10
WIRING TECHNIQUES FOR MAKING OR REPAIRING A WIRING HARNESS

MAKING OR REPAIRING A WIRING HARNESS

Whether it is advisable to make your own harness, as opposed to repairing the existing harness, depends on a number of factors. If you have no harness at all, it would be much easier, and cheaper, to buy a ready made harness. Building a harness from scratch, without a pattern to go by, is extremely tedious, to say the least. If, on the other hand, you have a fairly good harness, with only a few wires damaged, then it would be cheaper, and almost as easy, to do a repair. These two extremes make the choice fairly easy; it's when your situation is somewhere in between that the decision is difficult.

A common situation is to have one or more harnesses that have been salvaged from the junkyard. In this case, it may be desirable to save as much of the harnesses as you can, re-using the connectors and wire to make a new one, or to repair the better of the harnesses to make one good one out of those that you have.

As for re-using the connectors, I would advise caution. Of all the pieces of the harness that give problems, the most likely is the connectors. If you do re-use them, make sure they are clean and corrosion free. The bullet connector sleeves, the black pieces that are used to connect two pieces of wire, are particularly trouble prone. Often, the metal sleeve inside will crumble with age, and will no longer have sufficient tension to make a good connection (not being a metallurgist, I can't explain this, but when I removed about six sleeves on my '71, pieces of the metal sleeve fell out on the ground).

Salvaging the wire is not a problem, as long as the wire has not been damaged. If you can, i.e. the wire is long enough, I recommend cutting the wire an inch or two from any connector. Often, moisture will wick up the strands and corrode the wire, making it difficult to get a good connection. You should cut back to where the wire is clean and shiny.

The easiest way to repair a harness is to clear out a large space on the garage floor, and lay the harness down, stretched out, with each "leg" of the harness laid out by itself. Strip back the tape surrounding the damaged area, being carefully not to displace the wires from their original position. Lay the new wires down, one at a time, alongside the original wires, to make sure they are the same length (allowing 3/4 " overlap for the splice). Strip off 3/4" of the insulation from both the old, and the new, and slip a piece of heat shrink tubing over one of the wires. Twist the wires together, and solder. After the joint has cooled, slip the heat shrink tubing over the joint, and apply heat to shrink. Attach whatever connector is appropriate to the free end of the wire. Continue with each wire, till that section is done, and then go on to the next section. Use plenty of cable ties to hold the wiring in place as you work, prior to re-wrapping. As you come to each cable tie, during the re-wrapping process, cut it off and discard it. Be prepared to use ***plenty*** of cable ties.

Don't make all the splices in exactly the same place. If you do, the wire bundle will be very thick at this point, and all the stress will be concentrated in this area. Space the splices out over the length of the harness, at least six inches between each splice, if you can. Don't worry about making splices, all automakers do it.

When you do the re-wrapping, begin with the terminal, or connector end, and work back towards the main harness. That way, you have fewer loose ends of the wrapping tape to worry about, as the wrapping for each leg gets wrapped again by the main wrap. Start by running a short piece of the harness tape parallel to the wires, heading away from the connector end, and start wrapping back over this piece, towards the main harness. This way, the wrapping secures that end of the tape. Use the special harness tape supplied by British Wiring, which has no adhesive, but adheres to itself. When you get to the last piece, use electrical tape to secure the last wrapping.

Be careful to note any pre-formed bends in the harness, and reproduce them when you do the repairs. If you bend the wires and tie them tightly with the wrap, the harness will hold its shape surprisingly well.

Making a new harness will be exactly the same as above, except you will run the wires from one end to the other, using the existing harness as a guide. Even if you are making a new harness, there will be places where you will have to splice, just as the factory did. Just make your splices in the same place and manner as original.

If you don't have a harness to use as a pattern, you can still make your own, but the degree of difficulty goes up significantly. In this case, you will need to route each wire individually, in place, in the car, connecting each end as you go. If you can, It's a good idea to look at a completed car to see how the harness was ran by the factory. The factory provided sufficient supports, and these should be used for the new harness. The location of the supports provides a good indication of the correct harness routing. Connect one end, then route the wire to the other end, and make that connection. As you lay the wires down, pay particular attention to the need to remove and replace both the harness and the electrical components. There must be sufficient slack in the wire to allow for this. Also, great care must be given to the routing of the wire to avoid any possibility of damage from rubbing against sharp edges of the body, and to making sure that the wire is properly supported to eliminate strain on the connectors. As you run the wires, use plenty of cable ties to hold everything in place. When you have completed and tested the wiring, very carefully remove the harness from the car and wrap as described above.

Whichever route you take, you will need to obtain the required supplies. There are five different sizes of wire used in a Triumph (or most British cars for that matter), and over 50 different color codes on the later models (out of a possible 144, 106 of which are available), the exact number depending on the model year. British wire, as used in Triumphs, MGs, etc., is not sized by gauge as is American wire. The size of British wire is stated as the number of individual strands of 0.30 mm copper used to make the wire. The sizes available are listed below, along with the maximum current rating of each size:

Number Of Strands	Current Rating
9 strands	5.75 amps
14 strands	8.00 amps
28 strands	17.50 amps
44 strands	25.50 amps
65 strands	35.00 amps
84 strands	42.00 amps
120 strands	60.00 amps

A typical TR6, for example, will use the first 4 sizes, and either the 65 or the 84 strand wire, depending on the alternator rating (I think the later models with the larger alternators use the 84 strand - I haven't confirmed this. I know the earlier models use 65 strand.) For any given wire in your existing harness, just strip a short length and count the strands. This will tell you what size to buy for replacement. (you may find some oddballs - somewhere in my collection of British wire, I ran across a piece of 21 strand wire! I have no idea where it came from). It is very unlikely that you will encounter the 120 strand wire, but if you should ever upgrade your alternator to a more powerful unit, this is the size wire you should be using. The correct color and size wire is available from:

British Wiring
20449 Ithaca
Olympia Fields, Ill 60461
708-481-9050

Call them and ask for a catalog. They also supply all the associated wiring supplies, such as connectors, bullet terminals, etc., as well as complete harnesses. By the way, even if you plan to solder all of the British type bullet connectors, buy the bullets that are suitable for soldering OR crimping, and not the type intended ONLY for soldering. Why? They just work better for soldering. They fit onto the wire a little bit snugger so they don't have as much tendency to fall off while you are trying to solder them, and the finished connection is just a little bit better. The dual purpose type are just so much easier to use when soldering than the solder type.

At the end of this chapter is a table listing all of the colors used in a TR6, with a description of the usage for each color.

If you prefer, you can use American gauge wire, but you may not get a color match. Most wire that is readily available at auto parts stores is all of one color, without any stripes at all, and the color choices are limited (a late TR6 uses 54 different color codes). I'm sure there must be places that will sell American gauge color coded wire in a wide variety of colors, but I don't know of any at this time.

There isn't a one-to-one correlation between American gauge and British wire sizing, so you will have to base your size choice on the current load of the circuits, rather than what was there before. Use the table below to determine your wire size (for automotive use only).

AWG:	Current rating:
18 Gauge	5 amps
16 Gauge	10 amps
14 Gauge	15 amps
12 Gauge	25 amps
10 Gauge	50 amps
8 Gauge	80 amps

TERMINATION TECHNIQUES

SOLDERED VERSUS CRIMPED CONNECTIONS

There is a lot of contention among the experts over this subject. Some people swear by soldered joints, and others won't use them at all. My opinion is that EITHER soldered or crimped joints are perfectly OK, provided they are made correctly and the rest of the wiring installation is correct. Vibration is a problem only if there is a sufficient length of unsupported wire which is allowed to move with respect to the connection. In other words, it is the flexing of the wire that causes the wire to work harden and break.

Proponents of crimping say that solder wicks up the wire for a short length, causing it to be stiff. This is true, and the problem area is the point where the stiff portion of the wire meets the portion that is still flexible. This is also a problem with crimped joints. The joint itself is very stiff, exactly like the soldered joint. If the wire is allowed to flex, it will break just the same as it would for a soldered joint. The one real disadvantage of the solder joint is that the extra length of stiffening makes it a bit harder to route the wire, as the bend radius is a bit larger than for a crimped connection.

SIMPLE RULES FOR MAKING GOOD TERMINATIONS

RULE # 1:

Never allow the connector to be the only support for any appreciable length of wire. The wire must be supported so there is no movement relative to the connection. This is true even if you are wiring between two components that must move with respect to each other. The wire must be supported so there is no movement AT THE TERMINAL!

RULE # 2:

A ***GOOD*** type X connection is better than a ***POOR*** type Y connection. Insert your choice for X and Y. If I could get a good crimping tool, and good crimping terminals, I would never make another soldered connection. The joints made by the factory, using automated crimping tools, are unbeatable. The tools that are available for the average person are only OK at best, and terrible if not used properly. If you notice, the jaws on most crimping tools do not close completely. If you use the correct size terminal, the correct size wire, and the correct crimping tool opening, and squeeze till the tool stops, you will produce a good crimp. Otherwise, it is possible to crimp too hard, and weaken the wire, or not hard enough, and get a weak connection. The thing that bothers me the most about standard crimping tools is that they crimp "across" the wire. This places a great deal of stress over a very small area, making it very susceptible to breaking due to flex stressing. A "good" crimping tool will make the crimp along the length of the wire, distributing the stress over a larger area.

RULE # 3:

The ***material*** you are soldering must be hot enough to melt the solder. It isn't good enough that the ***soldering iron*** melts the solder. If you touch the solder to the iron till it melts, and let it flow around the wire, it will produce a glob, and the solder will not stick to the wire. It may look like it did, but it didn't. Unless the solder flows when touched to the wire, but not touching the iron, the wire isn't hot enough. Unfortunately, if you hold the solder to the wire, and wait til it is hot enough, the length of time that it takes may melt the insulation. A good technique to use is to melt a glob of solder on the iron, where it touches the connection, and let it flow around the connector. When the connector and the wire are hot enough to melt the solder, you will see the blob of solder flow and smooth out. At this time, the joint is hot enough to complete the soldering by adding more solder to the joint. The glob of molten solder acts as a heat sink, transferring the heat to the joint better than just the contact of the tip of the iron. When a solder connection is made well, the solder flows smoothly, and basically becomes one with the joint. If there is any abruptness in the solder flow, it is probably a cold joint. In other words, if it looks like the solder is just sticking on, it probably is just sticking on. A little practice with some scrap wire and connectors will make this all clear.

RULE # 4:

Use the right heat range soldering iron/gun. Too big is better than too small for our usage. A hot iron will get the joint to the proper temperature quickly, so you can make the connection and get away before the heat has had time to flow to adjacent areas, or up the wire. An iron that is too small will take so long to get the joint hot enough that the wire will be hot for an appreciable length, and might even damage the insulation before you can finish. It is also helpful to use low temperature solder. Radio Shack sells a roll of low temp solder that is just right for this purpose. In addition to being low temp, it also has a small diameter, making it perfect for wiring use. ***Whatever you do, don't use acid core solder, as it will cause severe corrosion later.***

TECHNIQUES FOR SOLDERING BULLET CONNECTORS

Soldering bullet connectors is actually pretty easy, once you get the hang of it. The first thing to do is to make sure you have the right size for the wire you are using. The bare wire should slip into the bullet easily, but with as little excess room as possible. Strip the wire just long enough so the wire end reaches the end of the hole in the bullet, and the insulation *just* slips into the end of the bullet. With the bullet on the wire, hold the iron to the bullet until it is hot enough to melt the solder by itself. Place the solder to the hole in the end of the bullet, and allow the solder to wick up into the bullet, until it has absorbed enough solder to completely fill the void in and around the wire. This guarantees a good joint, as the solder will not flow till the wire and the bullet are both hot enough. You can't get a cold solder joint this way.

If you are making connections on your workbench, rather than in some contorted position under the dash, you can simplify your process by clamping the iron in a vice, thereby freeing both hands. Use one hand to hold the wire and bullet against the iron, and the other hand to feed the solder. Working this way, you can make a lot of GOOD joints in a hurry.

If you are working upside down under the dash, these connectors can be a real pain, as they want to slip off the wire and hide in a crevice where they can't be found. To reduce this problem, try to bend the wire so the wire end is pointing upwards. It will help a lot if the wire is a snug fit in the bullet.

TR250/TR6 WIRE COLOR CODES

Body	Tracer	Code	Usage
Black	None	B	Ground connections
	Blue	B/U	Grounding lead from LH seat sensor to seat belt interlock module (later models only)
	Brown	B/N	Grounding lead from LH seat belt switch to seat belt interlock module (later models only)
	Green	B/G	Connection between ignition key contact and ignition alarm switch (later models only)
	Orange	B/O	Grounding lead from ignition key alarm switch to seat belt interlock module (later models only)
	Purple	B/P	Grounding lead from the PDWA to warning lights (later models only)
	Red	B/R	Grounding lead from RH seat belt switch to seat belt interlock (later models only)
	Slate	B/S	Grounding lead from RH seat sensor to seat belt interlock (later models only)
Blue	None	U	Power from the headlight switch to the dimmer switch
	Lt Green	U/LG	High speed power feed from WSW switch to wiper motor
	Red	U/R	Low beam power from dimmer switch to headlights
	White	U/W	High beam power from dimmer switch to headlights
Brown	None	N	Primary power feed, connected directly to the battery. These wires are NOT fused
	Lt Green	N/LG	Power return from WSW parking switch to wiper switch. This wire IS fused
	Red	N/R	(1) Feed from main power junction box to the alternator sensing input ('69 - '72 models only). This wire is NOT fused (2) Power feed from ignition switch to gulp or anti run-on valve (Later models only). (3) Hot when ignition key is off. This wire is NOT fused
	White	N/W	Primary power feed, connected to the ammeter on earlier models. These wires are NOT fused
	Yellow	N/Y	Alternator failure warning lamp connection to the alternator. This wire is NOT fused
Green	Black	G/B	Fuel gauge to sending unit
	Blue	G/U	Temperature gauge to sending unit
	Brown	G/N	Power from back-up light switch to back-up lights; high speed lead from switch to heater fan
	None	G	Main power feed to loads that are operable only when the ignition key is on. These wires ARE fused
	Lt Green	G/LG	Power feed from transmission neutral safety switch to seat belt interlock module (Circa '74, '75 models only)
	Purple	G/P	Power feed from brake light switch to brake lights
	Red	G/R	LH turn signal leads from TS flasher
	White	G/W	RH turn signal leads from TS flasher
	Yellow	G/Y	Oil pressure gauge to sender; Low speed lead from switch to heater fan

TR250/TR6 WIRE COLOR CODES

Body	Tracer	Code	Usage
Lt Green	Black	LG/B	Power feed from switch to WS washer
	Brown	LG/N	Output of turn signal flasher to turn signal switch
	Green	LG/G	Output of hazard flasher from hazard flasher switch (later models only)
	Orange	LG/O	Grounding lead from seat belt interlock module to seat belt warning light (later models only)
	Pink	LG/K	Output from hazard flasher to hazard flasher switch (later models only)
	Purple	LG/P	Power feed from hazard flasher to hazard flasher warning light (early models only)
	Slate	LG/S	Power feed from hazard switch to turn signal flasher (later models only)
	White	LG/W	Bulb test relay to EGR switch and warning lamp ('76 model only)
Pink	White	K/W	Ballast resister wire
Purple	Black	P/B	Grounding lead from horn push button to horns or horn relay
	None	P	Power feed to loads that are hot all the time, key on or off. These wires are fused
	Red	P/R	Power feed from hazard flasher switch to hazard flasher/relay (early models only)
	Slate	P/S	Bulb test relay to oil and brake warning lamps ('76 model only)
	White	P/W	Grounding leads from door, trunk, and glove box switches
	Yellow	P/Y	Power feed from horn relay to horns
Red	Green	R/G	Power feed from headlight switch to fuse for parking, marker, tail, license plate, and gauge lamps
	None	R	Power to parking, marker, tail, license plate lamps, & dash light dimmer from fuse
	White	R/W	Power to gauge illumination lamps from dimmer rheostat
White	Black	W/B	Grounding lead from the PDWA to warning light (early models only)
	Brown	W/N	Grounding lead from oil pressure switch to warning light
	Orange	W/O	Start signal return from seatbelt interlock to starter relay ('74 only) Start signal return “hardwired” from seatbelt interlock to starter relay ('75 only) Signal from starter to “bulb test relay” and to seat belt module (’76 only)
	Purple	W/P	Grounding lead from oil pressure switch to gulp or anti run-0n valve (later models only)
	Red	W/R	Power feed from ignition switch to/from starter relay or solenoid (to seat belt interlock for circa '74 models)
	None	W	Power feed from ignition switch. Hot only when key is in run or start position These wires are NOT fused
	Yellow	W/Y	Ballast resister bypass lead from starter relay or solenoid to ignition coil (later models only)
Yellow	Green	Y/G	OD relay switching lead to OD switch (early models).Solenoid Power feed to OD &transmission permissive switches (later models)
	Purple	Y/P	Power feed from OD relay (early models) or OD switch (later models) to OD solenoid
	None	Y	OD relay switching lead from transmission permissive switches to OD switch (early models only)