

Level 2

Operational Telecommunications - Maintenance Testing and Failure Investigation Process (TMT&FIP)

Endorsement & Authorisation

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6th December 2009

Compliance

This Network Rail Company Procedure is mandatory and must be complied with by Network Rail and its Contractors from 06th March 2010.

When this Company Procedure is implemented, it is permissible for all projects, which have formally completed GRIP Level 4, to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the Head of Telecoms has stipulated otherwise in the accompanying Briefing Note.



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1. Purpose

This procedure defines the minimum requirements to ensure that the reinstatement of previously working operational telecommunications equipment is tested properly to assure continued safe working when returned to service and that all safety related failures are thoroughly investigated.

In this manner compliance to GK/RT0209 parts D & E will be achieved.

2. Scope

The contents apply to all persons engaged in the maintenance and faulting of operational telecoms equipment and systems provided solely for operational purposes and also any equipment and systems which are indirectly used for safety related purposes. This includes all network bearer services utilising Network Rail owned infrastructure.

3. Reference Documentation

Reference No	Title
RGS GK/RT0209	Testing and Commissioning of Signalling and Operational Telecommunications Systems

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4. Definitions

Check	Ensure correct by visual, audible and/or physical inspection
Commissioning	The process by which equipment or systems are made ready for service following replacement and /or testing.
Design	Documented information which describes the operational and safety requirements of telecommunications equipment or systems. This is used along with engineering details to procure, install and commission equipment and systems.
Independence (see section 7.5)	Independent checking means that one MT undertakes the work and another MT checks or where appropriate, tests it.

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**Like for like replacement
(see sections 7.2.4 & 7.10)**

The removal and restoration of an item of equipment, including a cable or jumper, in a previously working and commissioned system where the work does not change the design or configuration.

Local Manager

A person with line management or appropriate engineering supervisory responsibility for staff using the Maintenance Testing process.

Maintenance Tester (MT) (see section 7.4)

A person competent and certificated in the application of Maintenance Testing and Failure Investigation processes.

**Missing Equipment
(see section 9.2)**

Equipment which was previously working and which is physically missing or separated from its normal position.

**Monitor
(see section 7.11)**

The connection of test equipment or a system of regular checks or surveillance to continuously record equipment or system performance.

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Note	Clearly record the facts on the record of test log at the time of discovery.
Operational Telecommunications Equipment	Telecommunications systems and equipment used for authorising and safeguarding the movement of trains, and communications systems and equipment provided for safety purposes in the direct operation of the railway.
Operationally equivalent (see section 7.10)	The replacement item of equipment, software, hardware or firmware is functionally identical to the item it replaces.
Safety-related Application	The use of a product which, if it fails to conform to the safety requirements pertinent to the application, could increase the risk to trains, persons working on the railway or the public.

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**Safety Related
Telecommunications
Failure**

A failure of an operational telecommunications system or item of equipment which may result in an increase in risk of an incident (due, for example, to the absence of, or deterioration of control measures necessary to prevent an accident.)

Software

A computer programme which can perform pre-defined functions.

SRTF

Safety Related
Telecommunications Failure

System

An organised set of sub-systems, people and procedures capable of providing a service or executing a function or defined set of functions.

Tail Cable

An external cable running from an apparatus case, relay room or disconnection box to an item of equipment.

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Temporary Diversion of circuits (see section 7.12)

The short-term reallocation of circuits or emergency repositioning of an item of equipment which has been operating correctly.

Test

Ensure correct by measurement using test equipment, gauge or tool or by operation.

Test Guides

These contain the recommended steps and are not intended to be a comprehensive test sequence in the right order for every circumstance. Each guide is separately numbered for convenience and to facilitate updating. Tests considered most relevant to the reported problem or observed symptoms should be carried out first. All non-destructive tests must be undertaken before moving to destructive testing. Testing should include associated equipment and circuits which could have led to the failure. It is important to always consider possibilities beyond the 'obvious' cause.

Validation

Demonstration by test, analysis or audit that the equipment or system meets the requirements in all respects.

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5. Responsibilities

Responsibility for this process is shared between Network Rail and other maintainers of operational telecommunications equipment and systems.

Organisation	Post	Responsibility
Network Rail	Telecoms Engineers	Monitor implementation and management of process.
Maintainers	Line Managers	Implement and supervise process. Escalate problems within or to Network Rail.
Maintainers	Technicians and Engineers	Use process in the field. Escalate problems to Line managers
Maintainers	Control Staff	Use the failure management parts of TMT&FIP including collation of failure information and inputting to failure management systems as required. Escalate problems to Line managers
New Works	Line Managers	Implement and supervise process where equipment and systems are carrying operational telecoms traffic but are not yet formally handed over to the maintainer.
Installation Works	Technicians and Engineers	Use process in the field where equipment and systems are carrying operational telecoms traffic but are not yet handed over to the maintainer

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6. Introduction

6.1. Arrangements for undertaking failure investigation and maintenance testing of operational telecommunications equipment and systems are contained in 3 sections of this procedure which are collectively known as the Telecommunications Maintenance Testing and Failure Investigation Process (TMT&FIP), they are: -

- Section 7 which describes the general requirements which must be complied with in order to use the TMT&FIP.
- Section 8 which describes the failure investigation aspects of the TMT&FIP.
- Section 9 which describes the Maintenance Testing aspects of the TMT&FIP

6.2 The same information is contained in a green Filofax binder and is used in the field by technicians and engineers. This is known as the Telecommunications Maintenance Testing and Failure Investigation Handbook (TMT&FIH).

7. General Requirements

7.1 Objective of Process

7.1.1 The objective of the TMT&FIP is to ensure the fundamental causes of safety related operational telecommunications failures are identified and through maintenance testing, equipment is returned to service in a safe and controlled manner and that any replacements are working correctly.

7.1.2. This is achieved through the use of Failure Investigation Guides and Maintenance Test Plans which require the maintenance tester to carry out the work in carefully controlled steps that reduce the risk of introducing a SRTF.

7.1.3. Where the outcome of the failure investigation process is such that –

- the immediate cause of the failure cannot be identified **or**
- the failure condition has cleared and cannot be replicated **and** the equipment is being returned to service

then control measures commensurate with the risks of returning the equipment to service without having identified and rectified the original failure condition must be implemented.

7.1.4. The maintenance testing process is intended to ensure that all items of hardware, firmware and software that are disturbed or replaced are returned to service in a manner that does not introduce the risk of a SRTF.

7.2. Application

7.2.1. The TMT&FIP applies to testing work on all equipment and systems that are carrying operational telecommunications traffic. This includes bearer circuits carried over Network Rail owned infrastructure.

7.2.2. Equipment and systems must have been previously working and commissioned and the design must remain unchanged. New installations that are carrying operational telecommunications traffic but are not yet handed over to the maintainer are also included.

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7.2.3. Use of the process may arise as a result of –

- a failure where Investigation Guides are used to identify the fault condition and where a Maintenance Test Plan is then used to replace and test a replacement or,
- routine maintenance, renewals or interruption of working equipment has taken place for other reasons and Maintenance Test Plans are then used to test and verify the equipment before handback for use.

7.2.4. In both the situations described in section 7.2.3 alterations to working operational telecoms equipment or systems are involved. These may take the form of a like for like replacement of an item of hardware, firmware, software, temporary circuit diversion or replacement of a missing item of equipment. Where like for like replacement is not possible an operationally equivalent item must be installed.

7.2.5. The TMT&FIP normally applies to individual items of equipment where they are associated with the same failure, routine maintenance or maintenance renewal work, but may also be applied to multiple items of equipment where they are associated with the same routine failure or maintenance work.

7.2.6. Where the installation is new, the design has changed or the work involves more work than is normally associated with a routine maintenance or failure task, then the contents of this procedure do not apply. In these circumstances a work package plan must be produced to undertake the work. This may draw upon the TMT&FIP including the use of Test Plans for inclusion where the contents will assist the testing and are appropriate to the work being undertaken.

7.2.7. The failure investigation part of the process applies to all reported failures that have a safety related implication. It should be assumed all reported failures are safety related until proven otherwise.

7.2.8. The process does not apply to train borne equipment where maintained by non Network Rail staff or product acceptance testing. Health and Safety requirements are not included in this procedure.

7.2.9. Failure investigation and maintenance testing work may only commence once arrangements have been made with the signaller to work on the equipment involved and any necessary line protection or special method of working has been put in place. Any repairs and tests that may affect the availability of signalling or operational telecommunications services must be carried out in accordance with the Rule Book.

7.2.10 When it is necessary to operate a signaller's control terminal as part of the TMT&FIP, the signaller shall be requested to do so or his permission be obtained.

7.3. Staffing

7.3.1 The testing of operational telecommunications equipment and systems falls within the scope of the Railway and Other Guided transport Systems regulation 2006. Any persons who carry out Maintenance Testing and / or undertakes safety related failure investigations shall be competent to work on the equipment or systems involved and shall also be competent in the TMT&FIP.

7.3.2. Local managers and other persons involved in managing the process are required to be competent in the management aspects of the TMT&FIP.

7.3.3. The method of determining competence for the TMT&FIP aspects of 7.3.1 and 7.3.2. is by attendance at an approved training course and further by a process of recognised work place assessments using an approved Network Rail assessment method in order to retain competency the

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assessment should be successfully completed within 12 months of attending the TMT&FIP course. Failure to do this will necessitate the individual re-attending the course to ensure competence is sufficient.

7.3.4. Persons assisting in the TMT&FIP but who are not actually responsible for using the process are not required to be TMT&FIP competent. Typical examples are cable jointers assistants and those working under instruction from the MT.

7.4. Maintenance Tester

7.4.1. A Technician or Engineer using the TMT&FIP is defined as the MT and must comply with the criteria shown in 7.3. This person is responsible for the work and for the work of any subordinate testing staff including those undertaking workplace training.

7.4.2. For most day to day applications of the TMT&FIP, the MT will both undertake the work and be responsible for checking or testing it. This does not however apply where independence is required.

7.5. Independence

7.5.1. Independence means that one MT undertakes the work and another MT checks or tests the work to ensure it has been properly completed and the equipment or system is functioning correctly.

7.5.2. Because the risks associated with operational telecommunications equipment and systems are generally not high, independence is only required under those circumstances where considered beneficial to ensure safe operation of the equipment or system that have been worked on.

7.5.3. The MT is responsible for determining if independence is required. Typical circumstances under which independence is required are as follows –

- Where mandated by the Maintenance Test Plan
- Where the size or complexity of the work is such that the risks imposed are sufficient to justify independence
- Where the work has involved a testing method statement because of the need for pre planning (see section 7.7)
- Changes to firmware, hardware or software issue levels. Note that any system upgrades should NOT be undertaken under the TMT&FIP
- Where the validity of records or information required to undertake the work is in doubt and independence would reduce associated risks
- Where use of an operational equivalent provides enhanced features and there is a risk these may impact on performance.

7.5.4. Where independence is required, the MT undertaking the final checks or testing must not have been involved in undertaking any work leading to the requirement for independent maintenance testing. It is however permissible to have participated in the peer review process (see section 8.3).

7.5.5. If the MT encounters circumstances where the need for independence is unclear or there is insufficient information regarding the work to determine the need for independence, this should be referred to the local manager who must investigate and advise the MT how to proceed.

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7.6. Records of Work Undertaken

7.6.1. Whenever the TMT&FIP is used, a record of the work must be kept in the MT logbook. All sections of this must be completed and if necessary further information may be recorded on the back or on an attached piece of paper (see section 7.6.4). Once the work is completed, the white page must be returned to the local manager, one copy left on site if facilities exist and the other remains in the logbook for safe keeping by the MT.

7.6.2. Where the maintainer wishes to use an alternative method of keeping records, for example an electronic system, this is permissible provided it contains as a minimum the same information which is contained in the log book with an equivalent audit trail.

7.6.3. When using the TMT&FIP it is essential to record all relevant information that may be of use to help undertake the work and importantly for future analysis purposes. In particular when undertaking failure investigation, care should be taken to note the facts as they are discovered and to record any information that may disappear as the work progresses. Any information given by members of the public must be recorded with particular care remembering that they may use words that have a specific meaning in railway terminology in a different way.

7.6.4. Typical supplementary information that may be recorded on the record of test is as follows

- Reference to any testing method statement produced (see section 7.7)
- Details of any involvement by the local manager
- Details of any significant measurements, readings or observations taken during the work
- Any train related information, unit number, formation, A or B cab, drivers name, depot etc.
- Names and involvement of any member of the public, non S&T staff, witnesses if appropriate
- Details of handover over the work to another MT or that work is a continuation of work by a previous MT.
- Any changed hardware, firmware or software
- Any steps in the Failure Investigation Guides or Test Plans not undertaken and why
- Any items sent for repair
- Any outstanding action and whom they have been reported to.

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7.6.5. Additionally all record systems (e.g. record cards, log book, cable rigs) shall be updated as appropriate by the MT.

7.6.6. Where equipment has built-in logging of events, arrangements should, if appropriate, be made to recover and protect any data. This includes voice recordings and event monitoring equipment. Arrangements shall also be made to archive the data for future reference in accordance with Network Rail requirements.

7.6.7. Records of testing must be stored by the maintainer for a minimum of 5 years and arrangements be agreed locally with the Network Rail engineer to regularly verify compliance by reviewing the stored records and instigating appropriate actions to address any weaknesses that are identified.

7.6.8. Local arrangements must be in place to ensure copies of the record of test forms, or the information contained in them, are forwarded to those persons responsible for analysis of data within the maintainer's organisation.

7.7. Pre-Planning of Work

7.7.1. Under certain circumstances, work should not be undertaken immediately but should be pre-planned. This minimises unforeseen problems and allows for the right conditions to be established with appropriate resources organised and thus helps ensure satisfactory completion of the work without introducing un-acceptable risks.

7.7.2. The testing Method Statement shown in appendix B should be used to pre-plan work. Typical examples of work that may (depending upon complexity) be pre-planned are as follows –

- Where a failure has been identified and it is not practical to undertake remedial work because of the prevailing circumstances. For example a lineside cable fault that requires a possession to repair or one circuit on a failed concentrator where repairs cannot be undertaken without a possession of the concentrator during a quiet period. Where a failure has been reported but it is not possible to carry out the investigation work immediately because of prevailing circumstances. For example the equipment involved cannot be accessed for safety reasons or because to interrupt the equipment for testing work could impact on other circuits.
- Where the work is complicated or requires several MTs to be involved. For example a software change to a different issue level or extensive testing on a transmission system that will involve other working circuits.
- Where maintenance renewal work is being carried out. For example repositioning a lineside telephone.
- Where the use of equivalents may introduce the risk of a SRTF occurring for example because a replacement is not an exact operational equivalent and a near equivalent is being introduced in order to restore service. Under these circumstances the testing requirements must be enhanced to cover any possible eventuality.

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7.7.3. All sections of the testing method statement must be completed and the section called 'Description of Testing Methodology' should be used to explain how the work will be done, what Failure Investigation Guides and/or Test Plans will be used, special testing requirements necessary because the replacements may impact on equipment performance (e.g. hardware, firmware or software). If the work undertaken actually varies from the plan, this should be recorded.

7.7.4. Where generic method statements for the work to be undertaken already exist in the maintainers organisation, it is permissible to use these as the basis for preparing the testing method statement which should refer to them but it does not eliminate the need for preparation and use of the TMT&FIP specific testing method statement. For example a copper cable jointing method statement could be used as the basis for a cable repair

7.7.5. When the work is completed, the testing method statement forms part of the record of test to which it should be attached when submitted to the local manager.

7.8. Handover Where the Work cannot be completed

7.8.1. Where a MT commences a task using the TMT&FIP but is unable to complete the work and it is handed over to another MT to continue the testing, the following requirements must be observed –

- The record of test log must be completed by the first MT up to the point of handover.
- When it is possible for the first MT to meet the MT taking over the work, the white logbook page or a copy should be handed over and a briefing take place.
- If the first MT cannot meet the MT taking over the work but is able to handover by telephone, the same information must be passed and if possible the white log book page be faxed to the MT taking over. When neither of these options is possible, as a minimum the information on the white logbook page should be recorded by the organisation tasking the work that should then pass on the information to the MT taking over the work.
- The MT taking over must complete their own record of test logbook entry recording the work carried out. Further testing to verify the first MT work may take place if considered necessary.
- It is acceptable for several MTs to be involved if the work is prolonged, third parties are involved or long term monitoring is required Under these circumstance each MT must complete their own record of test log book entry.

7.9 Supervision

7.9.1. Arrangements must be in place within each maintainers organisation to routinely check returned record of test forms from each MT to ensure they are being completed correctly. If the local manager is not satisfied with the information on any record of test, arrangements must be made to have the work re-tested by another MT.

7.9.2. The TMT&FIP must be subject to routine surveillance in each maintainer's organisation and records kept of the checks done and any remedial action taken. Where necessary the local manager must take steps to address any incorrect or inadequate use of the TMT&FIP process through one to one sessions with the person or persons involved, further briefing or refresher training.

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7.10. Operational Equivalents

7.10.1. Like for like spares must normally be used where equipment is being replaced as part of the TMT&FIP. Reference must be made to existing records where they are available and will assist in determining the replacement type.

7.10.2. When like for like spares are not available, it is permissible to substitute an operational equivalent which must be a Network Rail approved item and have the same or enhanced functionality as the item it replaces but must not degrade the features of the version it replaces.

7.10.3. The use of operational equivalents may be unavoidable where a product is no longer available or is currently manufactured to a different specification.

7.10.4. Maintenance Test Plans give guidance on the use of operational equivalents and care must be taken to check for any changes that may be required to the Maintenance Test Plan as the result of using an operational equivalent. In particular it may be necessary to apply independence (see section 7.5).

7.10.5. Where doubt exists regarding the use of equivalents the MT must escalate the problem to the Local Manager who will give guidance on how to proceed.

7.11. Testing With Test Equipment

7.11.1. Unwanted connections can arise via internal circuits within test equipment. It is therefore important to recognise that connecting test equipment to operational telecommunications equipment or systems that are carrying traffic may cause a SRTF and in certain circumstances a high risk signalling failure.

7.11.2. Before connecting test equipment steps must be undertaken to disconnect traffic unless the test equipment being used is specifically designed in a way that will not have any affect on traffic.

7.11.3 It is vital that before working on any telecoms equipment over which signalling circuits may be routed, that liaison takes place between the telecoms and signalling engineers and from which a clear understanding is gained to determine the condition of any alternative routes and whether complete isolation of the telecom bearer is required.

7.11.4. Use of test equipment by the MT will normally be limited to the duration of work being carried out under the TMT&FIP.

7.11.5. When it is considered necessary to extend testing for a longer period and the MT is not present throughout, for example to monitor a circuit, agreement must be given by the local manager.

7.11.6. Connection of test equipment should not exceed a period of 3 months. and labels must be attached to both ends of the circuit(s) under test giving contact details and the reason for the test equipment remaining connected. The record of test logbook must also include the details.

7.11.7. Testing of optical fibres should only be carried out after the person responsible is satisfied that the risk of eye damage caused by light sources in use on optical communications equipment is removed.

7.12. Temporary Diversion of Circuits

7.12.1. When using the TMT&FIP It is permissible to divert traffic from allocated circuits in order to maintain service whilst undertaking failure investigation or routine maintenance work. Under these circumstances the appropriate Maintenance Test Plan must be used to ensure the temporary arrangements are properly tested and brought into service.

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7.12.2. Where diversions involve signalling circuits, arrangements must be made with the maintainer of the signalling system to ensure the temporary arrangements are properly tested in accordance with the SMTH.

7.12.3. Where the diversions will remain in place after the MT has left site, labels must be attached to all disconnection points of the circuit(s) under test giving contact details and the reason for the diversion remaining in place. The record of test logbook must also include the details.

7.12.4 .When temporary diversion is no longer required, a MT must take steps to restore traffic to the proper positions and ensure the affected equipment or systems are properly tested using the appropriate Maintenance Test Plan.

7.12.5 If traffic is permanently diverted to maintain service, arrangements must be made to update all the related records. Any diversion that is planned to be left in place for longer than 36 hours must be treated as permanent.

7.13. Disconnections / Connections

7.13.1 When it is necessary to disconnect a circuit or remove any form of electrical connection in order to carry out work using the TMT&FIP, for example a jumper, link or strap, the following requirements must be observed –

- Check records to ensure the correct circuit is being disconnected and that it can be correctly restored after the work is finished.
- If records do not exist, take steps to identify the circuits involved and produce a temporary record to ensure service can be correctly restored on completion.
- On completion check the configuration of any re-connections to ensure they are correct and test the restored arrangements using the appropriate Maintenance Test Plans.

7.13.2. The point at which operational telecommunications circuits are disconnected must be clearly labelled to prevent inadvertent reconnection. In selecting the means of disconnection, the following shall be taken into account:-

- Do not apply a disconnection which may be ineffective under some circumstances. A typical example would be disconnection of primary transmission route where the system will automatically switch to the standby route.
- If the work is partially completed and some of the equipment is handed back for use, the disconnections must remain effective for that equipment which is not available for use.
- ‘It is vital that before working on any telecoms equipment over which signalling circuits may be routed, that liaison takes place between the telecoms and signalling engineers and from which a clear understanding is gained to determine the condition of any alternative routes and whether complete isolation of the telecoms bearer is required .

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7.14. Third Party Involvement

7.14.1 .Where the TMT&FIP requires the involvement of suppliers, specialists manufacturers, contractors or support staff who are not competent in the TMT&FIP, the following requirements must be observed –

- A MT must remain responsible for the work and should where practical remain on site during their involvement
- The point at which the investigation process is interrupted by third party involvement and the point at which it is resumed must be carefully controlled by a MT, in particular care must be taken when third party involvement is achieved remotely.
- Where repair work takes place the appropriate Maintenance Test Plan must be used.
- The record of test log must include details of the third party work.
- If there is a break in the work, for example there may be a delay in the involvement of the third party and consequently the first MT is no longer available and is replaced by another MT, the requirements of section 7.8 must be followed.

7.14.2. The MT in charge on completion of the third party involvement is responsible for ensuring the equipment or system involved is working correctly and for undertaking testing in accordance with the appropriate Maintenance Test Plan before handback.

7.14.3. Where any 3rd party providers supply bearer circuits to lineside telephones, care must be taken to ensure the appropriate Maintenance Test Plan is used to test the telephone following any work by the supplier.

7.15. Serious Incidents

7.15.1 When a serious incident occurs, the rules governing the use of the TMT&FIP may be changed, particularly if the police, O.R.R. or HSE are involved.

7.15.2. Procedures have been agreed between Network Rail and British Transport Police covering the actions of those engaged in investigation at the scene of a railway incident.

7.15.3. If a MT has to use the TMT&FIP as the result of or in connection with a serious railway incident, (e.g. derailment, or collision) the following requirements apply –

- Contact the local manager and agree what action should be taken. It may be advisable for the testing work to be carried out by a MT that is not usually involved in the equipment or system involved or from another maintainer's organisation.
- Check any local or maintainer specific procedures that may apply to serious rail incidents. A special testing method statement should be prepared for the work and should be checked by an independent MT.
- Contact the Rail Incident Officer (RIO) and explain what work is required.
- The RIO will liaise with the Police Incident Officer (PIO) and arrange access to the equipment or system as quickly as possible.
- Evidence must not be interfered with or removed without permission of the PIO and a necessary arrange to record the evidence:

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- The RIO must be told when the work is complete.
- The RIO will arrange for any evidence, for example voice recordings, to be retrieved and held by a responsible person for possible use at any inquiry.
- The usual record of test log must be supplemented with details of any evidence collected, names of the RIO / PIO or others involved and any other site activities that may be relevant.

7.16. Changes to Test Plans & Failure Investigation Guides

7.16.1 The Failure Investigation Guides in appendix C and Maintenance Test Plans in appendix D must always be used as part of the TMT&FIP unless the following circumstances apply -

- The MT considers there is a better way of undertaking the work.
- The MT considers a Failure Investigation Guide or Maintenance Test Plan is defective.
- There is no suitable Failure Investigation Guide or Maintenance Test Plans for the work to be undertaken.

7.16.2. Under these circumstances the MT must discuss how to proceed with the local manager and reach agreement to produce a new Failure Investigation Guide or Maintenance Test Plan. This must be prepared by the MT and where possible this should be based on the most relevant existing document.

7.16.3. The new document must be checked by an independent MT with technical competence in the equipment or system involved. On completion of the work the new document must accompany the record of test white page when submitted.

7.16.4. The line manager must check the submitted document and arrange for further testing to be carried out if it is considered that use of the new document may import additional risk.

7.16.5. Finally the new document must be submitted to the appropriate Network Rail telecommunications engineer who must check the document and discuss the contents with the maintainer and if satisfied, provide a copy to the Network Rail Head of Telecoms Engineering.

7.17. Specialist Investigation of Equipment

7.17.1. Where the cause of failure is localised to an item of equipment but the part or component cannot be identified, consideration should be given to the equipment undergoing specialist investigation. The MT responsible shall discuss this with the local manager and agree the appropriate course of action.

7.17.2. The local manager should also discuss the failure with the appropriate Network Rail telecommunications engineer where this is considered necessary. Network Rail may be aware of related information about failure modes that can assist in the decision making process or confirm if further investigation is necessary.

7.17.3. Where the immediate cause of failure is not identified and escalation is mandated by the failure investigation guide

and –

- The equipment or system is functioning correctly and
- The failure condition cannot be replicated

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- The immediate cause of failure has been identified and
 - Further investigation is considered necessary to identify the fundamental cause of failure
- then the MT must escalate details to the line manager.

7.17.4. Arrangements must then be made with the organisation that tasked the original fault to undertake further investigations under controlled conditions using specialists.

7.17.5. Where equipment is sent away from site for specialist investigation it should be suitably packed and labelled. All efforts must be taken to avoid transit damage, particularly where evidence needs to be preserved. Details of the equipment and its reported failure circumstances should be provided with the equipment.

7.18. Handback for Use

7.18.1. The MT responsible for the final testing work must be satisfied that the work is complete and the equipment or system is functioning correctly before handback for re-entry into service.

7.18.2. For operational telecommunications equipment and systems handback does not usually require any separate authorisation unless the circumstances are special, for example if the testing did not have a satisfactory outcome or following a serious incident. The decision to use the equipment or system following handback is vested in the Network Rail user representative.

7.18.3 Where the work is not complete and the system is being returned to service in stages, for example when there is a need to restore priority circuits on a concentrator, care must be taken to ensure this stage of the work is complete and functioning correctly and the signaller has a clear understanding and a written record of which facilities are being restored.

7.18.4. When it is necessary to return equipment or systems to service following failure investigation and the cause of the failure has not been identified and the failure condition is no longer present, this must be explained to the user on handback.

7.19 Security

7.19.1 On completion of the TMT&FIP, the MT must check the equipment or system is left in a secure condition and that adequate arrangements have been made for the prompt removal from site of any displaced equipment or materials.

8. Failure Investigation Process

8.1 Principles

- 8.1.1. When tasked to investigate an operational telecommunications failure the MT must comply with -
- The general requirements contained in section 7 of this procedure
 - The specific failure investigation requirements of this section
 - The flow chart in section 10
 - The appropriate Failure Investigation Guide(s) in appendix C

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8.1.2. It must be recognised the TMT&FIP is not exhaustive but is intended to ensure that reported failures are thoroughly investigated, that information is properly recorded and that vital evidence is not destroyed through testing.

8.1.3. The failure investigation process must always be conducted carefully and with an open mind. The assumption is always based on the reported failure details being correct and the person reporting the fault is not mistaken. The report must therefore be treated as correct until proven otherwise. The engineering judgement, competence, experience and common sense of the MT undertaking the investigation remain important factors in the investigation.

8.1.4. It is a requirement that the TMT&FIP is followed for all failures that have the potential to be a SRTF and also in a situation where the fault is not found and the system is working correctly, possibly as a result of a reset having been undertaken. If further investigation is required, either through a repetitive failure scenario or because the original failure was potentially serious, the special investigation process should be undertaken as a separate exercise and the TMT&FIP used before handing back for use.

8.2. Failure Management

8.2.1. Operational telecommunications failures must be reported to the recognised central fault management organisation.

8.2.2. This organisation must be structured to provide the following requirements –

- A means of receiving, recording and allocating failures of operational telecommunications failures on a 24 hour/365 day basis.
- A means of tasking, monitoring progress and escalating failure reports.
- Competent resources to manage the failure investigation process and to escalate problems.
- Arrangements are in place to ensure this information is kept up to date and is promulgated to those people in the maintainer's organisation who need to be aware and to the appropriate Network Rail telecommunications engineer.

8.2.3 If any item of equipment is subject to concerns over reliability or performance it must be removed from service and an independent investigation be carried out by the supplier or another approved organisation.

8.3 Failure Investigation

8.3.1. The MT tasked with the investigation is in charge of the work and of any other testers involved. It is permissible for different MTs to be involved in the failure investigation and maintenance testing aspects of the work.

8.3.2. Before proceeding, the MT must determine if the work can be carried out right away or requires pre-planning in accordance with section 7.7.

8.3.3. On commencing the investigation, the MT must follow the failure investigation process summarised in the flow chart contained in section 10. This requires the MT to gather facts, select a Failure Investigation Guide(s) and undertake testing until the immediate cause of the failure is identified and then if required rectified through the use of a Maintenance Test Plan.

8.3.4 Where the failure condition disappears and cannot be reproduced, care must be taken to investigate and eliminate all reasonable and credible explanations for the reported failure condition before concluding the failure condition is no longer present and cannot be reproduced.

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8.3.5. The failure investigation testing is carried out in 2 stages as follows –

1. Non-destructive tests – which must be carried out or directed by a MT in accordance with the appropriate Failure Investigation Guide(s). These involve visual examination of equipment and/or taking measurements without making disconnections and without disturbing the equipment or its wiring. All conditions that existed at the time of failure should be recorded by questioning and observing.

Where it is not possible to perform a test which is designated as 'non-destructive' without risk of disturbing equipment / wiring, then this fact should be recorded and the test conducted during the 'destructive testing' phase instead. This will regularly occur for telecommunications equipment and systems particularly where they are software controlled. Notes should be made of these initial findings as soon as possible so that there is less risk of information being lost or forgotten.

2. Destructive tests – which must be carried out or directed by a MT in accordance with the appropriate Failure Investigation Guides. These tests will usually alter the electrical, mechanical or physical state of the equipment. This disturbance might make a repeat of the fault impossible. Independent confirmation of fault diagnosis may be required where the circumstances involve a complex fault or there may be serious implications arising from the failure

8.3.6. The software based technology employed in some telecommunications equipment and systems can result in the boundary between non-destructive and destructive testing becoming unclear. When this occurs the MT carrying out the investigation must be satisfied that all reasonable steps have been taken to identify and if necessary record the 'as found' failure status before proceeding with any work on site. This may assist the investigation process at a later stage. It is however recognised that in many circumstances, the commencement of any type of test has the potential to destroy evidence.

8.3.7. Where the flow chart indicates the MT should undertake peer review or escalation, the following action is required –Peer Review – Where the investigation process is underway and the results indicate a more complex situation exists or the next steps are unclear, the MT may consult with the organisation who tasked the work, the local manager or another person of equal or greater technical knowledge in order to determine the next steps or to seek re-assurance about the findings so far.

- Escalation – Where the failure investigation process has failed to identify the immediate cause of the failure, the failure condition has disappeared and cannot be reproduced and the equipment or system is working correctly the MT must consult with the organisation who tasked the work, the local manager or another person of equal or greater technical knowledge in order to determine the next steps or to seek re-assurance about the findings so far.

8.3.8. All Failure Investigation Guides give guidance on escalation and some give guidance on peer review in the 'Preliminary Information' section, particularly where the rules are relaxed for low risk failures. Where there is no guidance, the requirements of the flow chart and Failure Investigation Guide(s) must be followed and particular, care is taken where high risk failures are being investigated.

8.3.9. The failure investigation process must always be completed when undertaking repair/replacement unless a single and obvious cause of failure is identified in which case the process may be terminated. The details must however be entered into the record of testing log book and the equipment or system be tested using the appropriate Maintenance Test Plan before handing back for use

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8.3.10. Where the failure investigation process involves a telecommunications bearer circuit carrying a signalling application, the TMT&FIP is mandatory where the signalling failure itself is classified as 'High Risk'. For all other categories of signalling failures on telecommunications bearers, the TMT&FIP is recommended as best practice but is not mandatory. When accepting a failure report from the signalling maintainer, the recipient telecommunications maintainer must clearly understand the level of risk involved.

9. Maintenance Testing

9.1. Principles

9.1.1. When an item of equipment is to be replaced using the TMT&FIP, the MT undertaking the work must comply with –

- The general requirements contained in section 7 of this procedure
- The specific maintenance testing requirements of this section.
- The flow chart in section 10.
- The appropriate Maintenance Test Plans(s) in appendix D.

9.1.2. The intent of maintenance testing is to carry out the work in single steps in a carefully controlled manner to minimise the risk of introducing a safety related failure. This is achieved through the use of Maintenance Test Plans and Missing Equipment Test Plans which define the equipment specific testing required by the TMT&FIP.

9.1.3. The MT carrying out the work becomes the MT in charge and is responsible for selecting the appropriate Maintenance or Missing Equipment Test Plans to be used and is also responsible for the work of any subordinate testers

9.2. Maintenance & Missing Equipment Test Plans

9.2.1. These are checklists of the minimum safety tests to ensure the safe operation of replaced operational telecommunications equipment and systems. The only difference between the 2 types of test plan is the inclusion of additional steps in missing equipment test plans because the equipment does not exist and evidence is required to ensure the replacement is of the correct type.

9.2.2. For ease of identification, Missing Equipment Test Plans are printed on green paper in the TMT&FIH.

9.2.3. Both types of Test Plan are divided into 2 sections covering tests required before the work and those required after the work. Together they form a list of numbered steps in logical sequence. Information on operational equivalents and independence is also given.

9.2.4. Both types of Test Plan do not include every task required to perform the work or list checks purely associated with reliability or functionality which must be carried out as best practice. They are designed to be used generically unless the title indicates a specific type of equipment or system.

9.2.5. Where the Maintenance or Missing Equipment Test Plan for an item requires specific tests or checks on another item as a consequence of the original replacement or alteration, the second Maintenance Test Plan is referenced from the first. This is identified in the first Maintenance or Missing Equipment Test Plan and the steps to be carried out in the second Maintenance or Missing Equipment Test Plan marked with an asterisk '*'. For example an SPT fed from a tail cable which has been replaced using Maintenance Test Plan CAB001 would require testing by use of steps 9, 11, 12, 13, 14, 15, 16 & 17 of Maintenance Test Plan TEL001 to confirm correct operation.

9.2.6. If the MT does not consider there is a suitable Maintenance Test Plan for the work to be undertaken then reference must be made to the arrangements in section 7.16

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9.2.7. Consumables for example dry cells and lamps do not require the use of Maintenance Test Plans.

9.3. Defined Checks

9.3.1. These are tasks which do not involve the use of any test equipment and are generally non intrusive. Both types of Maintenance Test Plans can use the following defined checks –

- Check for Correct Type - When a replacement item of equipment is selected for installation it shall be the same as or an operational equivalent of the item it replaces. The size of the replacement item should also be considered where different and may impact on the available space. If any rewiring or repositioning of the equipment is necessary the work shall be considered as temporary diversion of circuits.
- Check for Correct Labelling – Test Plans require the labelling of replacements, racks, frames, equipment, locations and wiring to be checked for validity. If the labelling relates to a replacement item and is clear, not misleading and not conflicting with any records, drawings or handbook and in all other respects is suitable, it may be considered operationally equivalent. A rack, frame, item of equipment, location, wire or cable pair is correctly labelled when it is uniquely marked or identified and its label corresponds to the appropriate record system, or where the label details can be referenced against local records. The essential feature is that everyone likely to be involved in the work shall understand the labelling system adopted.
- Check for Damage - When a replacement item of equipment is selected for installation it should be visually examined for physical damage. This includes obvious mechanical damage, dents, scrapes, cracks or misalignments. Mechanical parts should be checked to ensure they do not bind. Particular care is required when checking backplane alignment pins.
- Check for Safe Wiring - Immediately adjacent wiring, equipment and mountings likely to be disturbed by the work should be carefully examined. If the insulation or associated items are found to be defective the local manager should be advised and suitable action proposed. This may include replacement of defective wiring prior to allowing the work to continue.
- Check for Correct Installation - When a replacement item of equipment is installed it shall be examined to ensure it is correctly positioned in any base, mounting or route. This includes being the correct way up and level where required. The equipment shall be fixed securely as designed using any screws, bolts, pins and clips provided. The base, mounting or route shall also be suitably secure. Any protection required, such as terminal shrouds, shall be correctly fitted. Care must be taken to ensure any equipment connections are properly terminated and that no stray electrical connection or mechanical snagging is possible. Wires and cables shall be suitably restrained to minimise disturbance and prevent damage or trapping during routine access to the equipment room, apparatus case or route.
- Check for Correct Isolation - When an existing item of equipment is required to be electrically isolated from working equipment or systems this must be achieved through the use of a disconnection point specifically intended for the purpose, for example, a cable frame, MDF, IDF or back plane connector. Check for Correct Cable Function – Where the work has been carried out on a cable which involves jointing, termination or insertion of a new length then functional checks shall be carried out on all equipment or systems carried by the cable.
- Check for Correct Speech - When work on any equipment or system has been carried out that may affect speech functions, checks shall be carried out to levels, quality and the absence of cross talk.

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9.4. Defined Tests

9.4.1. These are tasks which may involve the use of test equipment and can be intrusive. Both types of Test Plans can use these which typically comprise but are not limited to tests such as continuity, resistance, impedance, transmission levels, attenuation and cross talk. These tests are not defined in the TMT&FIP as they are considered within the basic technical competence of a MT.

9.5 The Maintenance Testing Process

9.5.1. The requirement to undertake maintenance testing will arise from one of the following situations –

- Use of the TMT&FIP has identified a faulty item or items of equipment that have to be replaced and then be tested in order to restore service. See flowchart in section 10. Testing of any equipment that has been replaced or substituted as a result of the investigation work is required before restoration to service.
- Routine maintenance work has resulted in interruption to an item or items of working equipment that have to be tested before return to service.
- Renewal or re-location of an item or items of equipment that have to be tested before return to service.
- There has been an incident and equipment has to be tested to verify its working status. See section 7.15.
- There has been third party involvement or diversions have taken place and it is necessary to verify an item or items of equipment have to be tested before return to service. See 7.12 & 7.14.
- Where an item of equipment has to be replaced for a reason other than using the TMT&FIP.

9.5.2. When required to undertake maintenance testing work the MT must first determine if the work can be carried out right away or requires pre-planning in accordance with section 7.7.

9.5.3. Once the necessary arrangements have been made to undertake the work, the MT must select which Maintenance or Missing Equipment Test Plan(s) are required and then commence testing in accordance with the contents.

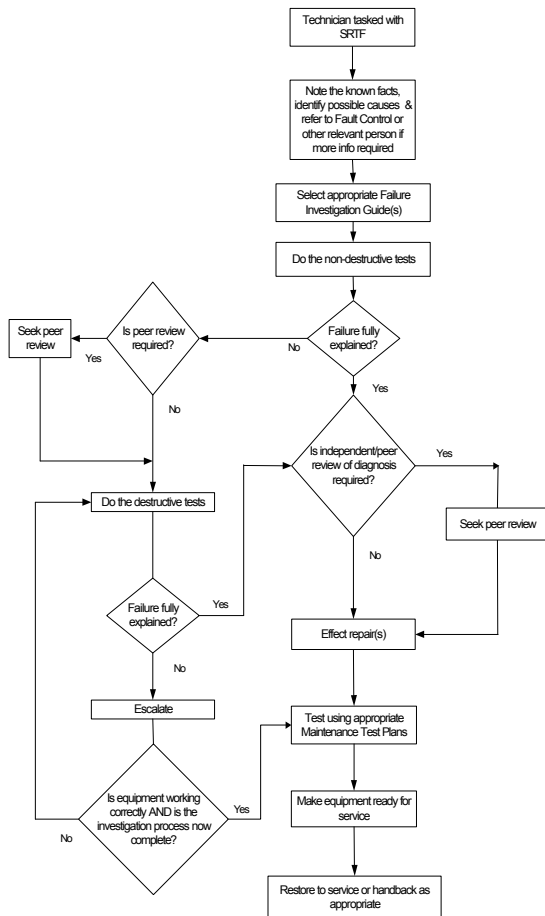
9.5.4. If a problem is encountered with the maintenance testing process the work must be stopped immediately. Typical examples of problems that may be encountered include but are not limited to the following –The wiring or equipment configuration on site is not in accordance with the available documentation or records

- There is an absence of verifiable documentation or records
- There is insufficient information about the equipment or system being worked on
- All the required resources or equipment are not available
- The replacement equipment being used is not suitable because it is the incorrect type, is faulty, damaged or cannot be verified as a good working item

9.5.5. Once the work is stopped, the MT must decide what level of risk is involved and if this is considered to be low, the work may proceed with caution and the record of test log book must include details of the problem and the decision taken. If however the risks are considered anything other than low, the MT must escalate the problem to the Local Manager who must then review the problem and advise the MT how to proceed. In both these circumstances the MT must invoke the Document Independence

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9.5.6. On completion of the maintenance testing work the equipment or systems affected must be functionally tested to a plan commensurate with the size and complexity of the work undertaken. For example the critical circuits on a large cable or a transmission system may be sample tested whereas a 10 line concentrator or PETS system can be fully tested.



Failure Investigation Flow Chart

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Appendix A – Record of Testing Logbook

Location or Site Details		Controlling Signal Box	
Failure / Task Number & Details			
Date & time work started		Date & time work finished	
Summary of work to be carried out			
Equipment/System Description/Serial No			
Test Plan or TFI	Name of Person doing the work	Name of Mtce Tester	Details of any test equipment used
Supporting Information or comments			
Name & Signature of person in charge on completion			Serial No

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Appendix B -Testing Method Statement Form

Description of work	
Serial number of page from Testers Record of Test Log Book	
Maintenance Tester in Charge	
Other Testers involved in the work	
Details of any possession arrangements	
Details of any circuit disconnection arrangements	
Description of testing methodology	
Name & Signature of Tester in Charge	Name & signature of Tester

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Appendix C – Failure Investigation Guides

Listed below are types of operational telecommunications equipment and systems covered by the TMT&FIP together with common failure modes which can occur.

The list is not comprehensive but includes all the Failure Investigation Guides included in this procedure, if the Maintenance Tester considers a new Failure Investigation Guide is required or an existing one be modified to suit a particular failure mode, reference must be made to section 7.16.

When tasked with a failure the MT must refer to this list and select the appropriate Failure Investigation Guide for the type of equipment or system involved. If the reported failure mode is not listed then the failure need not be considered a SRTF although use of the TMT&FIP is still recommended as best practice.

Equipment	Failure Modes	Failure Investigation Guide
Public Emergency Telephone System (PETS)	• Complete failure • Defective speech, crosstalk or noise • Ringer failure (code 1234 or 4567) • Multiple off-hook (code 1) • Remote equipment failure (code E) • Processor failure (code F)	AHBTFI001
Telephone Concentrator	• Complete failure • No incoming calls • Bell / Sounder OK but no visible identity • Visible identity OK but sounder not working • Noisy speech • Receives incoming calls but nobody on the line • Calls cutting out • Miss-routed calls • Telephone 'X' coming up as telephone 'Y' • Call tech alarm • Crosstalk or overhearing	CONTFI001
Copper Cables	No user symptom unless identified through a pattern of common failures in a particular geographical area or a signalling failure. Other TFIs may also refer	CABTFI001

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	the MT to this TFI.	
CCTV	• No picture • Incomplete picture • Distorted picture • Wrong picture • Rolling picture	DOOTFI001
Cab Secure Radio System (CSR)	• No coverage • Interference or poor speech • Phantom emergency calls • Emergency/general call not received • Emergency stop not received • Call technician 22/99 • No stepping, train running number not updating and train unable to set up • System calls radio 1 but makes contact with radio 2 (box to train or train to box) • Driver calling timed out • Spurious area changes • More than 1 radio with same number • General call repeat failure • Train list not updating • No train list • Constantly initialising • Blank operators screen • Not stepping properly/wrong description • Loss of radio in train cab. • Operators keyboard dead • Noisy or poor speech • One way speech • Screen frozen • Bell / Sounder too loud/too quiet • Unable to contact driver • Displays rubbish characters	RADTFI001



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Cab Secure Radio System (CSR) ctd	• Dropping out • Signaller unable to answer emergency call	
NRN/ORN Radio System	• No coverage • Phantom emergency calls • Emergency/general broadcast not received • System calls radio 1 but makes contact with radio 2 (box to train or train to box) • Driver calling timed out • More than 1 radio with same number • Noisy or poor speech • General call repeat failure • Bell / Sounder too loud/too quiet • Unable to contact radio • Dropping out • One way speech • Signaller unable to answer emergency call	RADTFI002
RETB Radio System	• Failure to exchange token • Noisy speech • Link fail alarm	RADTFI003
GSM-R	• No reported coverage • Poor noisy or one way speech during all system calls • REC, s cutting off • Phantom calls received by the train mobile • No calls received by signaller • Driver not included in REC when in area • Driver included in the REC when not in the area	RADTFI004
	• Poor noisy or one way speech during all calls	RADTFI005

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	• Calls cutting off • Phantom calls received by other than train mobile. • Calls not received by signaller • Signaller receives call from another signallers area • GSM-R does not display BTS/Service area while receiving call. • GSM-R terminal displays incorrect BTS/Service area whilst receiving a call • GSM-R signallers terminal dead • GSM-R signallers terminal bell / sounder not working • Driver not included in voice group calls • when in area • Driver included in voice group calls when not in the area	
Man Machine Interface (MMI)	• Complete failure • Blank operators screen • Operators keyboard dead • Noisy or poor speech • No incoming calls • Receive incoming calls Ok but nobody on the line • Call cutting out • Miss-routed calls • Telephone 'X' coming up as telephone 'Y' • Bell / Sounder OK but no visible identity • Visible identity OK but no sounder working • Screen frozen • Sounder too quiet/ too loud • Unable to contact driver • Signaller unable to answer emergency call • Displays rubbish characters • Dropping out • Cutting out • Noisy speech • One way speech	MMITFI001
Telephones	• Noisy speech • Bell / Sounder not working	TELFI001

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	• Unable to make outgoing calls • Unable to hear properly • Crosstalk or overhearing	
Emergency Short Code Dialling	• 17X call received at wrong ECR • 17X call receives busy or n/u tone • Loss of access of emergency services • Defective /noisy speech	TELTFI002
Telecoms Bearer Circuit	This TFI must be used when a bearer failure is believed to be the cause of other symptoms or a reported signalling failure. Other TFIs may also refer the MT to this TFI.	TRATFI001
Traction Supervisory System (Telecoms Equipment)	• Complete system failure • Complete failure of any one remote site	TRATFI002

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Telecoms Failure Investigation Guide (TFI) AHBTFI001 – PUBLIC EMERGENCY TELEPHONE SYSTEM (PETS)

ESCALATION REQUIRED

Preliminary considerations

This guide shall be used to investigate failures on the Public Emergency Telephone Systems (PETS) which have been reported by the Signaller with the failure symptoms listed in appendix C. Use of this guide is not mandatory for other symptoms.

Before proceeding with any tests, attempts shall first be made to determine if the reported symptoms are likely to be caused by a failure of the PETS or the line plant.

Where preliminary non-destructive testing indicates the symptoms are associated with the PETS, proceed with the tests described below.

If the preliminary testing indicates the symptoms are caused by a line plant failure, the appropriate guide shall be followed.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

Where the reported failure is proved to be a crossing phone handset off hook and it is possible to restore the handset by a person on site and carry out a 2 way test of the phone to confirm correct operation, a technician / engineer need not attend site. If however the handset is restored without a 2 way test being carried out a technician / engineer must attend and test using the appropriate Failure Investigation Guide.

It should also be noted that a PETS system reset is a destructive test, which may hide the true nature of a fault if carried out too early in the investigation process.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. The escalation procedures shall be applied during the investigation of failures in accordance with this test guide.

Non Destructive Tests

N1 *Note* any indications that are present.

N2 *Note* any alarms that are present.

N3 *Note* the date, time and type of last successful call.

N4 *Check* for any recent disturbance (includes the public and the LCU telephones)

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N5 *Check* for any damage (includes the public and LCU telephone).

N6 *Check* the PETS line system.

N7 *Test* power supply voltages (including mains).

Destructive Tests

D1 *Make* (or attempt to make) test calls.

D2 *Isolate* and carry out tests of the line plant (if necessary).

D3 *Check* security of cable terminations

D4 *Check* security / integrity of PCBs, equipment, cables, and power connections.

D5 *Carry out* a system reset where appropriate.

D6 *Test* using substitute PCBs and equipment (utilising maintenance testing principles).

D7 *Test* functionality appropriate to the equipment or circuits affected by the failure.

D8 Where absent switching is provided, test appropriate functionalities at the controlling signal box.

Other considerations

Care shall be exercised when using manufacturers' handbooks to avoid inadvertently carrying out destructive testing before non destructive testing is completed.

On some systems, routing of telephones connected to the PETS system can change when a signal box is switched out. This may cause variations to the status of reported symptoms. Where the PETS termination card is incorporated into a concentrator such as the STS Concept 32 system, the guide relevant to the concentrator shall also be consulted.

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TELECOMS FAILURE INVESTIGATION GUIDE (TFI) CONTFI001 – CONCENTRATOR

ESCALATION REQUIRED

Preliminary Considerations

This guide shall be used to investigate failures on all types and makes of concentrators which have been reported with the failure symptoms listed in appendix C. Use of this guide is not mandatory for other symptoms.

Before proceeding with any tests, attempts shall first be made to determine if the reported symptoms are caused by a failure of the concentrator or the line plant.

Where preliminary testing indicates the symptoms are associated with the concentrator, proceed with the tests described below. If the preliminary testing indicates the symptoms are caused by a line plant failure, the appropriate guide shall be followed.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

On systems fitted with a 'reset' facility, this must only be used when all non destructive and destructive testing has failed to identify a failure.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. The escalation procedures shall be applied during the investigation of failures in accordance with this test guide.

Non Destructive Tests

- N1 *Note* any indications that are present.
- N2 *Check* logging devices where applicable.
- N3 *Note* any alarms that are present.
- N4 *Note* the date, time and type of last successful call.
- N5 *Check* site records.
- N6 *Check* for any recent disturbance.
- N7 *Check* for any damage.

N8 *Check* security of cable terminations.

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N9 *Check* decoding / translation features.

N10 *Test* power supply voltages.

Destructive Tests

D1 *Test* common services.

D2 *Check* security / integrity of PCB's, equipment, cables and power connections.

D3 *Test* using substitute PCB's and / or equipment using TMT principles.

D4 *Test* functions appropriate to the equipment or circuits affected by the failure.

Other considerations

Care shall be exercised when using manufacturers handbooks to avoid inadvertently carrying out destructive testing before non destructive testing is completed.

Where selective systems are connected to the concentrator, additional testing may be required for the translation / TDM equipment; this may include checking of the coding of the individual telephones on the circuit.

On some systems, routing of telephones connected to the concentrator can change when adjacent signal boxes are switched out. This may cause variations to the status of reported symptoms.

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TELECOMS FAILURE INVESTIGATION GUIDE (TFI) DOOTFI001 - DOO CCTV

ESCALATION EXEMPT

Preliminary considerations

This guide shall be used to investigate reported failures on all types of DOO CCTV systems with the failure symptoms listed in appendix C. Use of this guide is not mandatory for other symptoms.

Where a single, obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification work must be carried out using the appropriate Telecommunications Failure Investigation Guide

Maintenance Test Plan.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. There is no requirement to carry out the escalation processes during the investigation of failures in accordance with this test guide.

Non Destructive Tests

- N1 *Check* whether the problem only appears on one monitor.
- N2 *Check* whether the problem only appears on one bank of monitors.
- N3 *Check* whether the problem appears on all monitors associated with one camera.
- N4 *Check* whether the problem appears on all monitors on this system.
- N5. *Check* if the monitors give incomplete coverage of the required platform edge.
- N6 Is the problem associated with sunlight or station lighting?
- N7 *Check* for any recent disturbance.
- N8 *Check* for any damage.

Destructive Tests

- D1 *Test* any power feed to the affected equipment.
- D2 *Check* that all connections to the affected equipment are correctly terminated and secure.

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- D4 *Check* that any T.V. Monitor hoods are secure.
- D5 *Check* that the fixings of the affected equipment are secure.
- D6 *Check* that each camera is correctly aligned.
- D7 *Check* that the affected equipment is in the correct alignment.
- D8 *Check* that the affected equipment is correctly terminated.
- D9 *Check* that the monitor adjustments are correctly set.
- D10 *Check* that the camera adjustments are correctly set.
- D11 *Test* any cables connected to the affected equipment.

Other considerations

If following investigation, the reported failure condition cannot be identified; consideration shall be given to carrying out the work described in Maintenance Test Plans DOO001 and DOO002 covering adjustment and alignment of cameras.

Care shall be exercised when using manufacturer's handbooks to avoid inadvertently carrying out destructive testing before non destructive testing is complete.

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(TFI) CABTFI001 – COPPER CABLES

ESCALATION EXEMPT

Preliminary Considerations

Failure of a cable would usually become apparent as a consequential symptom of the associated terminal equipment and not as a direct cable failure. This guide shall therefore be used to investigate failures on telecommunications cables which have become apparent as the result of referral from other guides used for primary investigation.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of cable which has failed. There is no requirement to carry out the escalation processes during the investigation of failures in accordance with this guide.

Non Destructive Tests

- N1 *Check* which circuits are affected and not affected by the failure.
- N2 *Check* for any recent work or disturbance in the area.
- N3 *Check* cables for physical damage, where appropriate.
- N4 *Check* circuits and spare pairs in the cable for signal quality and/or noise.
- N5 *Check* for possible sources of electrical interference, external to the railway infrastructure.
- N6 *Check* for possible sources of electrical interference from within the railway environment, e.g. traction faults or temporary traction feeds.
- N7 *Check* the integrity of any immunisation system, where appropriate.
- N8 *Test* V_L and V_T levels using dedicated test pairs, where appropriate.
- N9 *Check* air flow for pressurised cables.

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Destructive Tests

D1 *Check* integrity of links and IDC connectors.

D2 Isolate links (including fuse links) and *test* for continuity.

D3 Isolate section and *test* cable for insulation resistance.

D4 Isolate and *test* any lightning protection.

D5 *Test* and locate faults by means of TDR or bridge equipment. **Other considerations**

All high voltage (i.e. greater than 50V) insulation testing shall be considered destructive testing, even when carried out on spare pairs.

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Telecoms Failure Investigation Test Guide (TFI) RADTFI001 - CSR Radio Systems

ESCALATION REQUIRED

Preliminary considerations

This guide shall be used to investigate failures on all types and makes of radio systems used in CSR applications which have been reported with the failure symptoms listed in appendix C Use of this guide is not mandatory for other symptoms.

Before proceeding with any of the tests described below, test calls shall first be made to determine if the reported symptoms are caused by a failure of a mobile, train radio or the fixed equipment.

Where the test calls indicate the symptoms are associated with the fixed equipment, proceed with the tests described below.

If the preliminary testing indicates the symptoms are caused by a line plant failure, the appropriate guide shall be followed.

Where the test calls indicate the symptoms are caused by a mobile or train radio, arrangements must be made to advise the users involved in order that they can carry out tests.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

On systems fitted with a 'reset' facility, this must only be used when all non destructive and destructive testing has failed to identify a failure or where in exceptional circumstances, failure investigation cannot proceed until the system is reset.

The stage of the investigation at which the 'reset' button is pressed must be recorded in the record of test.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. The escalation procedures shall be applied during the investigation of failures in accordance with this test guide.

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Non Destructive Tests

- N1 *Check* symptoms with system users including the location of mobiles or trains associated with the failure report.
- N2 *Check* location of any mobiles or trains in valid area of coverage
- N3 *Check* any alarms that are present.
- N4 *Check* the fault log.
- N5 *Check* recorders.
- N6 *Check* call logs.
- N7 *Check* for any recent disturbance.
- N8 *Check* for any damage.
- N9 *Check* security of cable, equipment and terminations.
- N10 *Check* power supplies, where accessible.
- N11 *Check general* radio conditions and other user interfaces.
- N12 *Check* TD interfaces

Destructive Tests

- D1 *Test* relevant base stations
- D2 *Test* remote interfaces or links
- D3 *Test* signallers / management processors
- D4 *Test* land lines.
- D6 *Test* power supply voltages
- D7 *Check* security / integrity of PCB's

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Other considerations

Care shall be exercised when using manufacturers handbooks to avoid inadvertently carrying out destructive testing before non destructive testing is completed.

Where the CSR system is equipped with remote dial in access this can be used as part of this process.

The ability to replicate exact radio system failure conditions is almost impossible but recording as much objective evidence as possible during the investigation process is essential. Even if test calls cannot reproduce the exact failure condition, recording of evidence demonstrates all that is reasonably practicable has been done.

Where a single and obvious cause of failure has not been identified, the MP log must be downloaded, checked and printed and retained as part of the record of the investigation. In addition, the professional engineering judgement of the LIKELY cause is invaluable in the event no failure cause is identified.

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TELECOMS FAILURE INVESTIGATION TEST GUIDE (TFI) RADTFI002 - NRN RADIO SYSTEMS

ESCALATION REQUIRED

Preliminary considerations

This guide shall be used to investigate failures on all types and makes of radio systems used in NRN/ORN applications which have been reported with the failure symptoms listed in appendix C of this procedure. Use of this guide is not mandatory for other symptoms.

Before proceeding with any of the tests described below, test calls shall first be made to determine if the reported symptoms are caused by a failure of a mobile, train radio or the fixed equipment.

Where the test calls indicate the symptoms are associated with the fixed equipment, proceed with the tests described below.

If the preliminary testing indicates the symptoms are caused by a line plant failure, the appropriate guide shall be followed.

Where the test calls indicate the symptoms are caused by a mobile or train radio, arrangements must be made to advise the users involved in order that they can carry out tests.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

On systems fitted with a 'reset' facility, this must only be used when all non destructive and destructive testing has failed to identify a failure or where, in exceptional circumstances, failure investigation cannot proceed until the system is reset. The stage of the investigation at which the 'reset' button is pressed must be recorded on the Record of Test.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. The escalation procedures shall be applied during the investigation of failures in accordance with this test guide.

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Non Destructive Tests

- N1 *Check* symptoms with system users including the location of mobiles or trains associated with the failure report.
- N2 *Check* location of any mobiles or trains **were** in valid area of coverage.
- N3 *Check* any alarms that are present.
- N4 *Check* the fault log.
- N5 *Check* recorders.
- N6 *Check* call logs.
- N7 *Check* for any recent disturbance.
- N8 *Check* for any damage.
- N9 *Check* security of cables, equipment and terminations.
- N10 *Check* power supplies, where accessible.
- N11 *Check* general radio conditions and other user interfaces.
- N12 *Check* system interfaces.

Destructive Tests

- D1 *Test* relevant base stations or remote interface rack(s)
- D2 *Check* results of previous land line exercising
- D3 *Test* land lines.
- D4 *Test* MCU /OCU racks
- D5 *Test* power supply voltages
- D6 *Check* security / integrity of PCB's.

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Other considerations

Care shall be exercised when using manufacturers handbooks to avoid inadvertently carrying out destructive testing before non destructive testing is completed.

The ability to replicate exact radio system failure conditions is almost impossible but recording as much objective evidence as possible during the investigation process is essential. Even if test calls cannot reproduce the exact failure condition, recording of evidence demonstrates all that is reasonably practicable has been done. In addition, the professional engineering judgement of the likely cause is invaluable in the event no failure cause is identified.

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Telecoms Failure Investigation Test Guide (TFI) RADTFI003 - RETB Radio Systems

ESCALATION REQUIRED

Preliminary considerations

This guide shall be used to investigate failures on all types and makes of radio systems used in RETB applications which have been reported with the failure symptoms listed in appendix C Use of this guide is not mandatory for other symptoms.

Before proceeding with any of the tests described below, test calls and token exchanges shall first be made to determine if the reported symptoms are caused by a failure of a mobile, train radio or the fixed equipment.

Where the test calls indicate the symptoms are associated with the central equipment, proceed with the tests described below.

Where the test calls indicate the symptoms are caused by a mobile or train radio, arrangements must be made to advise the users involved in order that they can carry out tests.

Where a single and obvious cause is apparent steps shall be taken to rectify the problem immediately. Rectification must however be a straightforward repair which can be tested using the appropriate Maintenance Test Plan.

On systems fitted with a 'reset' facility, this must only be used when all non destructive and destructive testing has failed to identify a failure or where in exceptional circumstances, failure investigation cannot proceed until the system is reset. The stage of the investigation at which the 'reset' button is pressed must be recorded in the record of test.

Both non-destructive testing and destructive testing shall be carried out by a Technician or Engineer certified as competent in the Maintenance Testing Process and authorised to work on the specific type of equipment which has failed. The escalation procedures shall be applied during the investigation of failures in accordance with this test guide.