

Ref:	NR/L3/SIG/11303/1H05
Issue:	2
Date:	4 September 2010
Compliance date:	4 December 2010



Level 3 Module

Signalling Installation – Tools and Techniques: Wire Connections and Crimping

Endorsement and Authorisation

For endorsement and authorisation, please refer to NR/L3/SIG/11303.

This module is a reformatted version of the previous Signalling Installation Handbook with no change to the content other than correction of terminology.

It represents historic best practice which may no longer be relevant.

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Published and Issued by Network Rail, Kings Place, 90 York Way, London. N1 9AG.

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Issue record

Issue	Date	Comments
2	September 2010	Reformatted version of previous document incorporating the text of the installation handbook.
1	August 2000	First issue

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 4 December 2010.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

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1 Introduction

The techniques described in this module apply to all conventional safety signalling wiring, and where possible should also be applied to non-safety connections. Exceptionally, such as within plugs, sockets, lampholders, etc., restricted space may prevent the use of a crimped connector on a multi-strand wire before termination. Electronic equipment generally has special plug and socket connections, and some connectors (the older non-standard relay spade, for instance) are designed for soldered connection only.

2 General Rules

Wherever possible, a multi-strand conductor should have a crimped connector fitted.

A solid strand conductor is normally connected to a pillar terminal by forming a loop of wire. An exception is where the diameter of the conductor is less than the thread pitch of the terminal post. In this case, a crimped connector is used. Without the crimped connector the thin wire might become trapped in the thread groove and be severed as the nut is screwed down.

3 Wire Loop Connection

- a) It is an advantage if your round-nose pliers are first marked for 0BA and 2BA terminals. Push one of each size of washer tightly onto one nose of the pliers (See Figure 1). Mark completely around the nose, just on the lower side of each washer. Remove the washers and use the marks to position the wire when forming a loop.
- b) Remove the insulation with a properly adjusted stripping tool. (See Module 1H10 - Wire Stripping.)
- c) Do not use a knife. The strip needs to be approximately 20mm for 2BA and 30mm for 0BA terminals. Form the neck by bending the wire at right angles, 3mm from the insulation (See Figure 1).
- d) Hold the wire in the round-nosed pliers and form a loop by rotating the pliers (See Figure 1).
- e) Cut off surplus wire with side cutters. Re-form the loop if necessary so that there is approximately 1mm gap.
- f) When complete, check that the loop slides easily onto the terminal.

Points to note (refer to Figure 1):

- If labels are to be used, they should be slid onto the wire before forming the loop.
- The loop needs to go clockwise around the pillar.
- The loop should be just large enough to move freely over the terminal.

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- Mount the loop between washers.
- The insulation should stop just short of the washers.
- Do not overlap the wire loop on itself.
- The loop should be properly formed as shown. The wire should not be just wrapped round the terminal.

Figure 2 shows the correct arrangement of nuts and washers on 0BA and 2BA terminal blocks.

4 Crimping Tools: Points To Note

Crimping tools need to be hydraulic or ratchet type.

Use only authorised types.

Use the correct type of tool to suit the crimp being used.

Inspect the crimping tool daily. Check that it is complete, undamaged and clean.

If you have any doubts about the tool's condition or accuracy, do not use it. Seek your supervisor's advice.

Arrange for tools to be sent for inspection annually or whenever it appears to be faulty.

Crimping tools are precision tools. Look after them and do not use them for anything other than their designed purpose.

5 Crimp Connectors For Terminations With Nuts And Screws

The type of crimp connector to be used should be vibration resistant. The AMP name for such terminals is PIDG (Pre Insulated Diamond Grip), but there are other manufacturers' compatible products.

It is essential that the correct tool is used with a particular crimp connector. Usually a colour code helps you to check this. With AMP tools the colours of the connector end and the tool handle correspond. Other tools may have coloured spots to show which part of the head to use.

Choose a connector that suits the wire size. In addition the connector should be the right termination style. For example:

- Ring tongue for terminal studs.

Blade type for grub screw and pressure plate (tunnel type) terminals. Check that the blade is a suitable length and width for the terminal. Occasionally, the terminal block is designed to accept only a circular cross section conductor, in which case a pin type connector should be used.

Hook type for RS 32 and 63 fuses and track circuit fuse/links (including fuseholder type 32H).

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Do not deform, cut, or alter a connector to overcome terminating difficulties.

Put only one wire in each connector.

Note that aluminium cored power cables require special crimp connectors and terminals. See Module 2A10.

6 Crimp Connectors (Spade Style) For Terminations To Relay Plugboards

These are spade shaped connectors that slide and clip into the plugboard. A connector can have one or two wires crimped to it.

The spade used needs to be the correct style to suit the plugboard (See Figure 3). The shape of the spade is the recognising feature rather than any name stamped on it.

The only spades that can be crimped are the Westinghouse and the SGE (also known as modern GEC) styles, and different crimping tools are required for each of these. All other types of spade connector (including those for "P" series plug-in relays) require soldered connections.

Note that the Westinghouse type of plugboard and spade is now the standard for all new work. When making alterations to existing installations, check the make of relay plugboard and obtain the same make of spade.

Before using a spade, check that it is untarnished. Discard any that are discoloured.

Relay spades with only one wire connected should be installed so that the single wire is always on the same side (usually the left) when fitted into the plugboard. This assists wire counting and checking.

Do not deform, cut, or alter a connector to overcome terminating difficulties.

If a crimp is faulty, cut the connector off the wire and start again.

When inserting spades in the plugboard, make sure the spades are the correct way round. (See Figure 4.)

Push the spade carefully home. Do not push so hard that the spade is forced in too far. In the case of the Westinghouse style spade you may, if necessary, use the insertion (stubby) end of the insertion/extractor tool to push the spade fully in. Do not use any other type of tool for this purpose.

The spade should slide in smoothly and click into position. After insertion, give the wire(s) a gentle pull to check that the latching tab has operated.

When a considerable number of new plugboards have been completely wired, you can make a quick additional check using the following method.

- Before any relays are plugged in, view the plugboards from the relay side and shine a small bright torchlight beam at the plugboard face and at an angle of about 30 degrees to the line of sight (See Figure 10).
- Reflections from the end of the spade will stand out brightly and indicate how the spade is seated in relation to the slot wall. Figure 10 shows the

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appearance of correctly fitted spades and also how various types of faults will show up.

- While carrying out this check, bear in mind the relay contact and coil arrangement (cross checking with the relay contact analysis if necessary) and you will also be able to spot:
 - missing spades and wiring.
 - extraneous spades and wiring.
 - spades inserted in the wrong slot.
 - incorrect coil connections.
- Correct any errors found. Refit faulty spades, replacing any that are damaged. If a plugboard is damaged, replace that also.
- Keep a watch for any dirt or fragments of wire or insulation lodged in the spade slots. Blow or gently probe out anything that should not be there, making sure that it doesn't then fall into some other unsafe place.

Use only an approved extractor tool to remove spades from plugboards (see Figure 5). Use the tool carefully, and with extreme care when a relay is inserted into the plugboard. With the Westinghouse type, make sure it is inserted squarely between the flat side of the spade and the plugboard, push it fully home, and then withdraw the spade and extractor together. With the single prong types, insert the prong only sufficiently far to be able to lift the locking tab or notch clear to allow withdrawal.

7 Crimp Connectors – Faston Style

These connectors are a push-on fit to a tab on the equipment termination. Several different sizes are available, but the miniature size is most common and fits the plugboards of the continental style relays used in the Alstom High Voltage Impulse Track Circuit equipment. The AMP connector for these relays is:

- Faston PIDG, .110 series, for .020" tab thickness, Part No. 640923-1

This AMP connector has red coloured insulation to indicate the wire and tool size. Crimp these connectors to the appropriate size of wire using an AMP red handled tool. The locator will usually need to be temporarily removed to accommodate the connector head, so make sure the connector is correctly positioned before crimping.

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8 Examples Of Crimp Terminals

Colour Code	RED	BLUE	BLACK	YELLOW
Conductor Cross Section (mm ²)	0.25 - 1.6	1.0 - 2.6	1.0 - 2.6	2.7 - 6.6
Maximum Insulation Dia. (mm)	3.7	4.3	6.4	5.8
Wire Size (mm ²)	0.75* 1.15*	1.15 2.5 (f)	0.75# 1.15** 2.5 (f) 2.5	10 2.5 (f)***
Strip Length (mm)	5-6	5-6	6-7	6-7

- * Type A1 insulation fits these crimp connectors but Type A2 does not.
- ** Preferred for Type A2 insulation with Ring Tongue connectors.
- *** Used when jointing track circuit tail cables (but see method in Module 2A10).
- # Use for Type A2 insulation but the conductor needs to be doubled over.

Black terminations give improved wire support and are used in conditions where high levels of vibration are experienced. They are most commonly used for ring connectors for 0BA and 2BA terminals at, for example, track circuit terminations, clamp lock detectors and AWS inductors.

Cable made to specification NR/L2/SIG/00005 (see Module 1D10 under the heading REVISED CABLE SPECIFICATION) have slightly larger insulation than the previous BR 872 cable. Entry into Red and Blue ring tongue crimps is eased if the expanded version of the connector (which has a tapered entry) is used.

Details of all the commonly used types of connector are available from your materials supplier.