

REPAIR

HARNES REPAIR METHODS

SECTION OBJECTIVES

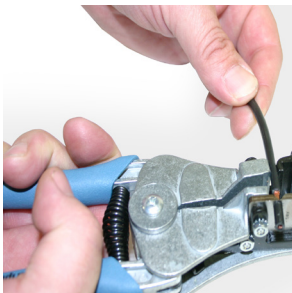
1. General Repair Methods
2. Splicing New Wire
3. Stripping & Crimping Basics
4. Sealing New Wire

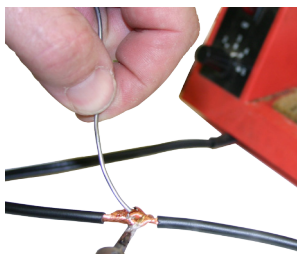
1. General Repair Methods

When cutting out the damaged portion of a wire, examine the cut ends of the remaining wire to be sure there is no corrosion present. If there is corrosion present, additional wire must be removed to ensure that the repair will not fail from the corrosion that is already present.



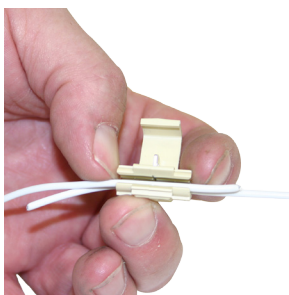
The cut and stripped wires should be clean and bright. If the wire is dull or dirty, it can be cleaned with steel wool or fine sandpaper to ensure a good electrical contact. If the internal wire is dark, this often indicates signs of corrosion or moisture, and it should be cut further back until clean, bright wire is exposed. It is best to remove and replace damaged or corroded wires, rather than perform repeated repairs.



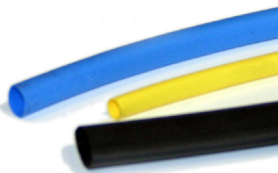


2. Splicing New Wire

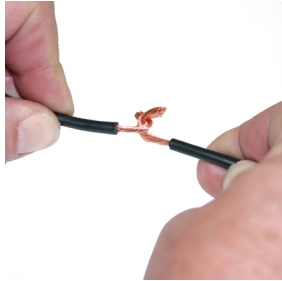
1. It is important to avoid any damage-prone methods, such as insulation-displacement clamp connectors. In harsh environments, they tend to create more problems than they solve. The blades in these connectors provide a weak mechanical connection, both mechanically and electrically. The exposed wire and weak connection also create an easy target for corrosives, arcing, and mechanical vibration. Sealing the connector with tape is also not practical because water can wick into gaps in the tape. A fully sealed, permanent repair is recommended to prevent the connection from failing in the future.



2. Soldering the wires together with heat shrink tubing seals provides the best electrical and mechanical solution, but it may not be practical at the time of repair. At times, a road repair may be necessary until you get to a location where a permanent repair can be made using solder and heat shrink tubing.



3. Solder is a weak material, but provides a permanent electrical contact. To compensate for physical weaknesses, a double J-bend is recommended to provide a strong mechanical joint in the wire. Without solder, wiring can move around within the new connection, which allows for arcing that can cause the adjoining connection to fail.



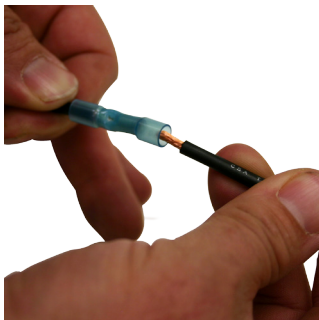
3. Stripping & Crimping Basics

A crimp connector is an acceptable solution to wiring problems that can be installed effectively on the side of the road. Crimp connectors can solidify and add mechanical strength to a connection, but must be properly applied and sealed to be effective.

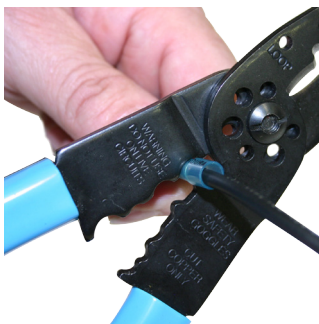
Care must be taken to make this type of seal permanent. Wire crimps are color coded to indicate which size wire gauge they are designed for. Using an incorrectly sized crimp connector can lead to a loose connection and joint failure.



1. Wire strip length is critical to ensure a strong mechanical and electrical joint, and each connection requires special care. To ensure a strong mechanical joint, the wire must pass all the way into the crimp and contact the bottom crimp pocket. To ensure a strong electrical connection, it is important that the insulation does not extend into the crimp and that the wire is clean and bright.



2. It is important to use tools that are specifically designed for crimping these connectors. Doing otherwise can compromise the connector or the tightness of the joint; tightness ensures that the wires do not move within the connector. A connection that is not fully crimped will likely fail.



3. Be sure all wires are cut to the same length and fully inserted into the crimp connector. If crimping is performed with only a few wires exposed to the device, it will lead to a loose or weak connection due to a reduction in current carrying capacity. Just like a weak link in a chain will make the whole chain weak, a poor splice connection will weaken the entire length of wire.

4. Test crimp connections by pulling apart both wires with the same force used to tie a shoelace. If the crimp connection cannot hold the wires together, or becomes loose, it will not survive on the vehicle. Be sure to inspect the connection and ensure all wires are included in the crimp, and that there are no gaps inside the connection.

4. Sealing New Wire

Sealing the splice is just as important as making solid mechanical and electrical connections.

SEALING WITH TAPE

Despite its flexible properties, tape is not recommended for permanent repairs. Tape can easily form holes and lose adhesion, especially on a dirty or oily surface. If you are in a situation where you must use tape to make an emergency repair, follow these instructions to maximize its effectiveness:

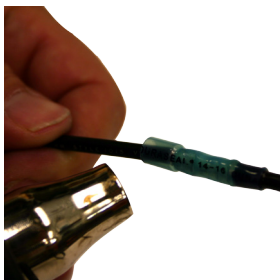
- a. Be sure the tape adheres on all sides to a clean surface; oily surfaces are especially difficult to bond to.
- b. Overlap the tape coverage at least 50% to strengthen and improve the seal over the joint.
- c. Make all of the overlap links tight and seal down each edge to prevent water wicking.
- d. Make a permanent repair to the taped area as soon as possible.

SEALING WITH SHRINK TUBING

Adhesive-lined heat shrink tubing is the preferred material to seal a soldered connection. When shrunk, the adhesive melts and glues the entire connection together, providing a strong seal and improving the mechanical strength of the joint. To ensure that the adhesive will make full contact and bond with the wires inside the joint, the tubing should not be too large. Proper sized tubing should be large enough that the joint can just pass through, but small enough that

after shrinking, the tubing can't move and there are no gaps in the adhesive.

It is important that the tubing size is matched to the size of the wire being repaired. If not, water can wick into the joint and corrode the connection. It is also important to know the differences between single-wall and double-wall tubing:



a. Single wall tubing relies on mechanical pressure to seal the joint from impacts, abrasion, and thermal expansion (which can compromise the connection's seal).

b. Double-walled tubing, the preferred type, uses an additional adhesive liner to fill the connection to ensure that even an abraded repair stays intact and sealed.

Specialty splice connectors are available that integrate a heat shrink tubing component into a standard crimp connector. These connectors are crimped on like a common crimp splice connector, but their sleeve is constructed of the same material used in double-walled heat shrink tubing. When the crimp is tightly completed, the entire connector can be heated to allow its casing to seal the connection.

