Fiber-Optics

There are advantages and disadvantages to sending signals using pulses of light.

The biggest advantage is that data is transferred faster than is possible with electrical wires and with improved signal quality. This is why fiber-optics is used primarily in the

“infotainment” systems on a vehicle. There is also reduced weight with fiber-optic cables. This is because a fiber-optic cable uses a one mm transmission core instead of multiple diameter copper wires. The fewer number of cables vs. wires is another advantage. Also, fiber-optic cables are not affected by electro-magnetic induction (EMI). When EMI occurs with conventional wiring, false or incorrect readings can be received.

Figure 1 - A fiber-optic circuit must be connected in a loop to operate.

Figure 2 - From the side view these plugs look nearly alike.

Figure 3 - When looking into the plug end, fiber-optics do not use common electrical terminal connectors.

A disadvantage of fiber-optic cables is that the transmission core is very fragile when compared to a bare wire. Data transmission is reduced or even lost if the insulation is damaged. If a fiber-optic cable becomes damaged or disconnected, none of the parts connected to that fiber-optic circuit will work. Similar to regular wiring that uses a positive feed cable and ground connection to complete a circuit, a fiber-optic information path requires that all devices be connected in a non-broken circuit (see Figure 1).

Figure 4 - Fiber-optic cables are not easily identifiable from copper wires.

Another disadvantage is that fiber-optic cables are highly sensitive to correct routing. The cables must be routed as straight as possible. If the cable must be bent, there is a minimum radius of 25 mm (1"). If the cables are bent tighter than the minimum radius, the transmission core can break.

Figure 5 - Special strippers are used to remove the protective jacket.

Identifying a Fiber-Optic Cable

Depending on the vehicle maker, fiber-optic cables may be black, orange, or orange with a heavy white plastic insulating coating. The insulating coating is rigid enough to reduce the chance of kinking the fiber-optic cable.

Figure 6 - Ferrules are installed with a special tool.

The plug connector for a fiber-optic cable from a side-view does not appear drastically different from a regular wire connector (see Figure 2). The difference is noticeable though, when the connector is viewed head-on (see Figure 3).

When viewing a handful of wires and cables, it is virtually impossible to precisely identify which is a wire and which is a fiber-optic cable (see Figure 4). Many times the only way to be sure is to reference the service manual, or disconnect the plug connector and look inside the plug.

Fiber-Optic Repair

Depending on the vehicle maker, fiber-optic cables may be repairable. Though fiber-optic cables are doing similar functions as conventional wiring, they are not repaired the same. Fiber-optic cables are not crimped, soldered, or twisted together when they are repaired. If the cable is broken, another cable must be cut to fit between the two connectors.

Some special tools are required. These tools include insulation strippers which also cuts the cable, a ferrule installer, and a repair kit that includes extra cable and ferrules. The repair kit may be only available as a vehicle maker-specific kit. A ferrule is the end that is attached to the cable, similar to a terminal for wire connections.

The following is an example of a Volvo fiber-optic repair procedure:

1. Remove the fiber-optic cable from the connector plug by removing the retainer pin from the connector. When this is done, ensure the input and output cable do not get switched into the wrong side of the connector plug.
2. Open the ferrule catch and pull the cable end out of the plug connector. Make note of this location so the cable ends go back into the correct locations on the plug connector. If a combination connector (optic and electrical) is being disassembled, remove the outer plug housing to gain access to the fiber-optic connector.
3. Cut the cable to the correct length.
4. Strip the protective coating from the fiber-optic cable (see Figure 5).
5. Cut the stripped cable to the proper length.
6. Attach the ferrule and check that it is secure (see Figure 6).
7. Reinstall the repaired cable end into the plug connector assembly, and insert the retainer pin.

Reroute fiber-optic cable following the vehicle maker's original routing. If there is a situation where a fiber-optic cable requires re-routing along a different path, keep the cables routed as straight as possible. This will reduce the opportunity for data loss. If a cable requires rerouting around obstructions, it must not be bent in a radius tighter than 25 mm (1").

Conclusion

Collision repair facilities will be more exposed to fiber-optic cables as they are used on more vehicle systems in the future. There is no definitive method to identify a fiber-optic cable by the protective insulation, but there are methods of identifying these cables. Fiber-optic cabling is usually used in the infotainment systems on vehicles. To effectively work with these cables, proper tools and knowledge will be required for performing repairs.