

NR/SIG/11231 Signal Maintenance Testing Handbook
NR/SMTH/Part 02
Index
Issue No. 02
Issue Date: 02/03/13
Compliance Date: 07/09/13

Note: The issue status of each SMT is detailed in the NR/SIG/11231 section and in the header of the individual SMT.

This section contains guidance in applying signal maintenance testing.

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1. PURPOSE



Important:

NR/SMTH covers Maintenance Testing of items that are replaced on a like for like basis only.

The purpose of this standard is to define the mandatory procedures and tests for Maintenance Testing of signalling equipment to make sure it is tested with sufficient depth and independence to assure safe working when returned to service.

Maintenance Testing covers both reactive corrective work (e.g. the rectifying of faults and the replacement of faulty items on a like for like basis) and minor renewals (e.g. pre-planned work to renew existing signalling equipment that are like for like) that are not Extensive and Simultaneous.



Definitions of Maintenance Testing and Extensive and Simultaneous can be found in [NR/SIG/11231.](#)

2. SCOPE

This standard is split into 4 defined sections:

- a) Parts 01, and Part 02
- b) Part 03.
- c) Part 04, Part 05, and Part 06.
- d) Part 07.

Parts 01 to 02 detail the references and processes applicable to all Maintenance Testing

Part 03 is applicable to all aspects of Maintenance Testing.

Parts 04 to 06 are applicable to reactive corrective maintenance items only.

Part 07 is applicable to pre-planned minor renewal items that are on a like for like basis only.

Generic outlines of the contents of Parts 03 to 07 are as follows:

[NR/SMTH/Part 03](#)

Covers defined checks and tests that are undertaken as part of Maintenance Testing.

[NR/SMTH/Part 04](#)

Deals with the like for like replacement of signalling assets or missing assets that arise through corrective maintenance activities usually as a result of a failure.

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[NR/SMTH/Part M04](#)

Deals with the like for like replacement of missing signalling assets that arise through corrective maintenance activities.

[NR/SMTH/Part 05](#)

Deals with failure investigation of signalling assets.

[NR/SMTH/Part 06](#)

Deals with like for like replacement of telecom assets or missing assets that arise through corrective maintenance activities usually as a result of a failure.

[NR/SMTH/Part 07](#)

Deals with Maintenance Testing of signalling assets that are like for like but are part of pre-planned activities



Note that more detailed information on Part 07 is contained in [Section 8](#).

NR/L2/SIG/30014, Signalling Works Testing Handbook (NR/SWTH) is applicable where the installation:

- a) is new (has never been Works Tested)
- b) is not a like for like replacement (including operational equivalents)
- c) is additional to an existing working asset that has been Works tested
- d) has a control system or application logic that has been changed by the design.

Maintenance Testing is based on the principle that the equipment was tested properly at commissioning and has been working correctly. The design may therefore be taken to be correct and the work will not require a change to diagrams unless permitted in the maintenance test plan required as a result of correlation.

Appendices for Maintenance Testing are arranged sequentially within this Part 02 of the NR/SMTH. Guidance on the scope of Maintenance Testing and clarification of operational equivalence are included in Appendix A.

Working on equipment that is in service, with further information on disconnection, insulation, releasing, isolation, reset, restoration, diversion and monitoring is covered in [NR/L3/SIG/10064](#) (General Instructions to Staff Working on S&T Equipment).

The principles for the diversion of circuits for various reasons (e.g. from faulty to spare cores, the reallocation of a faulty relay contact and the emergency repositioning of an item of equipment) are given in [NR/L3/SIG/10064/E031](#). Signalling circuits in cables shared with telecommunications functions shall be identified and tested in accordance with [NR/L3/SIG/10064/E041](#).

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A list of commonly used voltages and measurements is provided in [NR/SMS/Part/Z](#) (NR/L3/SIG/10663, Signal Maintenance Specifications NR/SMS) as a ready reference guide. It in no way supersedes the full testing of maintenance requirements laid down in maintenance test plans and other signalling standards.

References are also made to other parts of NR/SMS throughout this standard.

Responsibilities for the process of Maintenance Testing are detailed in the RACI in [Section 10](#).

3. OBJECTIVES of MAINTENANCE TESTING

The objective of Maintenance Testing is to prove that the signalling equipment is safely returned to service. The vital test requirements necessary to prove **safe** working of equipment are listed to validate that none are overlooked.

Checks directed at achieving reliable operation, but which are not directly involved in the safe working of the equipment, are not listed but shall still be carried out.

Equipment covered by Maintenance Testing shall be tested in accordance with the maintenance test plans or missing equipment test plans contained in this standard, unless an equivalent or better alternative is approved by a competent engineer nominated by the Signal & Telecom Maintenance Engineer. This approval process shall include a risk assessment and shall be required to demonstrate that the proposed alternative is no less safe. The requirements for a maintenance test plan and missing equipment test plan are given in [NR/SMTH/Part 02/Appendix B](#).

Wrong Side Failures, accidents and other serious incidents shall be investigated using the guidelines contained in [NR/SMTH/Part 05](#) of this standard (Failure and Incident Testing), unless an equivalent or better alternative is approved by a competent engineer nominated by the Signal & Telecom Maintenance Engineer. This approval process shall include a risk assessment and shall be required to demonstrate that the proposed alternative is no less safe.

This part of Maintenance Testing is not exhaustive but is intended to prove that reported failures are thoroughly investigated, that information is adequately recorded and that vital evidence is not destroyed by the testing.

4. TESTING MANAGEMENT

Maintenance Testing allows for safe testing to suit the varied circumstances of like for like equipment replacement as part of preventative and corrective maintenance where pre-planning cannot be undertaken.

For like for like replacement work that is not a preventative or a corrective maintenance activity and for like for like minor renewals, pre-planning of the work shall be mandatory. The process in [Section 7](#) shall be followed.

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The Maintenance Testing framework is provided as a mandatory support tool for those undertaking like for like replacement work.

4.1 Maintenance Tester

Maintenance Testing shall only be carried out by competent staff endorsed by the Signal & Telecom Maintenance Engineer.

A competent Maintenance Tester shall be in overall charge of the testing. The competent Maintenance Tester shall determine the extent of the work, confirm that the work can be undertaken using the maintenance testing standard and decide which maintenance test plans are appropriate.

4.2 Testing Work

Appropriate maintenance test plan(s) for the work in Part 04, M04, or 06 (corrective maintenance activities) shall be selected and carried out in sequence:

- a) 'Before Installation' tests, checks or preliminary work,
- b) The replacement or diversion work itself,
- c) 'After Installation' tests or checks.

Any errors found in the work during testing shall be corrected by the person doing the work. This shall be rechecked by the maintenance tester along with anything that could have been affected by the remedial work.

If the available diagrams have previously been amended by hand, e.g. with a temporary diversion, details shall be noted as part of the record of test. Maintenance test plan steps which are required but cannot be carried out shall be noted as part of the record of test and advised to the Section Manager (Signals) whose permission shall be obtained before equipment is returned to service.

If the work undertaken is pre-planned, the required maintenance test plan shall be identified as part of the planning process (see [Section 8](#)).

If a maintenance test plan is considered deficient in any way, details shall be noted as part of the record of test and any additional tests carried out before the equipment is returned to service. The query shall be reported to the Signal & Telecom Maintenance Engineer as soon as possible. The Signal & Telecom Maintenance Engineer shall arrange to have the equipment retested if a maintenance test plan is considered deficient. The Signal & Telecom Maintenance Engineer shall be responsible for escalating the deficiency to HQ Signal Engineering (signalengineers@networkrail.co.uk).

4.3 Testing Where No Maintenance Test Plan Exists

Where no suitable maintenance test plan exists for the work to be undertaken in Part 04 or M04, and unless an exemption is stated, a new maintenance test plan shall be produced by the Maintenance Tester. The requirements for a maintenance test plan and Missing Equipment Test Plan are given in [NR/SMTH/Part 02/Appendix B](#).

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Before use, the new maintenance test plan shall be checked by a Maintenance Tester not involved in writing it. This check shall be undertaken on site with reference to the equipment concerned except where the person concerned is sufficiently familiar with the equipment, in which case the new maintenance test plan may be agreed by telephone or checked off site.

If there is not a suitable maintenance test plan for items in NR/SMTH/Part/07, one shall be produced as part of the pre-planning process. The test plan shall be produced by a suitably competence Maintenance Tester and checked by an independent suitably competence Maintenance Tester. The process detailed in NR/L2/SIG/30014/A210 (Design and Testing Process for Minor or Repetitive Alterations) shall be undertaken for this work.

If there is any doubt about the testing required, and whether it can be covered by maintenance testing, the Signal & Telecom Maintenance Engineer shall be contacted.

On completion of the work and testing, the new maintenance test plan shall be forwarded as part of the record of test. The Signal & Telecom Maintenance Engineer shall arrange to have the equipment retested if the maintenance test plan is considered deficient. The Signal & Telecom Maintenance Engineer is responsible for ensuring the notification of a new maintenance test plan is escalated to HQ Signal Engineering.
(signalengineers@networkrail.co.uk)

4.4 Handover Where Testing Cannot Be Completed

If work is partially tested when the work is directly or indirectly handed over to someone else to complete, the record of test shall be completed for the testing that has been done. A copy shall be forwarded to the person continuing the testing.

The person completing the testing shall establish their own record of test, noting down the tests done by the first team Maintenance Tester to achieve a clear understanding of the state of work at handover. Tests documented as satisfactorily completed need not be repeated but any which are not listed as complete shall be assumed not done. Both records of test shall be submitted to the Section Manager (Signals) after completion.

4.5 Testing for Correct Operation

On completion of the required testing defined in the maintenance test plan(s) the part of the signalling system affected by the work shall be checked to prove correct operation.

This check may, for example, involve watching a train pass through a signalled route and observing that the track circuits occupy and clear in the correct sequence; signals are restored to danger, etc. It may involve observing that points move in correspondence with the signaller's controls.

If equipment cannot be safely restored to service, then the provisions of the GE/RT8000 (Rule Book) module T1A for failed equipment shall be applied.

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4.6 Testing After Replacement of Missing Equipment

Missing equipment shall be replaced using Maintenance Testing principles and Missing Equipment Test Plans. To qualify for replacement the missing equipment shall have been present and working prior to its damage or removal. Complete and accurate diagrams shall be available and the work shall not require any change to diagrams. A like for like equivalent replacement item shall be used.

Particular care shall be taken to check that critically positioned equipment is replaced in the correct position and orientation, on the correct line and as indicated on the relevant diagrams.

For example, a missing strike-in and strike-out axle counter head shall be replaced in the correct position to define the end of one axle counter section and the beginning of the next; a TPWS over speed loop shall be positioned to correctly detect a train travelling too fast. There are many further examples.

When dealing with missing equipment any other equipment nearby shall be checked for damage or disturbance.

4.7 On Completion of Testing

Before the equipment is returned to service, the work and all testing shall be completed and a record of test produced, unless exempted in the maintenance test plan. Any test instrumentation or straps provided for testing shall be completely disconnected from the commissioned system, except where permitted by [NR/L3/SIG/10064/U033](#) and [NR/L3/SIG/10064/U034](#).

On completion of the maintenance testing work the Maintenance Tester shall check that the installation / equipment is left in a secure condition and that adequate arrangements have been made for the prompt removal from site of any displaced equipment. Where manual handling is practicable, this removal shall be immediate.

Finally, the signaller shall be requested to restore any signalling functions operated for testing, e.g. cancel routes and normalise levers. Where applicable, the system shall be restored to its normal state in accordance with [NR/L3/SIG/10064/B003](#), i.e. with no stored conditions, before it is permitted to re-enter service.

5. STAFFING

The primary requirements for persons undertaking Maintenance Testing are independence and competence.

5.1 Competence

Maintenance Testers, Fault Finders and Incident Investigators shall be competent in accordance with NR/L2/CTM/012 and hold or be working towards an appropriate IRSE licence, as required by NR/L2/SIG/10160.

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Staff undertaking correlation activities shall demonstrate additional competency in accordance with NR/GN/SIG/11115.

The Signal & Telecom Maintenance Engineer shall be responsible for all staff under their control undertaking Maintenance Testing activities having valid competencies and authorities to work before undertaking this work.

Test instrumentation shall be used only by those deemed competent in its use. Multimeters, insulation testers and track circuit shunt boxes, for example, are considered to be part of general usage for those appointed to posts involving their application. However, the use of specialist test instrumentation, including any mains powered device, requires training appropriate to the equipment involved and additional competence assessment, as described in [NR/L3/SIG/10064/U033](#). Further requirements for tools are given in [NR/L3/SIG/10064/U011](#).

- For fault finding and incident investigation competencies, see also [NR/SMTH/Part 05/S001](#).

5.2 Independence

Maintenance Testing can be used to achieve independent verification of installation work. The Maintenance Tester shall be independent of the installer, except in the case of some straightforward replacements where the maintenance test plan is endorsed 'Independence Exempt'.

The nominated Maintenance Tester is wholly responsible for checking that the work is restored to use in a safe condition. Consequently, the Maintenance Tester shall not carry out or direct (but may assist) the work which will subsequently be verified by the Maintenance Testing.

Any new Test Plans shall be produced by a qualified Maintenance Tester and shall be checked by an independent qualified Maintenance Tester.

The disconnections described in [NR/L3/SIG/10064/B002](#) shall be planned and designed by a qualified maintenance tester and shall be checked by an independent qualified Maintenance Tester.

- For fault finding and incident investigation independence, see also [NR/SMTH/Part 05/S001](#).

6. SITE & TEST RECORDS

Maintenance Testing is based on the assumption that equipment is correctly wired and correctly documented before work commences. Complete and accurate site records shall be available at each installation. A record of test shall be provided by the Maintenance Tester for each replacement or alteration unless exempted in the maintenance test plan. The requirements for test records are given in [NR/SMTH/Part 02/Appendix C](#).

- Site and test records for pre-planned work are detailed in [Section 7](#).

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6.1 Testing with Site Records

The installation shall be checked by the Maintenance Tester against the diagrams before work is started and again after work is complete to check that the installation is correct. The extent of this correlation activity shall be defined in the maintenance test plan or missing equipment test plan.

6.2 Testing where Site Records have been Amended

If, when needed for fault rectification or renewal work, diagrams are available but have an unsigned and undated amendment which affects that work, the work shall **STOP**. Advice shall be sought from the Section Manager (Signals). This shall also apply to any diagrams found marked 'Installation Copy'.

The action to be taken shall be as follows:

- If the diagram shows amendments it shall be thoroughly checked to the wiring on site. If the diagrams are clear and in agreement with the wiring the Section Manager (Signals) may allow work to continue. Arrangements shall be made to obtain revised diagrams within six weeks. If revised diagrams cannot be supplied within six weeks, the Signal & Telecom Maintenance Engineer shall be advised and suitable arrangements made to reduce any risks to as low as reasonably practicable. In both cases a note shall be included with the record of test.
- If the diagrams are unclear, or if a discrepancy with the wiring is found, the Section Manager (Signals) shall arrange for the discrepancy to be resolved and determine an appropriate method for the work to be completed. Design assistance to produce any revised diagrams shall be arranged.

Diagram amendments reported that are unrelated to the work shall be dealt with using the local procedures for arranging revised diagrams.

6.3 Testing where Site Records Differ from Wiring

If a difference is discovered between the wiring being worked on and the diagram, the work shall **STOP**. Advice shall be sought from the Section Manager (Signals)

The action to be taken shall depend on the extent of the difference. In all cases where the diagrams are related to the work in hand a note shall be included with the record of test and arrangements made to obtain revised diagrams within six weeks:

- If the difference only involves the looping arrangement or contact / terminal allocation detail and is otherwise electrically identical, the Section Manager (Signals) may permit the work to proceed. The diagram shall be suitably amended, signed and dated in red
- If any other discrepancy is found the Section Manager (Signals) shall arrange for the discrepancy to be resolved and determine an appropriate method for the work to be completed. Design assistance to produce any revised diagrams shall be arranged..

Diagram discrepancies reported that are unrelated to the work shall be dealt with using the local procedures for arranging revised diagrams.

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6.4 Testing where there are No Site Records

If site records are missing, the work shall **STOP**. Advice shall be sought from the Section Manager (Signals).

The action to be taken shall depend on the work being done. Where work is permitted to continue, as outlined below, the appropriate maintenance test plan(s) shall be used. In all cases a note shall be included with the record of test and arrangements made to obtain revised diagrams:

- a) If the equipment being changed is a pin-coded plug-in component, the Section Manager (Signals) may allow the work to proceed omitting any requirement to check to the wiring diagram.
- b) If the component is a simple piece of equipment not involving control circuitry, the equipment may be changed on the authority of the Section Manager (Signals) who shall take into consideration the experience of the staff doing the work and testing. A sketch drawing shall be produced showing the wiring connected to the equipment which shall then be used in lieu of the proper diagram. The sketch shall be left on site, signed and dated in red. Transformers and lamp holders are typical of the equipment that can be dealt with in this way.
- c) If the equipment involves control circuitry, additional testing resource shall be involved in the change. Design assistance to produce any revised diagrams shall be arranged. The work shall be tested using NR/L2/SIG/30014 (NR/SWTH).

6.5 Test Records

The Maintenance Tester shall complete a record of the testing carried out and forward it to the Section Manager (Signals) at the first opportunity after the end of the shift. The record of test, including original Test Plans and NR/SMTH logbook sheets, shall be checked and retained by the Section Manager (Signals) for the lifetime of the equipment, in a manner that permits the location of specific records at a later date. A system shall be in place to routinely check returns from each team as well as a more thorough check at least once every three months. This check shall determine that the appropriate maintenance test plans have been used and that sufficient detail has been recorded. Deficiencies shall be followed up by appropriate corrective action such as monitoring or retraining.

6.6 Version Control of Site Records

- If there is reason to doubt that the site records are the latest version, ask your Section Manager (Signals) to confirm the status with the Network Rail Records Group.

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7. Pre-Planned Work and Non Corrective Maintenance Testing

7.1. Introduction

This section details the requirements for Maintenance Testing that are like for like replacements but are not part of reactive corrective maintenance activities and shall therefore be pre-planned.

7.2 Pre-Planned Like for Like Replacements

These activities can include items that are like for like replacements (e.g. relay re-servicing, Silec treadle replacements, installing and change over of a top nutted cable etc) but are not corrective maintenance activities (undertaken as part of reactive failure rectification).

Maintenance Testing of large items including the like for like replacement of a point machine, or the like for like replacement of a signal head shall also be undertaken as part of this section.

If any installation work is carried out off site in advance of site work, this shall be Maintenance Tested as per [Section 4.2](#). The extent of the Maintenance Testing completed shall be recorded. The record of the off site testing shall be included with the technical information details described in [Section 7.3.3](#). The record shall clearly indicate the item of equipment it applies to, i.e. by serial number or other unique identifier.

Details of the process required to undertake these activities are in [Section 7.3](#).

7.2 Testing Process Flowchart

In all cases the decision process flowchart in [Section 9](#) shall be used to establish if this section is applicable to the work to be undertaken.

7.3. Pre-Planned Work Process

7.3.1 Work Items

All Maintenance Testing activities that are included in NR/SMTH/Part 04 and Part M04 shall including in this process if they are pre-planned activities.

In addition corrective items that have arisen because of a failure but cannot be replaced on a like for like basis as part of the corrective maintenance process due to of accessibility of track assess or replacement item access (e.g. replacement of a point machine) will therefore have to become planned work and shall be included in this process.

The Section Manager (Signals) shall be responsible for planning the work. The Signal & Telecom Maintenance Engineer shall be accountable for the overall process.