Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Introduction

Student Notes

Section 1

Contents

Introduction

Introduction

Module Background

It was realised during the very early stages of development of the Signalling Maintenance Testing Handbook that there was a need to train staff to carry out Defined Tests, follow and apply the procedures, and deal with specified documentation. The development of the training and the Handbook in fact almost ran in parallel. It soon became clear that the training would have to be an integral part of the phasing in of the Handbook. It also became very clear that the training would require a lot of resource and would take at least two years to implement. The decision was then made to phase the training in two separate stages. The first being the Application of the Signalling Maintenance Testing Handbook Course (ASMTH), secondly, this module (SMT) being the second phase.

The development of the SMT module again almost ran in parallel to the development of the update to the Handbook. Eventually the date of release of the SMT module became dependent upon the release of the updated Handbook.

The development of phase two is now complete resulting in this training module. It has been developed to ensure that staff required to carry out Signalling Maintenance Testing are fully trained in the use of the handbook. In addition to the content from ASMTH course which has been revised in line with the revision to the handbook, all the defined tests are now taught and assessed practically.

The former ASMTH course was designed to train staff to use the handbook, the Supervisor/ Manager had to authorise suitability of those staff in being able to carry out Signalling Maintenance Testing. In order to properly train staff and assess competence in Signalling Maintenance Testing this 10 day module emerged, enhancing the content of the ASMTH course. It was originally intended that anyone who had passed ASMTH would be exempt from the first part of the Signalling Maintenance Testing module, but because of the changes to the handbook every one will have to take all of the 'Core Testing Skills' portion.

Aims

On completion of the full module (10 Days) you will be able to carry out Defined Tests, follow and apply the procedures and deal with the documentation specified in the Signalling Maintenance Testing Handbook.

Who Can Attend The SMT Training Module?

This module is aimed at the following staff catagories:

Any member of staff capable of leading a Signalling Maintenance and Faulting Team.

Technical Support Staff, Supervisors, Signalling Maintenance Engineers and Signalling Works Leading Installers.

Other groups requiring Signalling Maintenance Testing skills and meeting the Entry Requirements, e.g. Fault Controllers.

Entry Requirements

For you to be nominated for the SMT Training Module you must have experience of assisting with fault finding on signalling equipment.

Also competence in the following is required:

circuit reading,
relay inspection,
cable core number and colour identification,
use of a:
multimeter,
insulation tester, and
bell/buzzer unit.

Module Content

The course is structured around 15 elements of competence based on the Signalling Maintenance Testing Handbook. These Elements of Competence have been grouped into Testing Competences each of which has a unique 'PEARLS CERTIFICATE CODE.' The Testing Competences and the associated Elements of Competence are listed below.

Core Testing Skills
Identify scope of work and select the appropriate Maintenance Test Plan
Carry out Logbook procedures for Maintenance Testing
Complete and deal with Maintenance Test Plan Lists
Understand standard SMTH terminology
Understand safety procedures to be followed when work involves links
Apply and remove temporary labels
Carry out a Wire Count

Cable and Wire Testing
Carry out a Continuity Test
Carry out an Insulation Test
Carry out a Cable Function Test

Earth Testing
Carry out an A.C. and D.C. Earth Test

Aspect Testing
Carry out an Aspect Test

Point Testing
Carry out a Point Detection and Correspondence Test

Block Testing
Carry out a Block Controls Test
Carry out an Emergency Block Recovery Test.

Core Testing Skills

The Testing Competency 'Core Testing Skills' is a direct replacement for the former Application of the Signalling Maintenance Testing Handbook course which is now withdrawn.

Module Format

This module consists mainly of short theory sessions with practical demonstrations and practice.

The sessions, in general will be based around the individual elements of competence, although some may be grouped.

The individual sessions are listed below.

1. Introduction.
2. Identify scope of work and select the appropriate Maintenance Test Plan.
3. Carry out Logbook procedures for Maintenance Testing.
4. Complete and deal with Maintenance Test Plan Lists.
5. Understanding of standard SMTH terminology, the safety procedures to be followed when work involves links, and error reporting procedures.
6. Carry out a Wire Count and apply temporary labelling to wire terminations.
7. The Testing of Cables.
8. The Testing of Power Supplies.
9. Carry out an Aspect Test.
10. Block Testing.
11. Point Testing.

Assessments

Theory and practical assessments are carried out in this module. Practical assessments are used for the bulk of the assessing, but, theory questions are used where this is not possible.

Each element of competence is assessed separately (See Module Content opposite) and your performance will be recorded as 'Competent' or 'Not Yet Competent'.

Certification

The 'Signalling Maintenance Tester' Competency Certificate will be awarded if you are competent in the elements of competence under Core Testing Skills (See Module Content opposite). In this case you will only be able to carry out those testing activities. This is the minimun Testing Competence that you can achieve; without this you cannot carry out any of the other testing activities, even if you have passed the assessments relating to the other Testing Competences.

If you are awarded 'Core Testing Skills' the other Testing Competences will be awarded depending on your performance in the assessments.

Don't forget each individual Maintenance Tester may have different testing skills. These will be indicated on your Competency Certificate. Your instructor will explain this in detail in Session 2. See Student Notes Section 2 Page 11.

Safety

Due regard must be taken to ensure compliance with all relevant Health and Safety legislation. Departmental instructions such as General Instructions to S&T Staff (Including Electricity At Work Regulations and unterminated wire requirements), Signalling Maintenance Specifications and any other instructions issued must also be complied with.

Your instructor will detail any specific instructions and precautions.

Notes

Notes

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Core Testing Skills

Student Notes

Section 2

Contents

Core Testing Skills

Page

Core Testing Skills

Introduction

These notes deal with the Core Testing Skills required for Maintenance Testing, which takes the form of seven competences (listed below). These competences enable a Maintenance Tester to select Test Plans and deal with the 'paper work' aspect of Maintenance Testing. It also covers other basic principles such as dealing with links, temporary labels, and the defined test - Carry out a Wire Count.

This section is particularly useful to a member of staff who only works on mechanical equipment. It will allow a Maintenance Tester to select and perform the tests within a Test Plan for mechanical equipment which does not require any of the defined tests which are electrically biased.

Competences

Listed below are the competences which this section of notes deals with:

1. Identify the scope of work and select the appropriate Test Plan.
2. Carry out Logbook procedures for Maintenance Testing.
3. Complete and deal with Maintenance Test Plan Lists.
4. Understand standard SMTH terminology.
5. Understand safety procedures to be followed when work involves links.
6. Apply and remove Temporary Labels.
7. Carry out a Wire Count.

Within this section each of the competences above will be dealt with as a separate item.

1. Identify The Scope Of Work And Select The Appropriate Test Plan

After successfully completing the work relating to this competence you will be able to:

- Classify a given job as either: like for like, missing equipment replacement or temporary diversion of circuits.
- Deduce whether a Test Plan is required for a given situation.
- State action if no Test Plan exists.
- State who is permitted to produce a Test Plan where one does not exist.
- State who is qualified to carry out Maintenance Testing.
- Define Independence of Testing and Maintenance Tester.
- State procedures on non-compliance of any part of a Test Plan.

Purpose Of The Handbook

The purpose of the Signalling Maintenance Testing Handbook is to list the tests necessary to ensure safe working after the like for like replacement of equipment. The Signalling Maintenance Testing Handbook also covers the temporary diversion of circuits and the replacement of missing equipment.

Like For Like Replacement

In the space below write down some jobs which you consider to be a like for like replacement.

.....

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.....

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How did you do?

You will find the definition of like for like replacement in section A004 in your Handbook.

Don't forget like for like replacement may involve restoring the original item of equipment or replacing it with an operationally equivalent new item.

Cables And Wires

A cable or wire found cut or separated from its connection or with a length missing are dealt with as like for like replacement.

What Is Not Like For Like Replacement?

In the space below write down some jobs you consider to be outside the definition of like for like replacement.

.....

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Check how you did. refer to sections A004 and A007 in your handbook.

Missing Equipment

When equipment is found to be physically missing or separated from its normal position it can be dealt with under Maintenance Testing procedures. What extra checks do we need to carry out? List them below.

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Refer to your handbook section A009.

To Qualify For Replacement
To qualify for replacement under the SMTH, the missing equipment must have been present and working prior to its vandalism or renewal.

Maintenance Test Plans

These Test Plans are basically checklists to cover the minimum safety tests required, each acting as a reminder at the various stages of the work.

Remember complete and accurate diagrams must be available, the work must not require any change to diagrams, and an operationally equivalent item must be used.

Typical Maintenance Test Plan

Below is a typical Maintenance Test Plan, D PC01 (Figures 1 and 2)

This plan is broken down into logical steps, which comprise of before and after installation checks. Some steps must be carried out in the order stated for safety reasons. These are indicated on the individual test plans, e.g. test plan D CA04 step 10.

Within the Test Plans are some Defined Tests, which are shown in capitalised italics and are defined in your handbook in Sections B006 to B014. (Look at Step 13 '*EARTH TEST*' on Figure 2).

REPLACE A COMPLETE POINT MACHINE **D PC01**

Includes: Electric and electro-pneumatic point machines, chair locks.

Excludes: Clamp locks.

BEFORE INSTALLATION WORK

1 *Check* replacement point machine is *not damaged* and is *correct type.*

2 *WIRE COUNT* existing point machine to the wiring diagram.

3 *Check* existing wiring has *safe insulation.*

4 *Check* existing wiring (and hoses for EP machines and chair locks) are *correctly labelled.*

5 *Check* existing point machine is *isolated* from the electrical supply.

6 *Check* air supply is disconnected (ELECTRO PNEUMATIC MACHINES AND CHAIR LOCKS ONLY).

Figure 1. Maintenance Test Plan D PC01 - Before Checks

Defined checks are shown in lower case italics, these are defined in Section B003 of your handbook (Look at Step 3 '*Safe Insulation*' on Figure 1).

In some steps you will see [(SMS)] this directs you to the Signalling Maintenance Specifications to carry out a test. (Look at Step 14 Test (gauge) point detection on Figure 2). Generally the section of the SMS you should refer to will have the same number as the Test Plan.

D PC01

AFTER INSTALLATION WORK

NOTE: Where any plug coupler is used check that no metallic dust exists between the two halves before reconnecting the plug couplers.

7 *Check* replacement point machine is *correctly installed.*

8 *Check wiring* (and hoses for EP machines and chair locks) are replaced as labelled.

9 *WIRE COUNT* replacement point machine to the wiring diagram.

10 *Check* any links and red dome nuts are secure and correctly replaced.

11 *Check* terminations are secure and suitably protected.

12 *Check* wires and cables are secure and clear of moving parts.

13 *EARTH TEST* circuits and supplies if designed to be earth free.

14 *Test* (gauge) point detection [(SMS)].

15 *Test* facing point lock [Facing point lock test (SMS)].

*16 *POINT DETECTION AND CORRESPONDENCE TEST* affected ends.

Figure 2. Maintenance Test Plan D PC01 - After Checks

Also some steps have a star test '*' these tests will be referred to from another test plan. e.g. renewing tail cable to a point machine carry out step 16 Detection and correspondence test. However if you were replacing a point machine you would also carry out step 16. (Refer to Figure 3.)

The following example demonstrates the use of Test Plan Asterisk "*" Tests

A technician is required to renew a cable to a point machine for maintenance purposes. By refering to the equipment index, Maintenance Test Plan D CA03 is selected. The Test Plan steps are carried out in order until step 17 is reached. In this case the item of equipment being fed by the cable is a point machine, so Maintenance Test Plan D PC01 is selected. The Asterisk "*" item (in this case there is only one) is carried out. When the Asterisk item is completed, the remaining step is carried out on the original Test Plan.

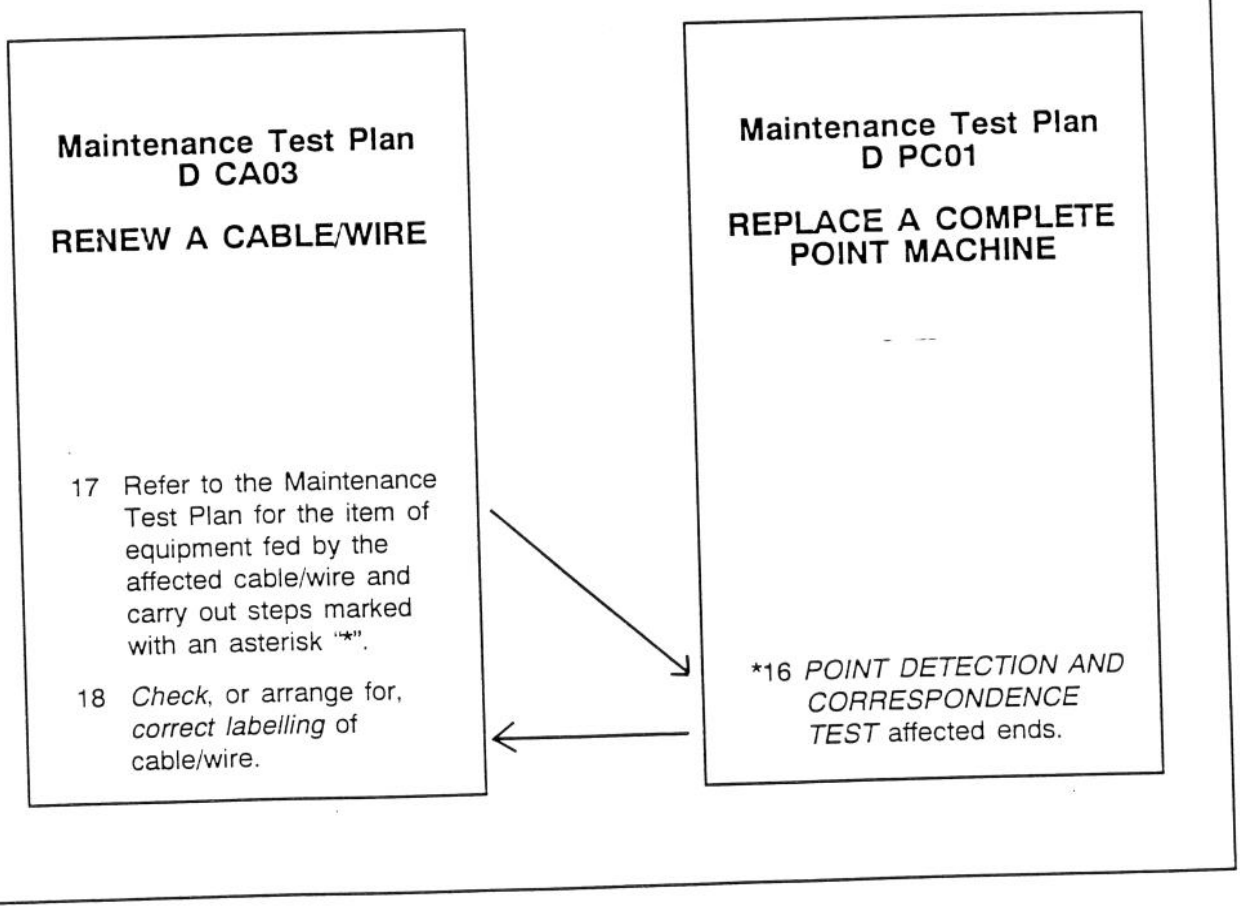

Figure 3. Test Plan Asterisk Tests

Missing Equipment Test Plans

As you can see Missing Equipment Test Plans (Figures 4 and 5) follow the same style as Maintenance Test Plans, plus the extra checks and enhanced steps required to cover the fact that missing equipment cannot be checked to diagram. Look at Step 2 on Missing Equipment Test Plan E AW02M. (Figure 3.) Note, these Test Plans are coloured green for easy identification.

MISSING AWS ELECTRO INDUCTOR **E AW02M**

Includes: All electro and suppressor inductors.

NOTE: Where a not *correctly labelled* cable core/wire is encountered and is causing a fault, see Signalling Maintenance Testing Handbook section DEFINITIONS - CHECKS, *correct labelling of cables and wires*, for how to proceed.

BEFORE REPLACEMENT

1 *Check* supply is disconnected.

2 *Check* for evidence on site and on the wiring diagrams that the inductor(s) were previously fitted. If no evidence is present consult the supervisor.

3 *Check* any existing wiring has *safe insulation*.

4 *Check* any existing wiring is *correctly labelled*.

5 *INSULATION TEST* existing cable if reused.

6 *Check* diode or resistor is fitted where fed directly from a relay contact or where shown on the wiring diagram.

7 *Check* replacement inductor is *not damaged* and is *correct type* (Electro/suppressor, correct strength) Refer to the wiring diagrams for details of feed equipment to determine strength [SMS] (Normally DC traction areas have high strength inductors).

8 *INSULATION TEST* replacement inductor (Minimum 2 M Ohms terminals to case).

Figure 4. Missing Equipment Test Plan E AW02M - Before Checks

AFTER REPLACEMENT **E AW02M**

9 *Check* replacement inductor is *correctly installed*.

10 *Check* wiring is replaced as labelled.

11 *WIRE COUNT* replacement inductor to the wiring diagram.

12 *Check* any links and red dome nuts are secure and correctly replaced.

13 *EARTH TEST* supplies when replacement inductor energised.

14 *Check* height of replacement inductor above or below rail level [(SMS)].

* 15 *Test* replacement inductor [Strength and polarity, diode (SMS)].

Figure 5. Missing Equipment Test Plan E AW02M - After Checks

Benefits Of Test Plans

If you are a member of a Faulting/Maintenance Testing team you may not always have the time to think through the tasks required, due to pressures on site, etc. A Test Plan lists these for you. The use of a Test Plan ensures vital tests are not missed and enables you to walk away from a job knowing you have left it safe.

What other benefits can you think of that using a Test plan will give? List them below.

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Tick Sheets

For your use while carrying out the tests in a Test Plan a tick sheet is available (Figure 6).

This is provided as an aid to doing your job, it is optional and not auditable. A blank sheet is provided at the back of the handbook for copying.

As you carry out each step in a Test Plan you should tick it off on the tick sheet. It will then provide an instant reference showing you exactly where you are up to during Maintenance Testing especially if you get disturbed or for some reason have to leave the testing for a while. An example of a completed tick sheet is in the Handbook on A005 page A01.

SIGNALLING MAINTENANCE TESTING HANDBOOK

MAINTENANCE TEST PLAN TICK SHEET

Copy and store in binder pocket for use as required

Maintenance Test Plan No.:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Maintenance Test Plan No.:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Maintenance Test Plan No.:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Maintenance Test Plan No.:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Figure 6. Tick Sheet

Selecting The Test Plan

First you must determine the extent of work to be done (what we have got to replace, renew, missing equipment etc.).

Once you have done this you must refer to the Equipment Index or Missing Equipment Index. D 001 or E 001. Find these in your handbook.

Certain items of equipment will have 'Not required' on the right hand side. If a piece of equipment has this, it means no Test Plan required. e.g. Bond galvanised.

Also adjustment of equipment, replacing covers, location doors etc. do not require a Test Plan.

Below, make a list of tasks that are exempt from using a Test Plan.

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Check these to your Handbook.

Exercise 1

Study the following scenarios. Using your handbook and refering to SMT Drawing Set 5 select the Test Plans or other appropriate course of action required. Write your answer in the space provided after each scenario.

1. The 240/110 volt transformer in case A has burned out blowing the location fuses.

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2. A fault where number 6 signal is showing no light when it should be showing a green aspect is traced to a high resistance contact A3-A4 on 6 DR in case A.

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3. A derailed train has run into location 209/178 case B causing extensive damage. The location (case B) needs to be completely renewed.

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4. A failure of a number of track circuits is traced to location 209/178. Vandals have broken into Case A and removed relays T83 TR, T83 TPR, T84 TR.

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5. A complete failure of all 3 aspects on number 12 signal is due to a cut tail cable.

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6. A number of panel lamps have blown and require changing.

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Test Plan CA01

Maintenance Test Plan D CA01 was written specifically for removing and replacing a single wire or cable core rather than a piece of equipment which will have its own Test Plan, and already contain parts of D CA01,

e.g., removing cable from rail for a rail change use D CA01,

renewing a signal head tail cable use D CA03.

Exercise 2

During Routine Maintenance a technician cannot obtain a reasonable shunt value on T77 Track Relay. This was traced to a faulty Track Feed set in location 209/178 case B. (Refer to SMT Drawing Set 5.)

The track feed set requires changing.

Without referring to your Handbook write down in the space below the procedure you would follow before, during, and after changing the feed set. Also write down any tests you would carry out.

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In principle what you have just done write a Test Plan. Check how it compares to Maintenance Test Plan D TC02 in your Handbook.

If No Test Plan Exists

Once you have checked for a Test Plan and any exemptions, if no Test Plan is found then a new one must be written by a certificated Maintenance Tester.

What To Use As A Basis?
The most appropriate list plan should be used as a basis for producing the new one. Blank sheets are available at the rear of the Handbook.

Before Use
Once produced this Test Plan must be checked by escalation to a certified Maintenance Testing tester who has not been involved in writing it. e.g. supervisor, technical support.

New Plans
The supervisor after checking the Test Plan can send it forward to BR HQ for possible inclusion in the Handbook.

Who Can Carry Out Maintenance Testing

Only a Maintenance Tester who is competent to carry out a particular testing activity can carry out Maintenance Testing in that activity. This will be indicated on the Competency Certificate
(Figure 7).

As you can see it may be possible to have certain competences, but not have others. You must have Core Testing Skills as a minimum requirement, the other activities give you your additional testing capabilities.

Independent Checking

In the space below write down what you think is a fair definition of 'Independent Checking'.

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Check your Handbook and check your definition against the Handbook.

There are certain exemptions to Independent checking. Look at Maintenance Test Plan D EL 08

Are there any others?

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Don't forget as a Maintenance Tester you must avoid becoming involved in the precise details of work you have to check. This however, does not stop you from leading the fault diagnosis or directing any installation work.

Differences And Diagrams

Site records form an essential part of the safety process defined in the Handbook; it is essential that they are available and accurate.

If when needed for fault rectification or renewal work, there are no diagrams available **STOP** and advise your supervisor.

No. _____

BRITISH RAILWAYS
S & T ENGINEERING
COMPETENCY CERTIFICATE

SIGNALLING MAINTENANCE TESTER

A

NAME _____

has been passed as competent in the following Signalling Maintenance Testing competencies ticked below:

	Competent	Valid Until
1. Core Testing Skills		
2. Cable & Wire Testing		
3. Earth Testing		
4. Aspect Testing		
5. Point Testing		
6. Block Testing		

SIGNED _____
ASSESSOR

B

and is suitable to undertake Signalling Maintenance Testing in the competencies ticked above.

SIGNED _____
SUPERVISOR/MANAGER

Note : The above competencies are valid until the dates shown above. This certificate can be withdrawn, or refresher training arranged at any time at the discretion of your manager.

S&T Engineering

BR 13152/4 July 92

Figure 7. Competency Certificate

If a difference is discovered between the diagrams and equipment being worked on, **STOP** and advise your supervisor.

If a set of diagrams have unsigned and undated amendments **STOP** and advise your supervisor.

Maintenance Test Plan Steps Which Are Required But Cannot Be Carried Out

If any steps which are required cannot be carried out, a note must be made in the logbook and the supervisor advised, who must give permission for equipment to be brought into use. Also, if a Test Plan is found to be deficient in any way, details must be recorded in the Logbook and additional tests carried out. The query must be reported to the supervisor as soon as possible, and details forwarded for possible inclusion in the Handbook.

Pre-Planned Work

If during pre-planned work any deviation or change to the listed work must be recorded on the Maintenance Test Plan list by a certificated Maintenance Tester.

Logbook Sheets

If any of the work recorded on the logbook sheet is thought to be inadequate the Supervisor must arrange for the work to be re-tested.

Exercise 3

Study the following scenarios along with the diagrams provided and select the appropriate Test Plans and/or procedures. Once you have finished check your answer with the instructor.

Write in the space below each scenario the Maintenance Test Plan(s) (if any) that are required.

1. On a maintenance visit the strength and polarity meter reading on 89 inductor would only reach the yellow. The electromagnet needs changing.

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2. The signal lamp in the yellow aspect in number 6 signal is on stand-by and requires replacing.

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3. During an insulation test of cable RL 1b it is found that the first 6 way terminal block is causing low meggar readings and requires changing.

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4. While carrying out routine maintenance in case A it is found that 89 ECR plug in relay base is cracked and needs changing.

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5. During Civil Engineer's relaying operations number 6 signal head is damaged by a crane but still attached to the signal post.. The head needs changing.

.....

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6. While walking along the track investigating a track circuit failure. the technician sees a broken bond wire and decides to replace it.

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7. The rectification of a track circuit failure requires the track circuit tail cables from the rails feeding T83 TR to be changed.

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Notes

2. Carry Out Logbook Procedures For Maintenance Testing

After successfully completing the work relating to this competence you will be able to:

- State when to use the Logbook.
- Defined Unplanned Renewals.
- Complete a Logbook entry for a given task.
- Describe the arrangements for custody of current Logbook and sheets.
- State how full Logbook is dealt with.

When To Use The Logbook

The Logbook used to record the basic details of all work where a Maintenance Test Plan is used except where specifically exempted.

It must also be used for recording slipped links but will exclude details associated with adjustments.

Refer to A010 page 01 in your handbook which gives more details.

Pre-planned And Unplanned Work

What is meant by pre-planned and unplanned work?

Well unplanned work results from a failure, whereas pre-planned will be work planned in advance, for example, weekend work, renewals etc. If the work is pre-planned a Maintenance Test Plan List must be prepared. This will be dealt with later in these notes. More details are in your handbook section A005 page 6.

Logbook Sheets

Figure 8 shows a typical completed Logbook sheet which you will find on A005 page B01 in your Handbook.

These Logbooks are kept in the front of your Handbook and are a stationery item, ordering details you will find in the front of each Logbook.

As you can see the Logbook sheet gives details of the place, date, time, fault number, details of the equipment, actual work, Test Plans used, the person doing the work and who it was tested by.

A Logbook entry will also be required when a Maintenance Test Plan List has been prepared.

Place:
Barton Mills

Date : *5/6/91*

Time : *14-20*

Fault No. :

Equipment (inc. serial nos.):

54 'A' Pts
HW Machine
65321B

Detail of work:

Replace Motor

Maintenance Test Plans used:

PC O2

Work done by:

A. N. Other

Work tested by:

A. Tester

Notes:

Figure 8. Typical Logbook Entry

Exercise 4

For the given scenarios below complete the Logbook entries.

Assume today's date and time. The work has been carried out by William Jones and tested by you.

Once you have finished your instructor will go through the exercise.

The following scenarios relate to Location 209/178.

1. A failure is traced to no 50 Volt supply on the busbars in case A, caused by a blown fuse. The BX 110 Volt fuse needs changing. (Fault No. 516.)

2. No light in the red aspect of number 6 signal is found to be due to a faulty lamp holder. The lamp holder requires changing. (Fault No. 214.)

3. A failure where number 6 signal will not change to a proceed aspect is due to the wire between link D12 to 6 HR R1 being cut, probably chewed by rats. (Fault No. 867.)

Three blank Logbook sheets are provided on the following pages for your answer. It is probably a good idea to use pencil first and then go over in pen when you are sure your answer is correct.

Place: Date :

Time :

Fault No. :

Equipment (inc. serial nos.):

Detail of work:

Maintenance Test Plans used:

Work done by:

Work tested by:

Notes:

Place: Date :

Time :

Fault No. :

Equipment (inc. serial nos.):

Detail of work:

Maintenance Test Plans used:

Work done by:

Work tested by:

Notes:

Place: Date :

Time :

Fault No. :

Equipment (inc. serial nos.):

Detail of work:

Maintenance Test Plans used:

Work done by:

Work tested by:

Notes:

Handover Arrangements

What is meant by handover arrangements?

. . . . . .

The logbook top sheet compiled by the first maintenance tester is handed onto the next maintenance tester who is going to finish the testing. If their name is known this should also be included as "passed to B Tester".

The second tester must then complete their own logbook sheet and both are then forwarded to the supervisor.

Place: Temple Mills Date : 03/06/92

Time : 13.30

Fault No. : 1017

Equipment (inc. serial nos.):

27 Signal Transformer Green Aspect

Detail of work:

Transformer changed

Maintenance Test Plans used:

PW 02

Work done by: A Nother

Work tested by: A Tester

Notes: Steps 1 to 6 completed only

First Testers Logbook Sheet

Place: Temple Mills Date : 03/06/92

Time : 14.15

Fault No. : 1017

Equipment (inc. serial nos.):

27 Signal Transformer Green Aspect

Detail of work:

Transformer changed

Maintenance Test Plans used:

PW 02

Steps 7 to 15 carried out only

Work done by: J Bloggs

Work tested by: B Tester

Notes: Steps 1 to 6 carried out by A Tester

B Testers Logbook Sheet

It is important to note that the second tester must record on their logbook sheet how far the first tester got, even though they have the first testers logbook sheet.

If any tests carried out by the first maintenance tester had unsatisfactory results then these tests must be carried out again by the second maintenance tester.

Completed Logbook Sheets

What happens to Logbook bottom sheets?

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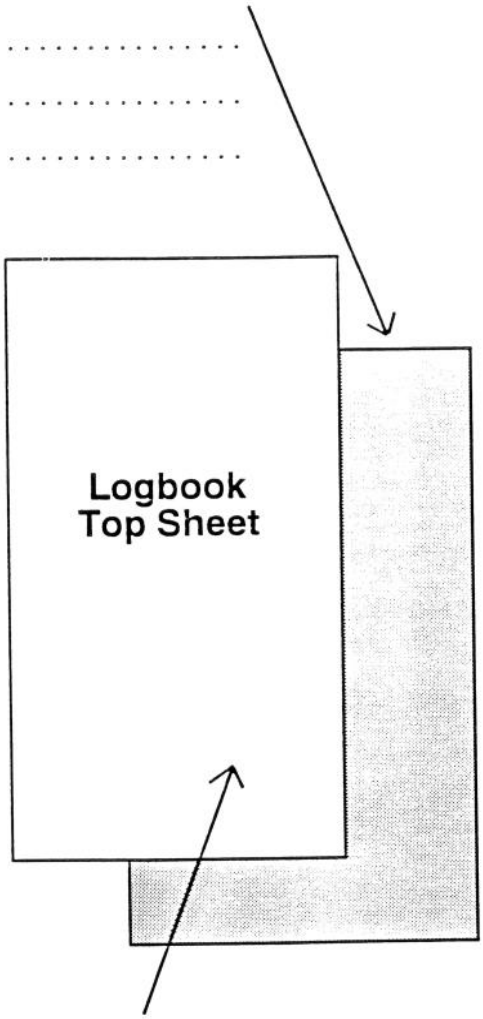
.....

.....



What happens to Logbook top sheets?

.....

.....

.....

Check your answer to your Handbook.

Logbook Sheets - Who Fills Them In?

Only the team member designated as the Maintenance Tester needs to complete a Logbook entry.

Full Logbooks

Once a Logbook is full it can be kept as a personal record, the benefit of this means you have a record of testing carried out by you, similar to fault reports, correspondence etc.

Notes

3. Complete And Deal With Maintenance Test Plan Lists

After successfully completing the work relating to this competence you will be able to:

- State when a Maintenance Test Plan List is required.
- Complete a Maintenance Test Plan List.
- State how a Maintenance Test Plan List is dealt with.

Purpose

As mentioned previously a Maintenance Test Plan List is used for pre-planned work, as against unplanned work resulting, for example, from a failure.

Below make a list of jobs that could be Pre-planned

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Benefits

Obviously if we pre-plan anything beforehand it means materials and equipment can be ordered, staff can be arranged etc. So before any pre-planned work is undertaken a list of associated Maintenance Test Plans must be prepared.

Requirements

The minimum requirement when compiling a Maintenance Test Plan List is to detail the Maintenance Test Plan(s) to be used, equipment to be affected, the work location and the work to be carried out.

Refer to your Handbook section A005 page 06 for more details.

Look at the example of a completed Maintenance Test Plan List, in your Handbook section A005 page C01.

Maintenance Test Plan List Pads

These pads are not in your Handbook as they are only required for pre-planned work. These are available as a stationery item, or can be made up locally, providing that all the information required on the Maintenance Test Plan List is provided.

Typical Maintenance Test Plan List

An example of a completed Maintenance Test Plan List is shown in Figure 9. Another example is in section A005 page C01 in your Handbook.

This form is used to detail the Maintenance Test Plan(s) to be used, equipment that will be affected, the work location and the work to be carried out.

If the same test plan is to be used several times, for example changing say 7 relays of the same type, then it is acceptable to put change relay **x** 7.

Partially Completed Lists

The top sheet of the partially completed Maintenance Test Plan List is taken to site whilst the bottom sheet remains with the pad as a record of the work planned. Remember, a Logbook entry is still required from the Maintenance Tester for any job listed on a Maintenance Test Plan List which has been completed and tested.

The completed list must accurately reflect the work carried out and record the names of all those involved with the work and testing.

MAINTENANCE TEST PLAN LIST

SITE: *NEWTOWN STATION* DATE: *2/12/91* COMPILED BY: *J. DAVIS*

CONTROLLING SIGNAL BOX	LOC. NO. OR EQUIPMENT ROOM	EQUIPMENT	DETAILS OF WORK		MTCE. TEST PLAN NO.	PERSON DOING WORK	PERSON TESTING
NEWTOWN	*LOC 209/178*	*ALL RELAYS IN CASE 'A'*	*REPLACE*	*6HR*	*EL 08*		
			"	*6DR*	*EL 08*		
			"	*6ECR*	*EL 08*		
			"	*12HR*	*EL 08*		
			"	*12DR*	*EL 08*		
			"	*12ECR*	*EL 08*		
			"	*89HR*	*EL 08*		
			"	*89DR*	*EL 08*		
			"	*89ECR*	*EL 08*		
			"	*T83TR*	*TC 01*		
			"	*T83TPR*	*EL 08*		
			"	*T84TR*	*TC 01*		
			"	*T84TPR*	*EL 08*		

ALTERATIONS TO LISTED WORK:

SIGNATURE OF PERSON IN CHARGE ON COMPLETION: ..... 1 TIME & DATE: .....

Figure 9. Partially completed Maintenance Test Plan List

Exercise 5

Study the following scenarios and make out the Maintenance Test Plan Lists as directed in each scenario.

Once you have finished, your instructor will go through the exercise.

The following scenarios relate to Location 209/178.

1. You have been requested by your supervisor to find a quiet period during the week to renew 6 I T/J, 12 I T/J and 89 I T/J.

Partially complete a Maintenance Test Plan list as required by the Maintenance Testing Handbook before starting the work.

Once you have partially completed the Maintenance Test Plan List assume that the work has been correctly carried out by Peter Jones and Tested by you.

Complete the Maintenance Test Plan List.

Assume today's date and time.

2. Cable RL 2b to walk in location hut 209/300 has been damaged by rodents and requires changing. This has been scheduled for next Sunday.

Partially complete a Maintenance Test Plan List as required by the Maintenance Testing Handbook before starting the work.

Once you have partially completed the Maintenance Test Plan List assume that the work has been correctly carried out by Alan Nelson and Tested by you.

Complete the Maintenance Test Plan List.

Assume today's date and time.

Totally Completed Lists

The completed Maintenance Test Plan List must be signed and dated by a certificated Maintenance Tester to show that Logbook entries and the Maintenance Test Plan Lists are correctly completed. They must be forwarded with the associated Logbook top sheets to the supervisor at the first opportunity after the end of the work. The bottom signature says that the list has been completed correctly. The Logbook top sheet is the document that confirms that the testing has been completed

The supervisor will check and retain this sheet, though it is not auditable.

If any of the work particularly any deviation is considered inadequate the supervisor must arrange for the work to be retested.

MAINTENANCE TEST PLAN LIST

SITE: ..... DATE: ..... COMPILED BY: .....

CONTROLLING SIGNAL BOX	LOC. NO. OR EQUIPMENT ROOM	EQUIPMENT	DETAILS OF WORK	MTCE. TEST PLAN NO.	PERSON DOING WORK	PERSON TESTING
ALTERATIONS TO LISTED WORK:						

SIGNATURE OF PERSON IN CHARGE ON COMPLETION: 1

TIME & DATE: .....

MAINTENANCE TEST PLAN LIST

SITE: ..... DATE: ..... COMPILED BY: .....

CONTROLLING SIGNAL BOX	LOC. NO. OR EQUIPMENT ROOM	EQUIPMENT	DETAILS OF WORK	MTCE. TEST PLAN NO.	PERSON DOING WORK	PERSON TESTING
ALTERATIONS TO LISTED WORK:						

SIGNATURE OF PERSON IN CHARGE ON COMPLETION: 1

TIME & DATE: .....

Notes

4. Understand Standard Signalling Maintenance Testing Handbook Terminology

5. Understand Safety Procedures To Be Followed When Work Involves Links

This part of the notes will deal with the above two Competences together.

After successfully completing the work relating to this competence you will be able to:

- Define checking equipment for
- Define in relation to checking equipment for the terms: *Correct Type, Damage, Safe Insulation, Correct Installation, Isolation and Correct Labelling.*
- Define the term *Slipped Links.*
- Explain safety procedures to be followed when working in situation where links have been slipped.
- Explain safety procedures to be followed when work involves links associated with unused cable cores.
- State error reporting procedures.

Definitions

Many Test Plans require the Maintenance Tester to carry out certain checks or tests on equipment.

Without referring to your Handbook write down below your definitions of *Check* and *Test* in the context as used by the Signalling Maintenance Testing Handbook.

Check

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Test

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Check how you did by referring to your Handbook section A003 pages 01 and 02 and check your definitions against those in the Handbook.

How do they compare?

Defined Checks

Many Test Plans ask for checks to be carried out and with reference to a defined check.

As you already know, if on a Test Plan something is written in italics it tells you there is a definition elsewhere in your Handbook. Defined checks are in lower case italics.

Refer in your handbook to Test Plan D AW03 and pick out the defined checks.

The full list of defined checks are:

correct type, *damage*, *safe insulation*, *correct installation*, *isolation*, *correct labelling*.

Isolation is split into three categories:

disconnection at a plugboard, *removal re-fitting of a cable core/wire*, *slipping links/removing fuses*

Labelling is split into two categories:

correct labelling of equipment, and *correct labelling of cables and wires*

Without referring to your Handbook, write down below what you think a fair definition of each defined check would be:

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Check how you did by referring to your Handbook section B003 pages 01 to 04 and check your definitions against those in the Handbook.

How do they compare?

Slipped Links

Before starting work all slipped links must be noted in the Logbook.

The recording may be limited to slipped links on the vertical strip of terminals where the links are required to be moved as part of the work.

However if links are being slipped as part of the work (or testing) and there is no danger of not remembering which ones were slipped then it is not necessary to record these in the logbook.

Red Dome Nuts

Where a link has to be removed and must not be replaced after the work red dome nuts must be fitted.

The fitting of red dome nuts must be noted in the Logbook.

These act as a reminder that a link must not be fitted.

Completion Of Work

On completion of work check no originally slipped links have inadvertently been restored. Remove any links from spare cable cores at either end of the cable

Hand Over Arrangements

When handing over testing to a different team forward the details of the slipped links to the person taking over.

Exercise 7

Figure 10 on the next page shows core 3 in the cable between locations 6 and 7 open circuit.

Draw in the circuit modification required to divert the circuit through a spare conductor. Indicate: any links needing to be slipped, any links that should be removed and not replaced, the fitting of any red Dome Nuts, and anything else you may think of.

Section A010 of your Handbook may help.

Once you have finished check with your instructor for the correct answer. It may be a good idea to mark the diagram in pencil until you are sure of the answer.

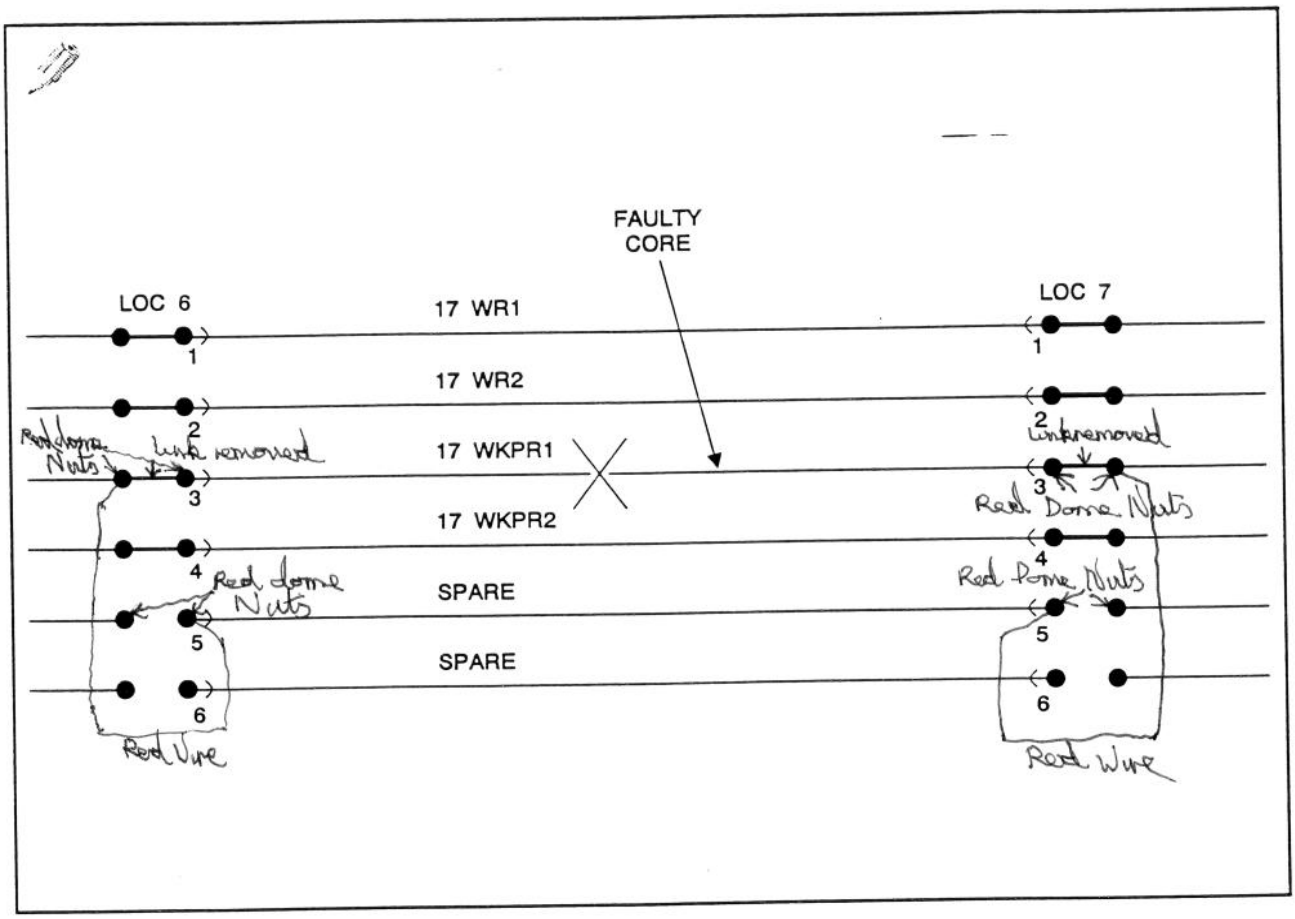

Figure 10. Work Involving Links

Errors Found During Testing

Write below the procedure if an error is found during the testing.

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Give some examples

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Check your answers to your Handbook section A005 page 03.

It is important to remember that any errors found must be corrected (by following the correct procedures) and independently tested again before the equipment can be brought into use.

Notes

6. Apply and Remove Temporary Labels

7. Carry Out a Wire Count

This part of the notes will deal with the above two competences together.

After successfully completing the work relating to this competence you will be able to:

- Identify occasions when a Wire Count is required.
- Wire Count relay bases to wiring diagrams and contact analysis sheets.
- Wire Count a selection of equipment, other than relays, to include fuses, links and terminal blocks to circuit diagrams.
- Record the results of the Wire Count.
- State procedure for reporting errors.
- Identify wires requiring Temporary Labels.
- Affix Temporary Labels.
- Remove Temporary Labels.

What Is A Wire Count?

In the Test Plan D EL12 (Figure 11) you can see steps 2 and 8 require a Wire Count to be carried out; this is a defined test.

What do you think a Wire Count is and why do we do it? Write your answer below.

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Now check the definition in your Handbook section B 014.

REPLACE A PLUGBOARD D EL12

Includes: Plugboard for all plug in components.

BEFORE INSTALLATION WORK

1 *Check* replacement plugboard is not damaged and is *correct type* (Pin code).

2 *WIRE COUNT* existing plugboard to wiring diagram.

3 *Check* existing wiring has *safe insulation.*

4 *Check* existing wiring is *correctly labelled.*

AFTER INSTALLATION WORK

5 *Check* replacement plugboard is *correctly installed.*

6 *Check* wiring is replaced as labelled.

7 *Check* connections securely locked in plugboard.

8 *WIRE COUNT* replacement plugboard to wiring diagram.

9 *Check* item 4 equipment fitted to the plugboard is correctly installed and the retaining clip is in place.

* 10 *Check* with the maintenance test plan for the item of equipment fitted to this plugboard and carry out steps marked with an asterisk "*".

Note: If the affected plugboard forms part of a track feed circuit carry out steps marked with an asterisk "*" on the appropriate maintenance test plan for the track feed equipment.

11 *Check*, or arrange for, *correct labelling* of unit.

Figure 11. Test Plan D EL12

Equipment

Care must be taken to include any relevant equipment e.g. cable links, fuses, busbars, equipment terminations etc.

The Wire Count must be carried out with all wires terminated.

Method

Wire Count To Diagram

Every wire terminated on the affected piece of equipment should be checked, by first checking the number of wires connected to each termination point on the equipment, and then ensuring this corresponds with the number of wires indicated on the wiring diagram.

In this way, if an extra wire or wires are terminated on spare positions, they will be found along with any extra wires on terminations already in use.

If you first look at the diagram and then check that the equipment corresponds to the diagram, you would only check terminations that are in use, and could possibly miss extra wires on spare terminations not shown on the diagrams. For example, a spare fuseholder (therefore not shown on the diagram) has a wire attached to it. The only sure way to find it, is to check all terminations on the equipment and ensure this corresponds to the diagram.

During a Wire Count of 89 (OFF) GPR, two wires are found terminated on contact A5. Now check the diagram (Figure 12) to see if it is correct.

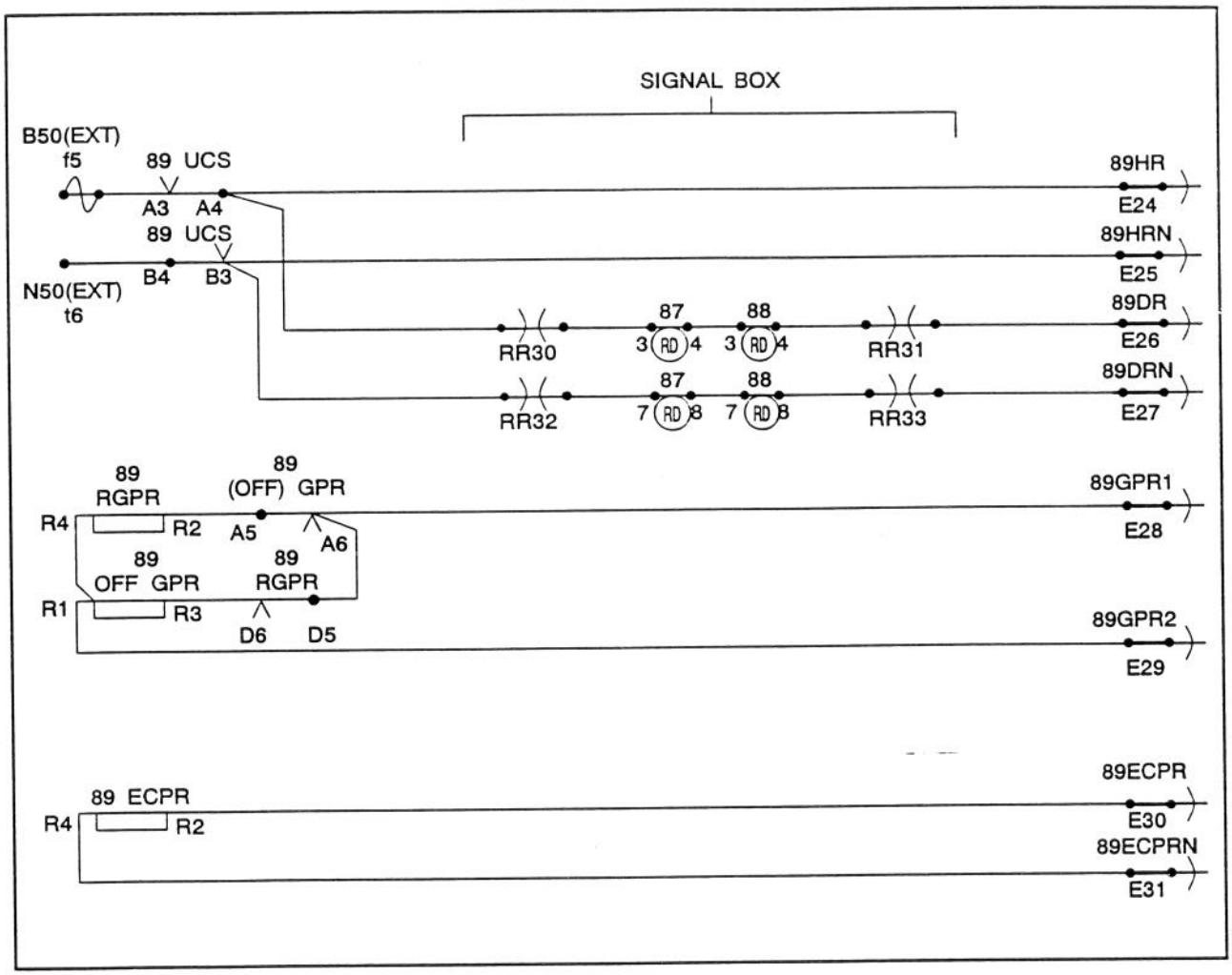

Figure 12. Wire Count to Diagram

What Have you found?

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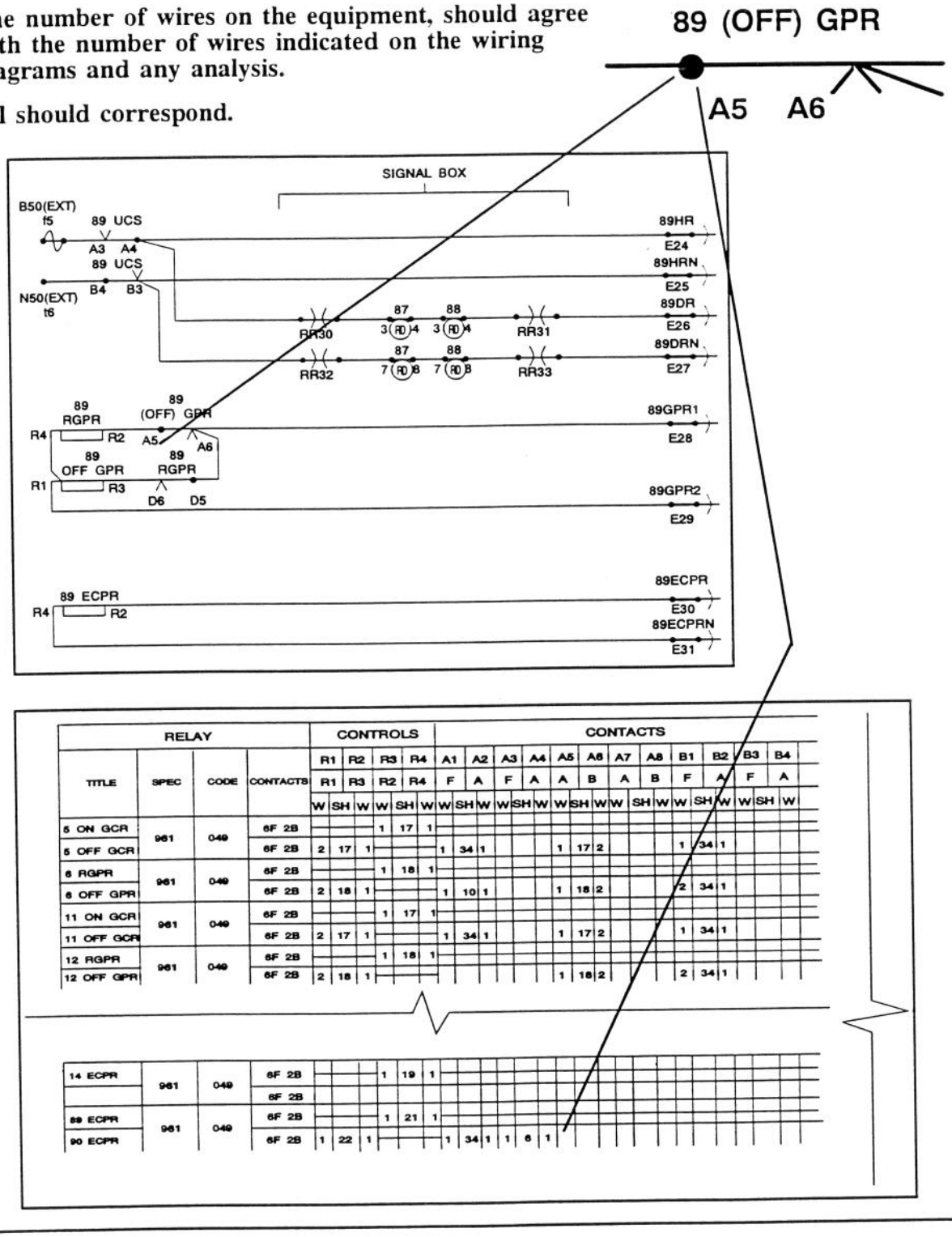
Wire Count To Analysis Sheet

If an analysis is available, it is not sufficient to Wire Count to the analysis on its own, but must be used in conjunction with a Wire Count to the wiring diagram. One method of doing this, is to initially Wire Count to the wiring diagrams and then check if the diagram and the analysis correspond.

The number of wires on the equipment, should agree with the number of wires indicated on the wiring diagrams and any analysis.

All should correspond.



RELAY				CONTROLS				CONTACTS											
TITLE	SPEC	CODE	CONTACTS	R1 R2 R3 R4				A1	A2	A3	A4	A5	A6	A7	A8	B1	B2	B3	B4
				R1 R3 R2 R4				F	A	F	A	A	B	A	B	F	A	F	A
				W SH W W SH W W				W SH W W SH W W SH W W											
5 ON GCR	961	049	6F 2B			1 17 1													
5 OFF GCR			6F 2B	2 17 1				1 34 1				1 17 2				1 34 1			
6 RGPR	961	049	6F 2B			1 18 1													
6 OFF GPR			6F 2B	2 18 1				1 10 1				1 18 2				2 34 1			
11 ON GCR	961	049	6F 2B			1 17 1													
11 OFF GCR			6F 2B	2 17 1				1 34 1				1 17 2				1 34 1			
12 RGPR	961	049	6F 2B			1 18 1													
12 OFF GPR			6F 2B	2 18 1								1 18 2				2 34 1			
14 ECPR	961	049	6F 2B			1 19 1													
			6F 2B																
89 ECPR	961	049	6F 2B			1 21 1													
90 ECPR			6F 2B	1 22 1				1 34 1 1 6 1											

Figure 13. Wire Count to Wiring Diagrams and Analysis

Recording Of Wire Count

It is not necessary to record results of a Wire Count, for example by ticking the wiring diagrams; it may be recorded if it assists the Tester; to do this a Wire Count Grid Sheet is provided in the Handbook.

Complete the grid sheet below in for a selected piece of equipment of your choice. When finished ask someone to check it for you.

SIGNALLING MAINTENANCE TESTING HANDBOOK

WIRE COUNT GRID SHEET

Copy and store in binder pocket for use as required

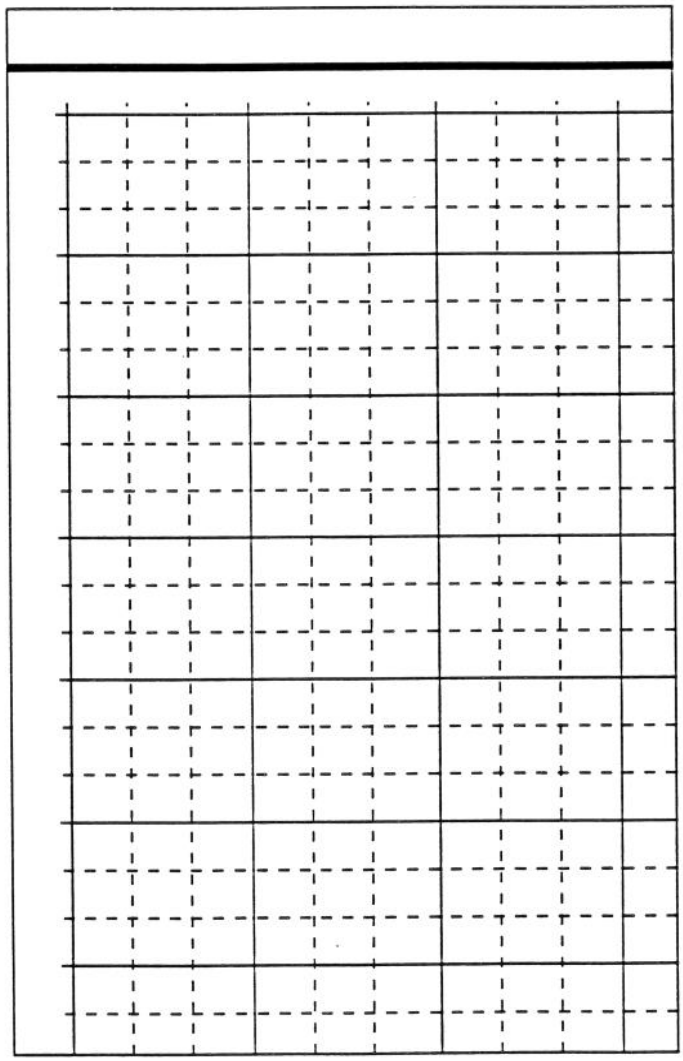


Figure 14. Wire Count Grid sheet

Things To Remember

While carrying out a Wire Count it is important to ensure spade terminals are not loosened, wires are not broken and there are no loose nuts, washers, off cuts of wires or other superfluous metal objects in the vicinity of working circuits.

Errors

If, during the BEFORE section of a Test Plan, the wire count reveals an error, **STOP** and advise the supervisor.

If, during the AFTER section of a Test Plan, the wire count reveals an error, then the work must be corrected and independently re-tested.

Labels

As well as Wire Count a check of the labelling may be required which may result in a Temporary Label or Labels being applied.

Many Test Plans require the labelling and subsequent checking of wires and cables where a disconnection is required as part of a like for like replacement.

Suitable Labels

Cable core numbers or wire bead markers may be acceptable when clearly visible and unambiguous and correspond to the wiring diagram. Otherwise a suitable temporary label must be applied.

Diversion of Circuits

Existing wiring which is to be diverted must be clearly labelled.

Temporary diversion of circuits means, the short term reallocation of cable cores, relay contacts, or emergency repositioning of an item of equipment which has operated correctly.

Suitable Temporary Labels

Any Temporary Labels must not damage either wires or equipment and shall be removed on completion of the work to avoid confusion.

Write a few examples where Temporary Labels would be required

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Discuss these with your instructor.

Fit for Service

A Temporary Label is fit for service when it uniquely marks or identifies the wire or cable core and corresponds to the diagram.

Remember, everyone likely to be involved in the work or testing must understand the labelling system adopted.

Notes

Notes

S&T

SAFETY • QUALITY • TEAMWORK

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Cable And Wire Testing

Student Notes

Section 3

TRAINING DEVELOPMENT

Contents

Cable And Wire Testing

Cable And Wire Testing

Introduction

Listed below are the competences that this section deals with:

- Carry out a Continuity Test.
- Carry out an Insulation Test.
- Carry out a Cable Function Test.

These competences will be dealt with as one item in this section.

What should you be able to do at the end of this section:

- Identify occasions when a Continuity Test, Insulation Test, and Cable Function Test are reqired.
- Identify the cable, cable core, and circuit to be tested.
- State methods of isolating a cable/cable core prior to Continuity Testing and Insulation Testing.
- Isolate cable/cable core to be tested.
- Select suitable test instruments for the tests to be carried out.
- Connect and use the test instruments to carry out Continuity, Insulation, and Cable Function Tests.
- Recording of results.
- State how to test a diverted cable core.

Defined Tests

There are three basic elements to cable Testing:

- Continuity Test.
- Insulation Test.
- Cable Function Test.

When Will These Tests Be Required?

These tests are called for in many Test Plans, mainly when a cable or wire is jointed, renewed, or a length added; also when a cable core is brought into use.

Where these tests are required they will be shown in capitalised italics as shown Figures 1. and 2. (Steps 7, 12,16) in Maintenance Test Plan D CA03.

RENEW A CABLE/WIRE

D CA03

Excludes: Renewing a cable/wire with intermediate terminations, links or contacts.

BEFORE INSTALLATION WORK

1 *Check* identity of existing cable/wire by physically tracing or electrically proving.

2 *Check* no intermediate terminations, links or contacts exist between the ends to be disconnected.

3 *Check* replacement cable/wire is *not damaged* and is *correct type*.

4 *WIRE COUNT* existing cable/wire to the wiring diagram.

5 *Check* equipment terminals associated with the existing cable/wire are *correctly labelled*.

6 *Check* existing cable/wire is *isolated* from supply.

7 *CONTINUITY TEST* all cores in the replacement cable/wire (EXCLUDING TRACK CIRCUIT CABLES).

8 *Check* replacement cable/wire or insulated line wire has *safe insulation*.

9 *Check* replacement cable/wire is *correctly labelled*.

Figure 1. Test Plan D CA03 - Before Checks

AFTER INSTALLATION WORK

D CA03

10 *Check* replacement cable/wire is *correctly installed*.

11 *Check* replacement cable/wire is replaced as labelled.

12 *INSULATION TEST* replacement cable/wire (EXCLUDING TRACK CIRCUIT CABLES).

13 *Check* replacement cable/wire is not liable to mechanical damaged.

14 *WIRE COUNT* replacement cable/wire to the wiring diagram.

15 *Check* any links and red dome nuts are secure and correctly replaced.

16 *CABLE FUNCTION TEST* the affected circuits (LINE WIRES AND MULTICORE CABLES EXCLUDING TAIL CABLES).

17 Refer to the Maintenance Test Plan for the item of equipment, fed by the affected cable/wire and carry out steps marked with an asterisk "*".

NOTE: If the affected cable/wire goes to a point detector or microswitch carry out steps marked with an asterisk "*" on the Maintenance Test Plan for the point detector/microswitch.

NOTE: If the affected cable/wire forms part of a track feed circuit carry out steps marked with an asterisk "*" on the appropriate Maintenance Test Plan for the track feed equipment.

18 *Check*, or arrange for, *correct labelling* of cable/wire.

Figure 2. Test Plan D CA03 - After Checks

Purpose

You know that a Test Plan will show when a particular test is required, but what are the tests for? Write down what you think are the reasons why each of the 3 tests is carried out.

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Once you have done this use the index at the front of your Handbook to look up and check for definitions.

Identification And Location Of Cables/Cable Cores

Once the fault repair has been located the information you require as always depends on diagrams.

Any cable that has been jointed, had a length added, or renewed will require all the cores within it to be tested. Also any spare cores in a cable that has been brought into use will also require testing.

Study Figures 3. and 4. Figure 3. is a typical example of a Cable Plan. In this case a 19 core 1/0.85mm cable runs from Location 2. and ends at Location 6., and a 2 core 7/0.67mm power cable runs from Location 2. and ends at Location 5. Using a Cable Plan to determine what cables run where, as you can see makes life a lot easier.

By inspecting the diagram see if you can identify what cables: call into a location, terminate in a location, and are a continuation from another diagram.

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.....

Discuss your answer with your instructor if you require help.

Figure 4. shows a Cable Core Plan, this shows what circuits are carried by each core in a cable. Look at Cores 1. and 2., the lines representing them are continuous from Location 2. to Location 5. Any idea what this means?

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Discuss your answer with your instructor if you require help.

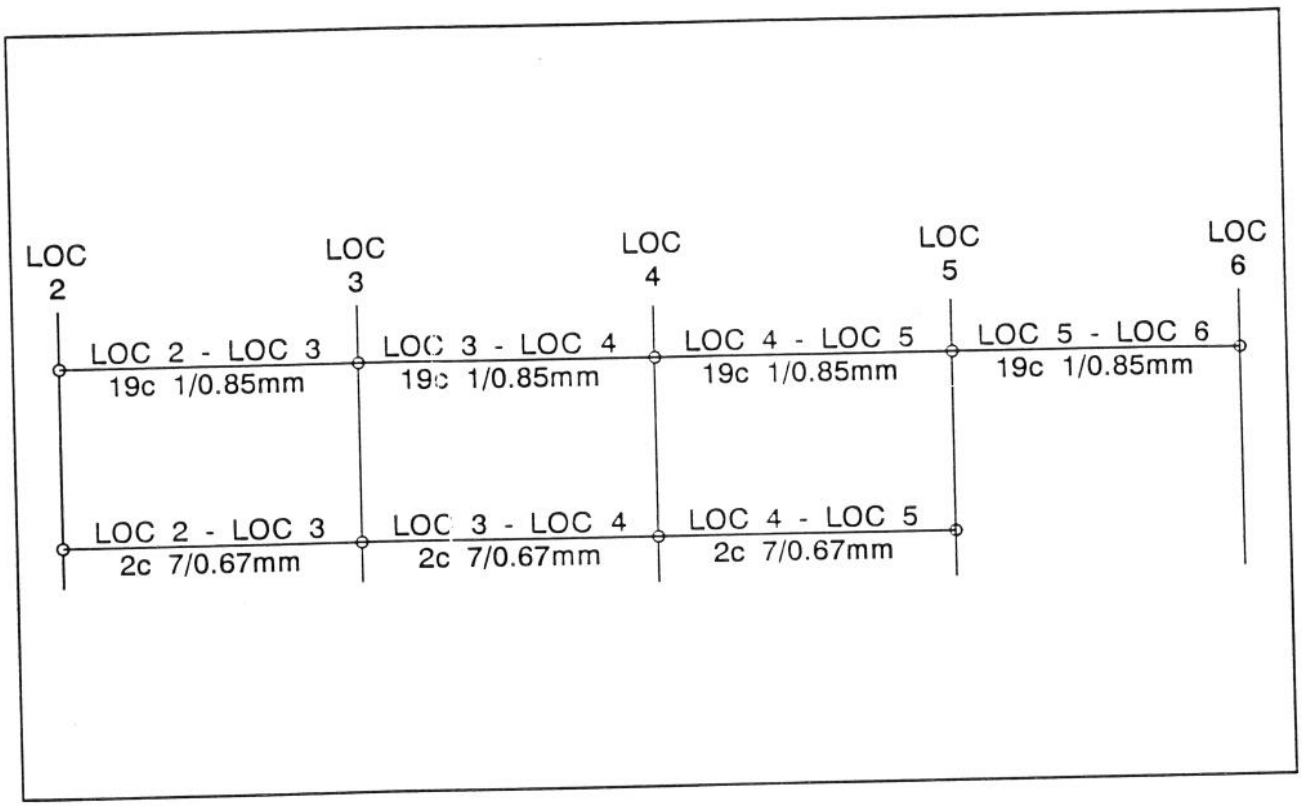

Figure 3. Cable Plan

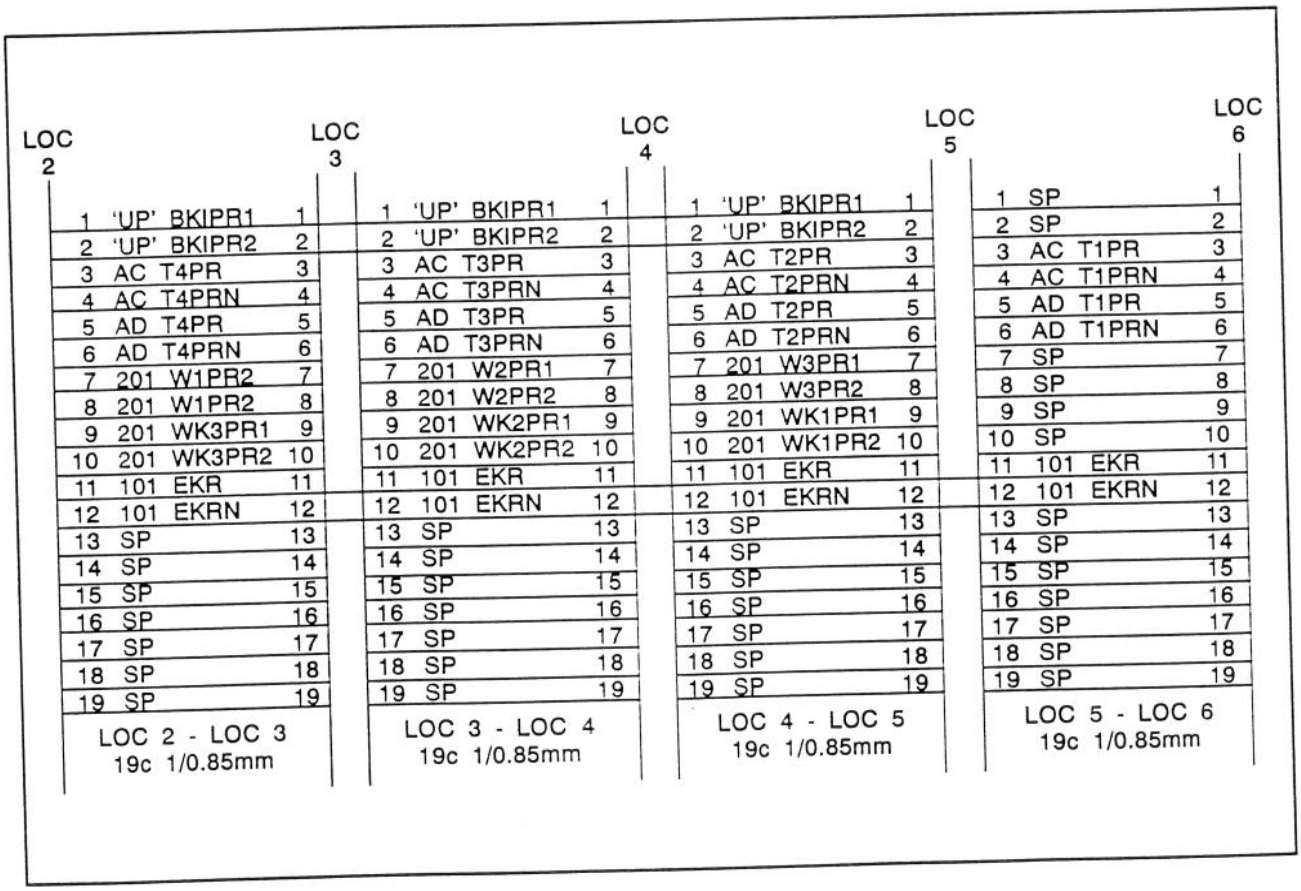

Figure 4. Cable Core Plan

Isolating A Cable/Cable Core

Prior to carrying out Continuity and Insulation Tests, the cable will need to be isolated. This can be achieved by the slipping of links, or removal of the wires from the termination point where there are no links. In the latter case the wire will need to be insulated using a method described in GI E52. See also Handbook Section B 003 Defined Check - Check For Isolation.

Test Instruments

What test instruments would you use for cable testing?

In the space below make a list of suitable and non suitable test instruments for Cable and Wire Testing.

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If you have read the Defined Tests you will see what test instruments to use. Refer to Handbook Sections B 008, B 009 and B 012.

Typical Cable Faults

Figure 5. shows typical faults that a cable may develop during service, or even when new. Typical faults include: Open Circuit/Continuity Fault, i.e. a break or high resistsance in the core; Core to Core Fault, i.e. low insulation resistance between cores; Core to Earth Fault, i.e. low insulation resistance between a core and earth. All under the right circumstances could produce a wrong side failure.

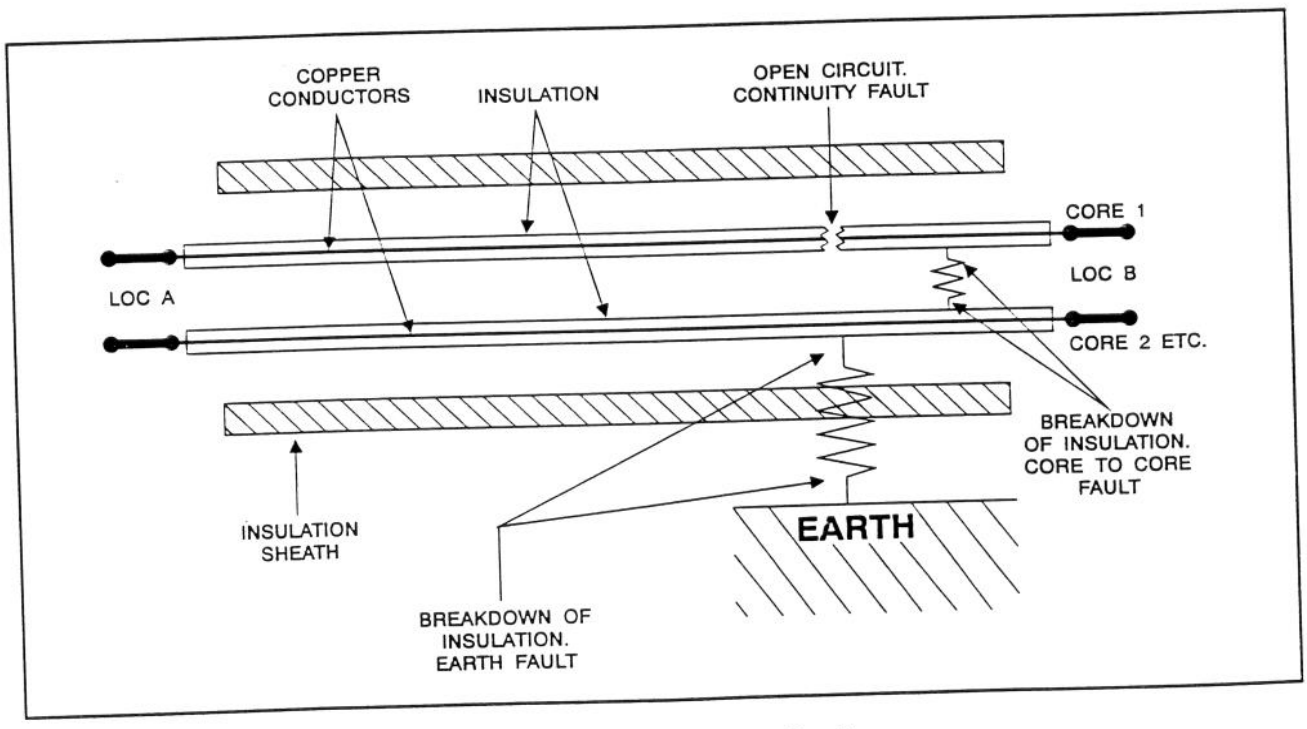

Figure 5. Typical Cable Faults

Continuity Test

The method of carrying out a Continuity Test is described in your Handbook Section B 009.

When a Continuity Test has to be carried out on a cable core a practical method of carrying out this test is to: a) loop two cable cores together at one end of the cable and b) connect the test instrument to the same cores at the other end. This is shown in Figure 6. In a multicore cable, it is practical to use one core as a common, say core no. 1, and use it to test the other cores. Again this is shown in Figure 6.

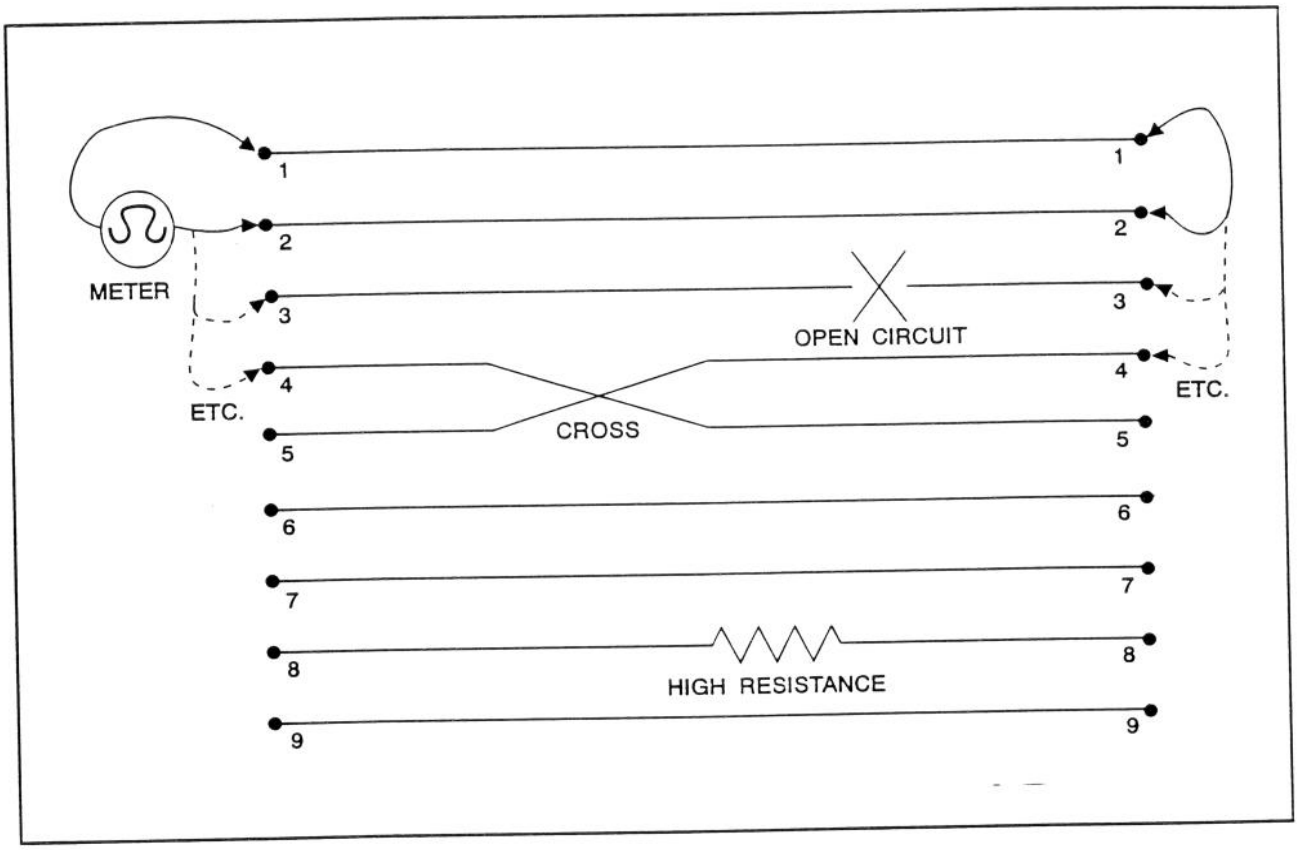

Figure 6. Applying The Continuity Test

What results would you get if you applied the Continuity Test to the cable cores on Figure 6?

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Check your answer with your instructor.

Correspondence Of A 2 Core Cable

Use your Handbook as a reference and draw in the way to test correspondence of the 2 core cable shown on Figure 7.

Check your answer with your instructor.

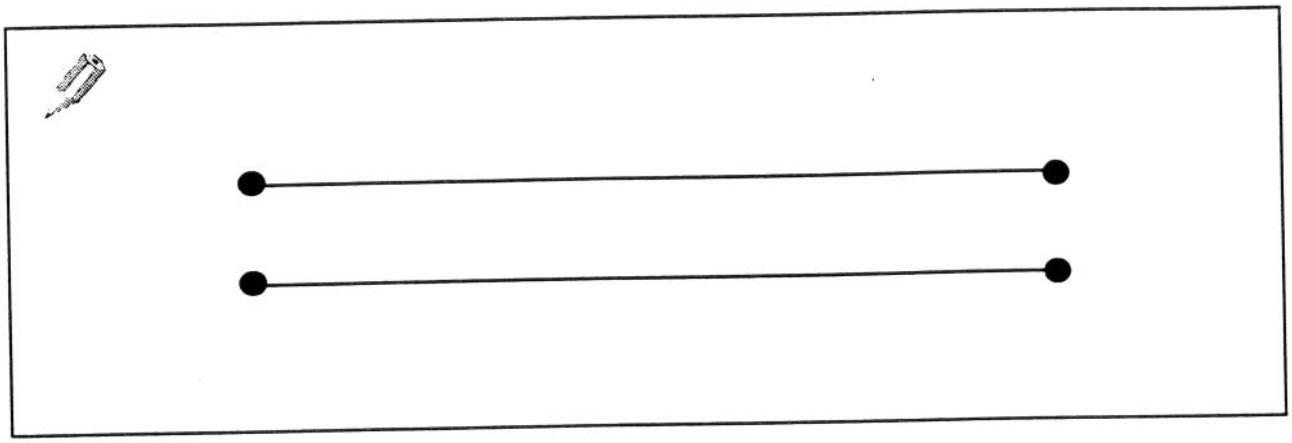

Figure 7. Correspondence Of A 2 Core Cable

Insulation Test

This test is defined in Section B 012 in your Handbook.

Suitable Earth

It is important that when you carry this Test out you have a good connection to earth.

Obviously it is easier if you've got a test earth, if not you will have to provide one.

The integrity of a test earth can be proven as shown in figure 8.

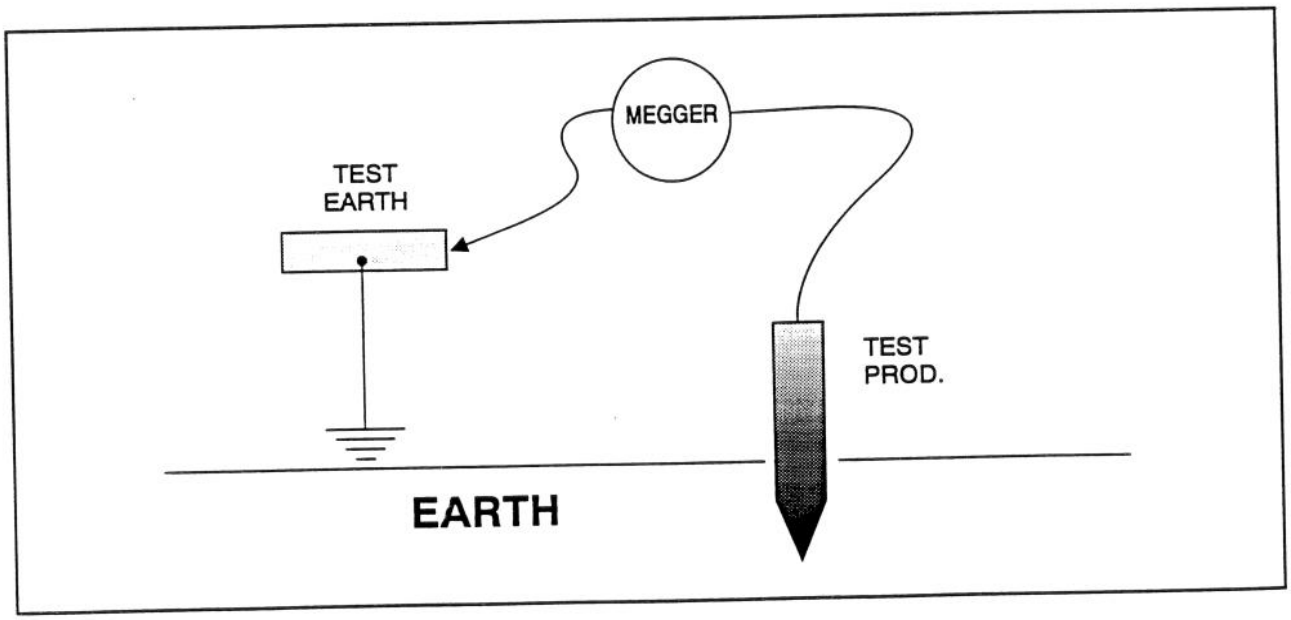

Figure 8. Proving The Integrity Of The Test Earth

Carrying Out The Tests

Core To Earth

Each core is tested to earth individually as shown in Figure 9.

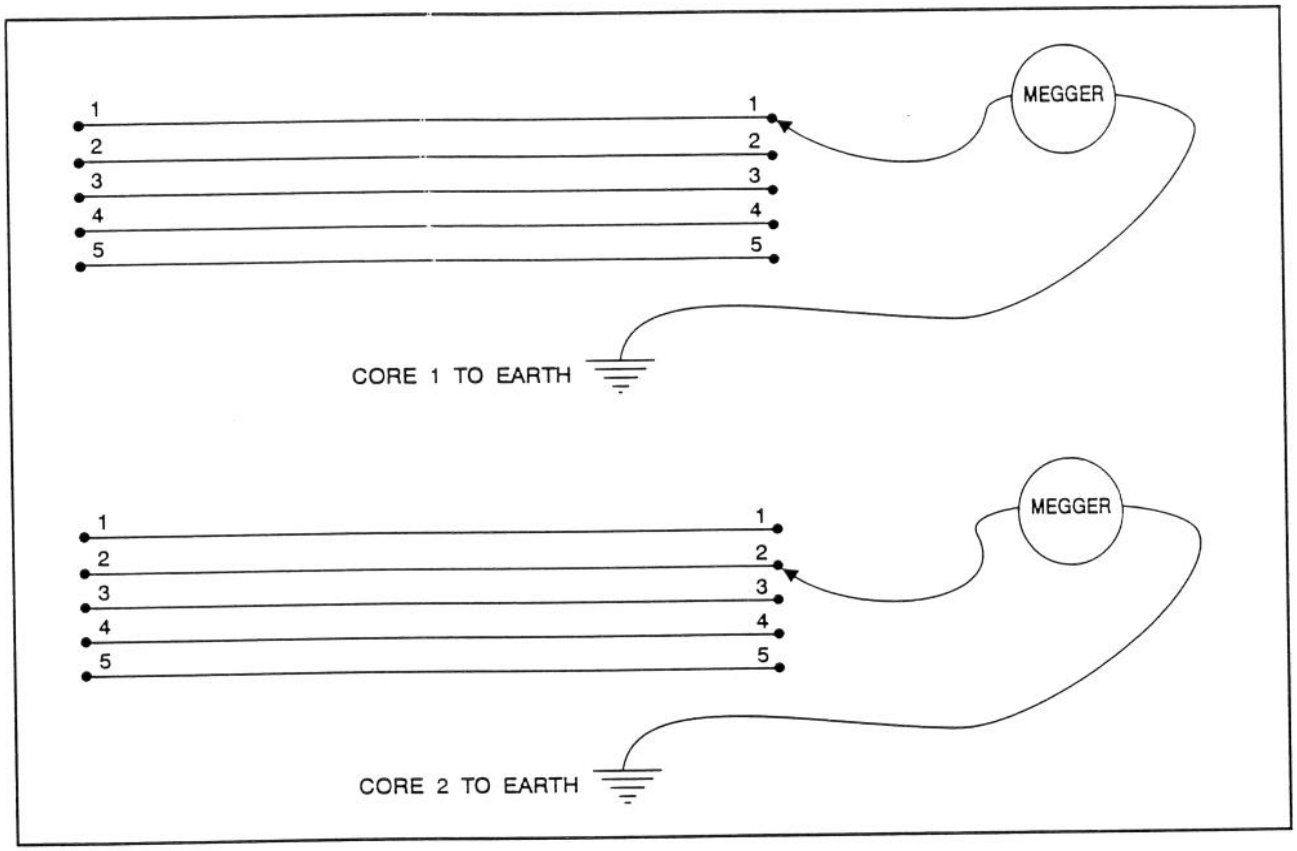

Figure 9. Insulation Test - Core To Earth

Core To Core

Each core is tested to all other cores bunched together as shown in Figure 10. The cores are bunched together using the approved 24 way Insulation Test Straps. Don't forget to put unused clips in the bag.

What do you think is the reason for bunching the cores together?

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Look at Figure 11. for the reason.

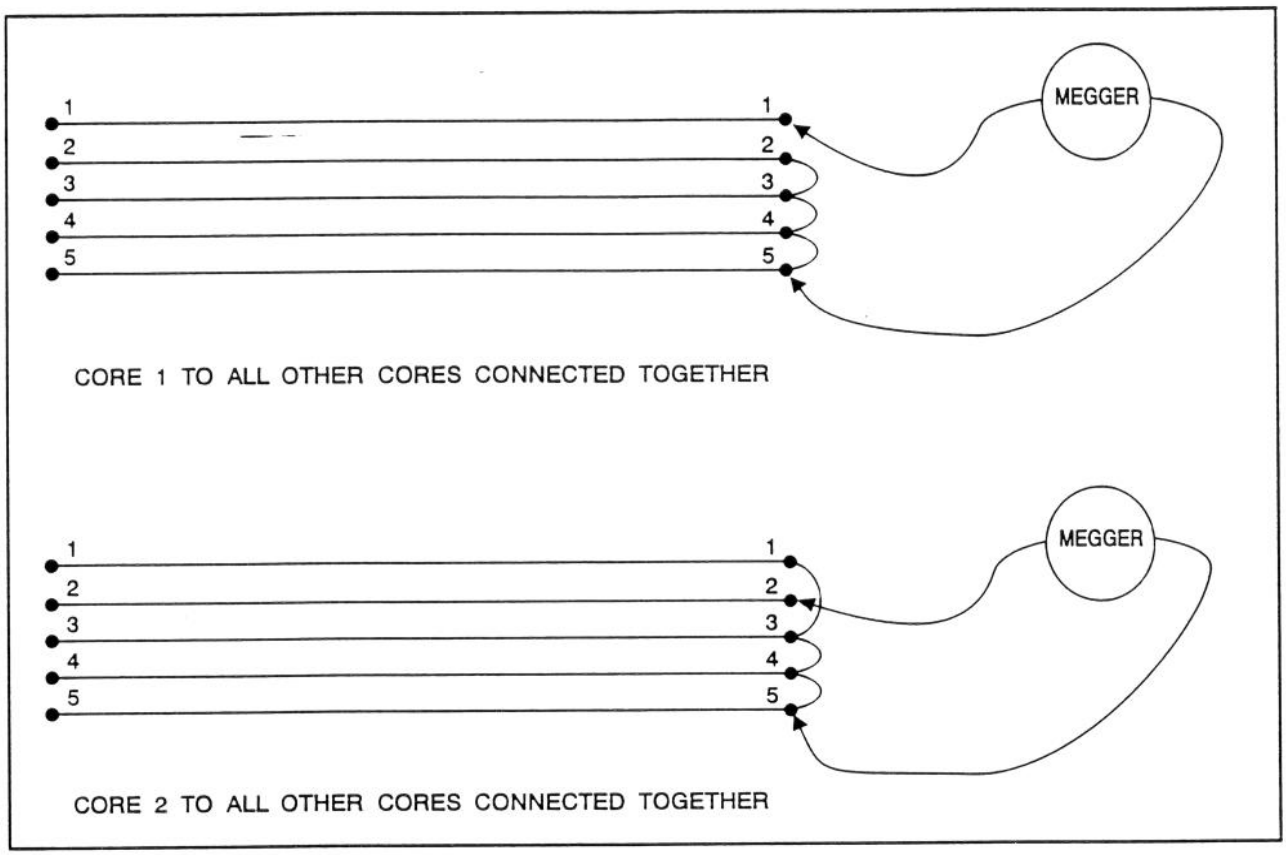

Figure 10. Insulation Test - Core To Other Cores

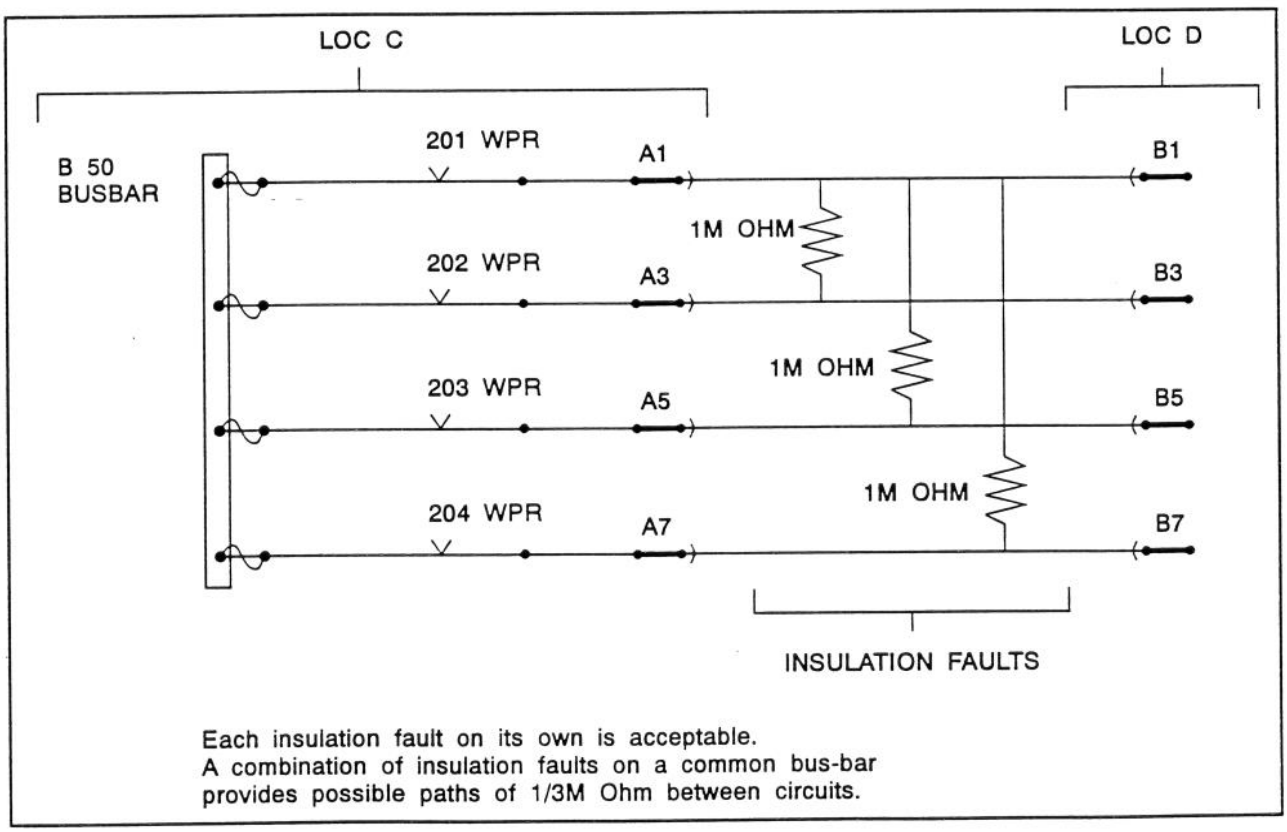

Figure 11. Parallel Insulation Faults Provide An Overall Low Resistance

Cable Function Test

This test is defined n Section B 008 in your Handbook.

Carrying Out The Test

Study Figure 12. and using your Handbook apply the Cable Function Test to it. Find the steps that would find the faults and write them down below. Also detail how each fault would show up when testing.

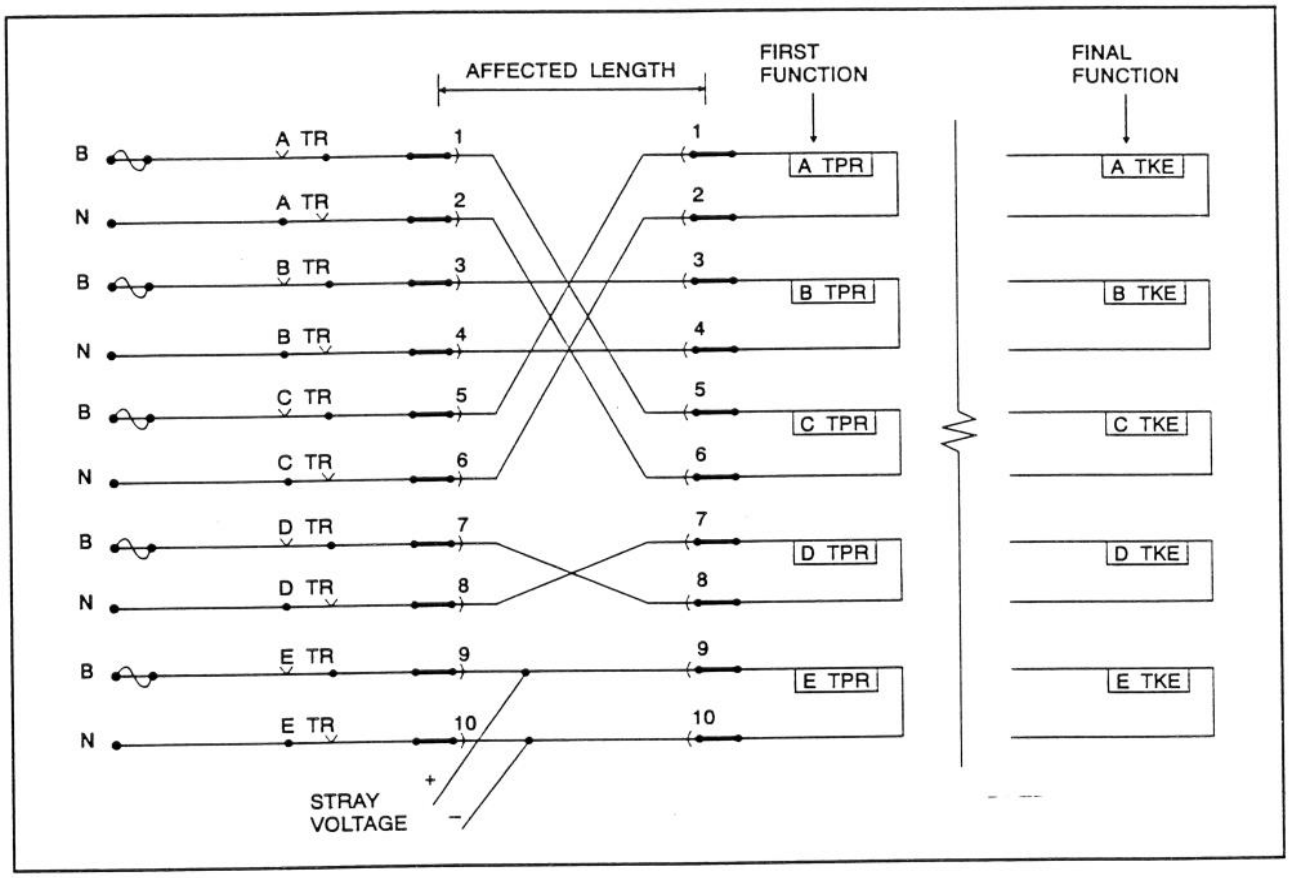

Figure 12. Cable Function Test - Typical Faults

Check your answers with your Instructor.

Belt And Braces

You may find that other tests you may have carried out could have located a fault before you get to the Cable Function Test. For example. the cause stray voltage may be found by another test. for example the insulation test. but if it is induced voltage rather than as a result of poor insulation it would not. It is always better to be safe than sorry.

What other faults would be located by other tests?

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Check your answers with your Instructor.

Double Cross

In the example on Figure 13. a cross had been introduced in the cable between Location A. and Location B. To compensate for this a second cross had deliberately introduced in the cable between Location B. and Location C.

Everything is O.K. until a length of cable goes missing between Location A. and Location B.

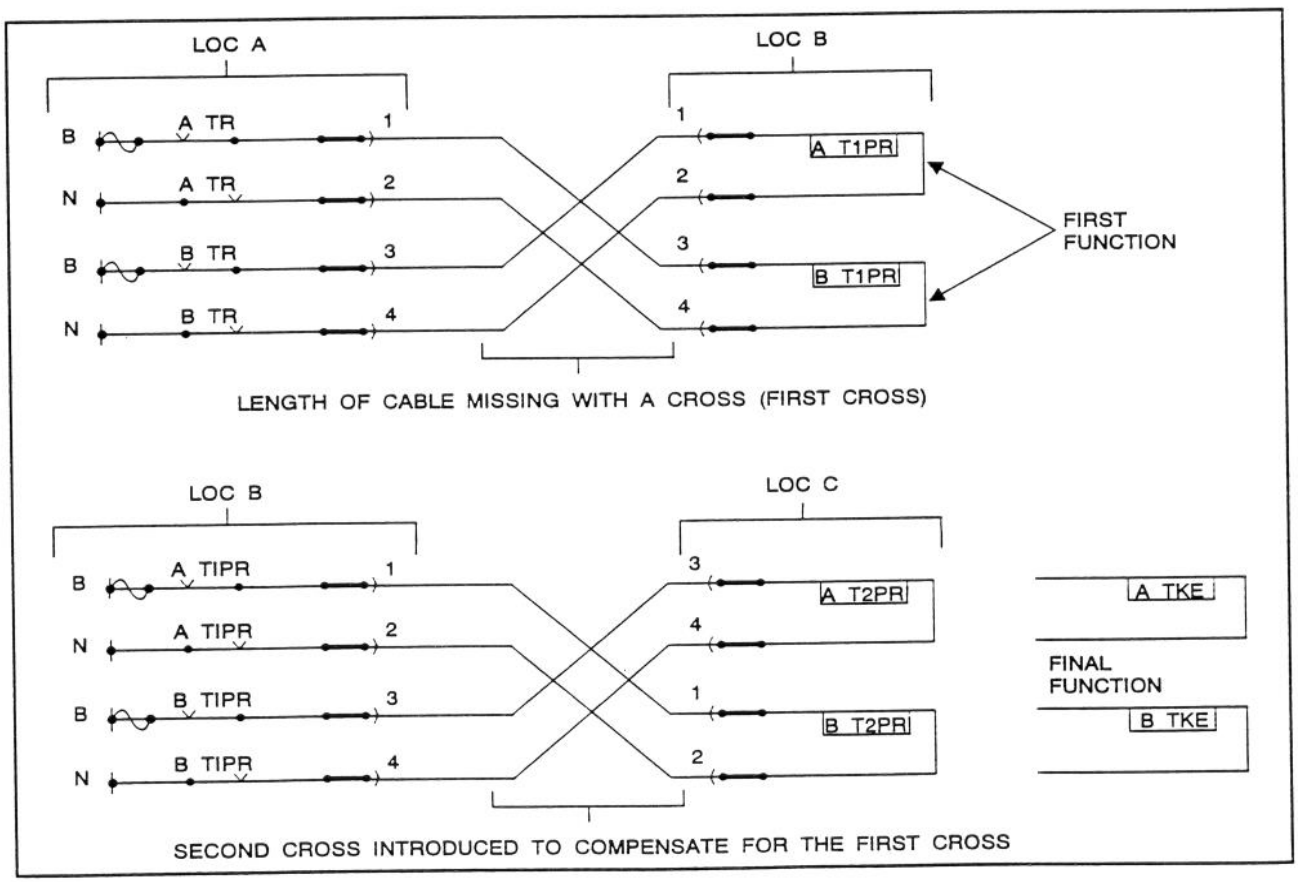

Figure 13. Typical Circuit With A Double Cross

The problem occurs when it is replaced as shown on Figure 14. The cable itself may test O.K. ie. continuity, insulation, but in fact what has happened is that the second cross is now causing the wrong final function to operate.

Because when a cable goes missing there is no way of telling if there was a cross in it, it is absolutely vital that the Cable Function Test is carried out, and properly.

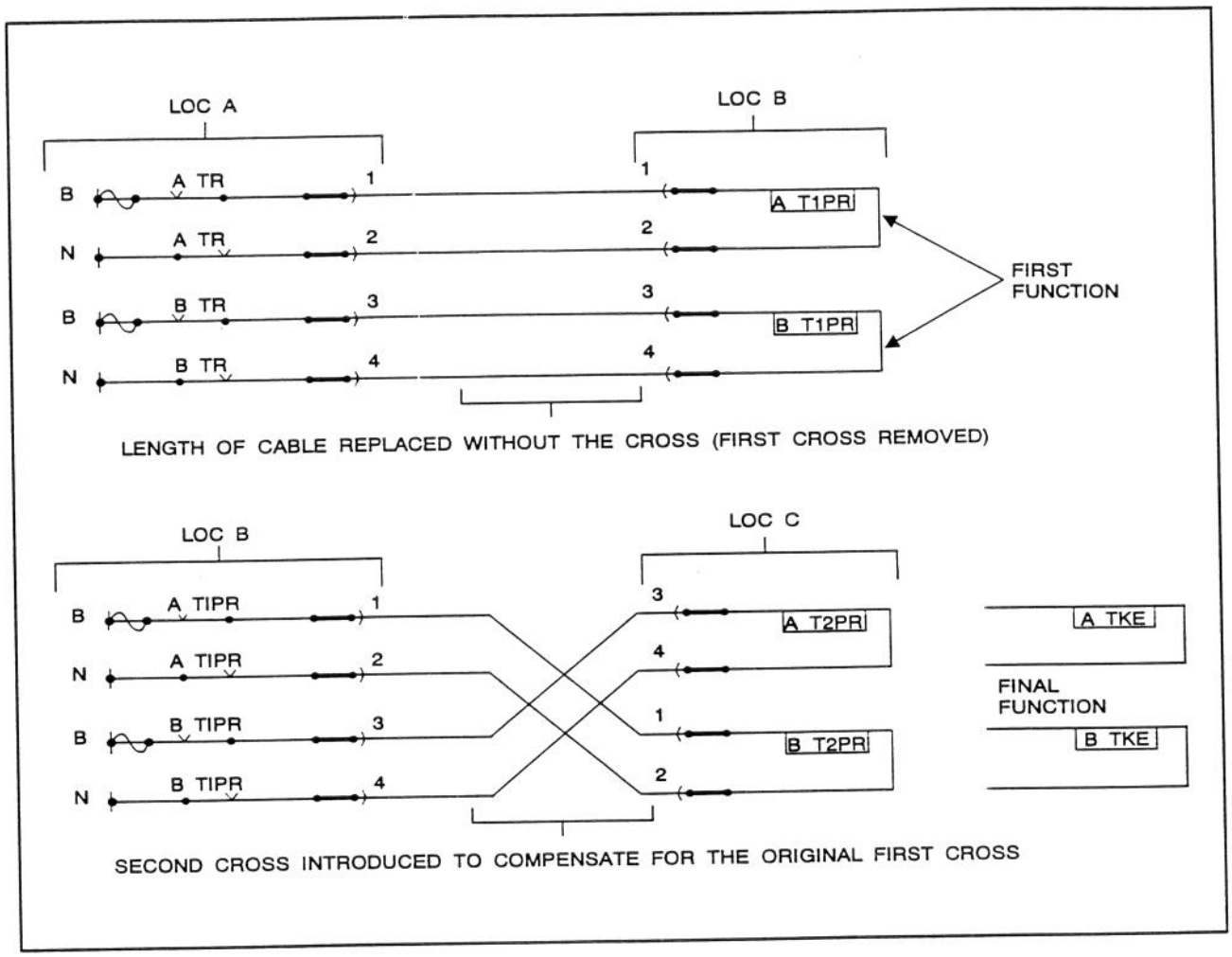

Figure 14. Typical Circuit - Wrong Function Operates

Records

Once a repair or renewal has been completed it is necessary to record results on the cable record card, because these may differ from those on the card already. This could lead to confusion at a later date. The card should also be endorsed that a joint has been made or length added etc.

Note: The maintenance tester may direct what needs to be done during repair/renewal of a cable but must not carry the work out or state such things as "core 1 to terminal A1" etc.

For details on how to divert a cable core see Section 2 of these notes, Slipped Links.

Notes

Notes

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Earth Testing

Student Notes

Section 4

Contents

Earth Testing

Earth Testing

Introduction

This section deals with the following competency:

- Carry out an A.C. and D.C. Earth test.

What you should be able to do at the end of this section:

- Identify occasions where an A.C. Earth Test is required.
- Identify occasions where a D.C. Earth Test is required.
- Identify type and number of tests to be used.
- Select appropriate test instruments.
- State polarity of multimeter connections for each test.
- Connect and use multimeter, if necessary using the A.C. Busbar Earth test adaptor.
- Describe error reporting procedures if an unacceptable earth reading is found.

Basic Elements

There are 2 basic elements to power supply earth testing:

- A.C. Earth Test
- D.C. Earth Test

When To Do The Tests

As with other Defined Test they will be called for on a Test Plan, and when required will be shown in 'capitalised italics', as shown in Test Plan D PW02, step 10 (Figure 2).

Purpose

Look up the Defined Test - Earth Tests and below write down the purpose of these tests

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D PW02

REPLACE A TRANSFORMER

Excludes: Track circuit feed sets, Aster track circuit transformers, decoding transformers.

BEFORE INSTALLATION WORK

1 *Check* replacement transformer is *not damaged* and is *correct type.*

2 *WIRE COUNT* existing transformer to the wiring diagram.

3 *Check* existing wiring has *safe insulation.*

4 *INSULATION TEST* replacement transformer (use 1000V insulation tester) (Minimum 2M Ohms terminals to case).

5 *Check* existing wiring is *correctly labelled.*

6 *Check* existing transformer is isolated from the supply.

Figure 1. Test Plan D PW02 - Before Checks

D PW02

AFTER INSTALLATION WORK

7 *Check* replacement transformer is *correctly installed.*

8 *Check* wiring is replaced as labelled.

9 *WIRE COUNT* replacement transformer to the wiring diagram.

10 *Check* any links and red dome nuts are secure and correctly replaced.

11 *EARTH TEST* supply and outputs.

*12 *Test* correct operation of ALL ac phase sensitive equipment where local or control coils are fed from a supply via the cable under test (AC RELAY AREAS ONLY).

*13 *Test* voltage with input and output circuits restored.

*14 *Test* signal lamp [signal lamp test (SMS)] (SIGNAL FEED SETS ONLY)

15 *Check*, or arrange for, *correct labelling* of unit.

Figure 2. Test Plan D PW02 - After Checks

Suitable Test Instruments

What instruments would you use for these tests. Write below some suitable test instruments.

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Look up Section B 010 in your Handbook to see how you did.

How To Carry Out The Earth Tests

As you can see from your Handbook there are two parts to the Defined Test - Earth Tests.

D.C. Up To Nominal 120V

Connect the meter as shown in Figure 3. to test for an Earth Fault on the -VE (N50) Busbar.

Connect the meter as shown in Figure 4. to test the +VE (B50) Busbar.

In both the D.C. Earth Tests, a D.C. voltmeter connects one leg to a busbar and the other leg to earth. If an earth fault is present, then it will be indicated by a reading on the meter.

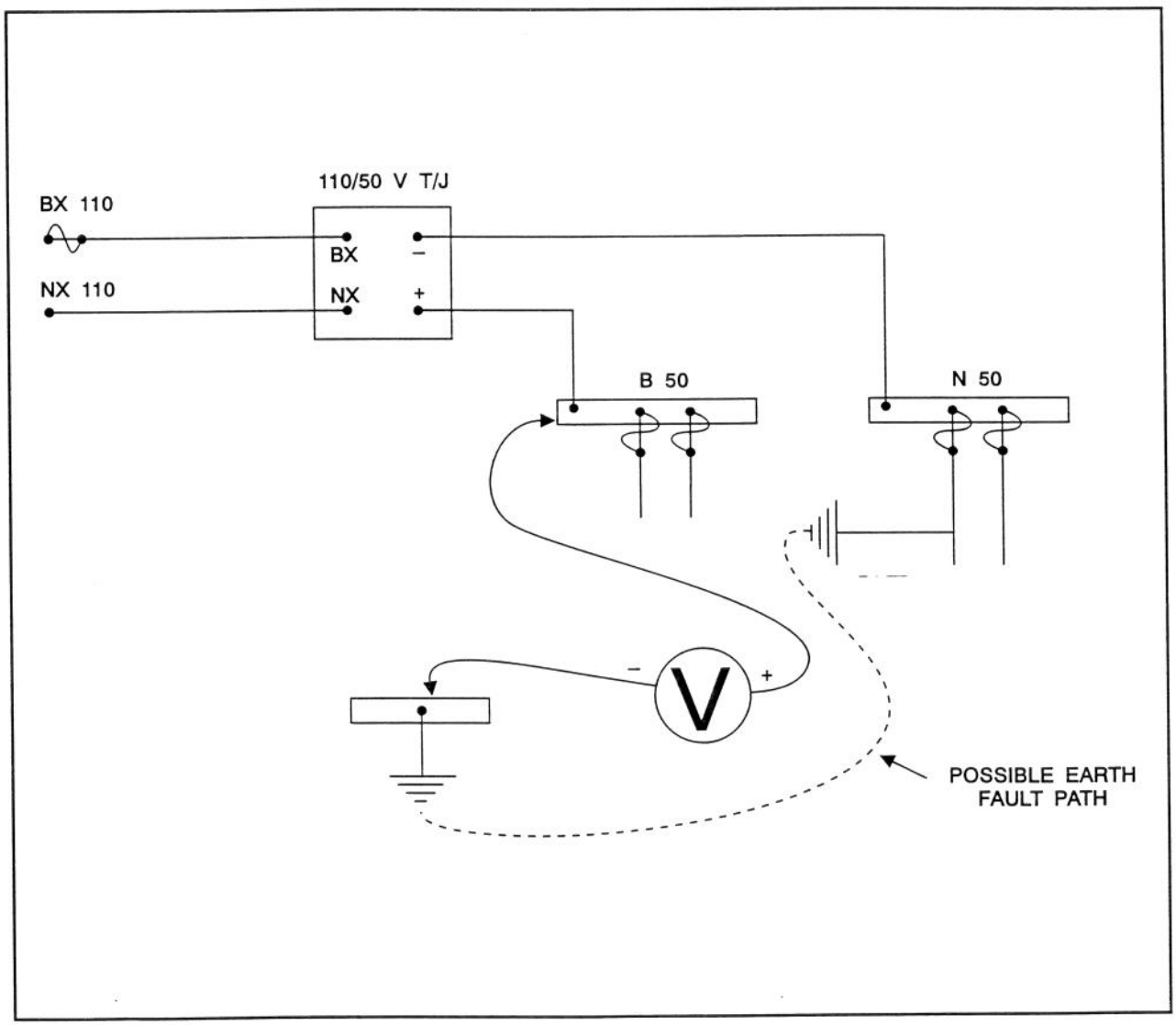

Figure 3. D.C. Earth Test Indicating An Earth Fault On The N50 Busbar

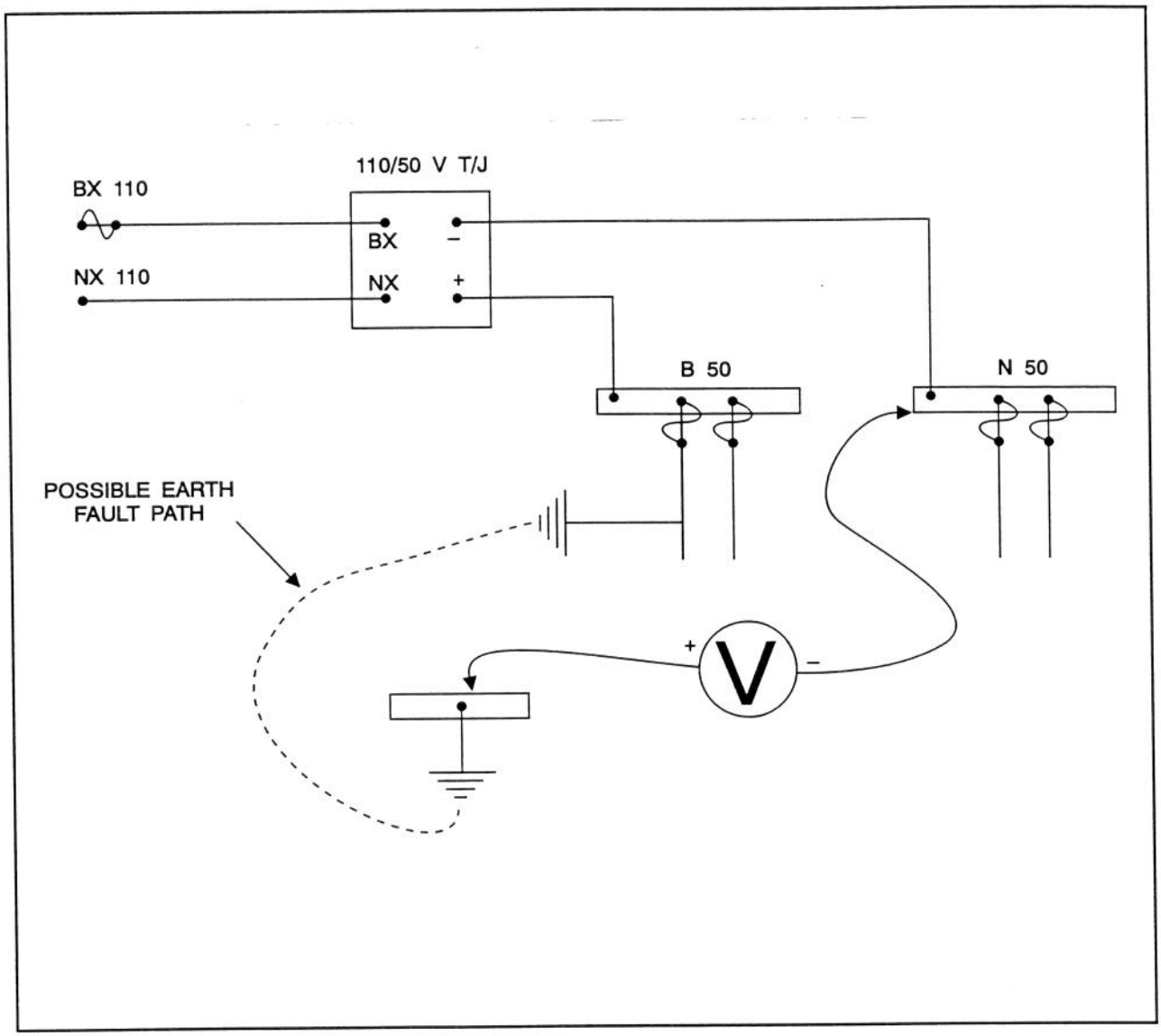

Figure 4. D.C. Earth Test Indicating An Earth Fault On The B50 Busbar

A.C. Up To Nominal 110V, 50 Hz

Figure 5. is basically the diagram shown in Section B 010 page 02 of your Handbook, but also showing the transformer windings for the A.C. supply. This test is carried out using the A.C. busbar Earth Test adaptor.

Refer to your Handbook B 010 page 02 for this method.

This test takes simultaneous values from both BX and NX busbars.

The A.C. Earth Test works by applying a voltage (9V battery in the A.C. busbar Earth Test Adaptor) to the BX busbar and earth. An Earth Fault will complete the circuit and a current will flow, causing a reading on the meter. Note in the case of the NX busbar the D.C. current (indicating an Earth Fault on the NX busbar) will flow via the secondary winding of the transformer.

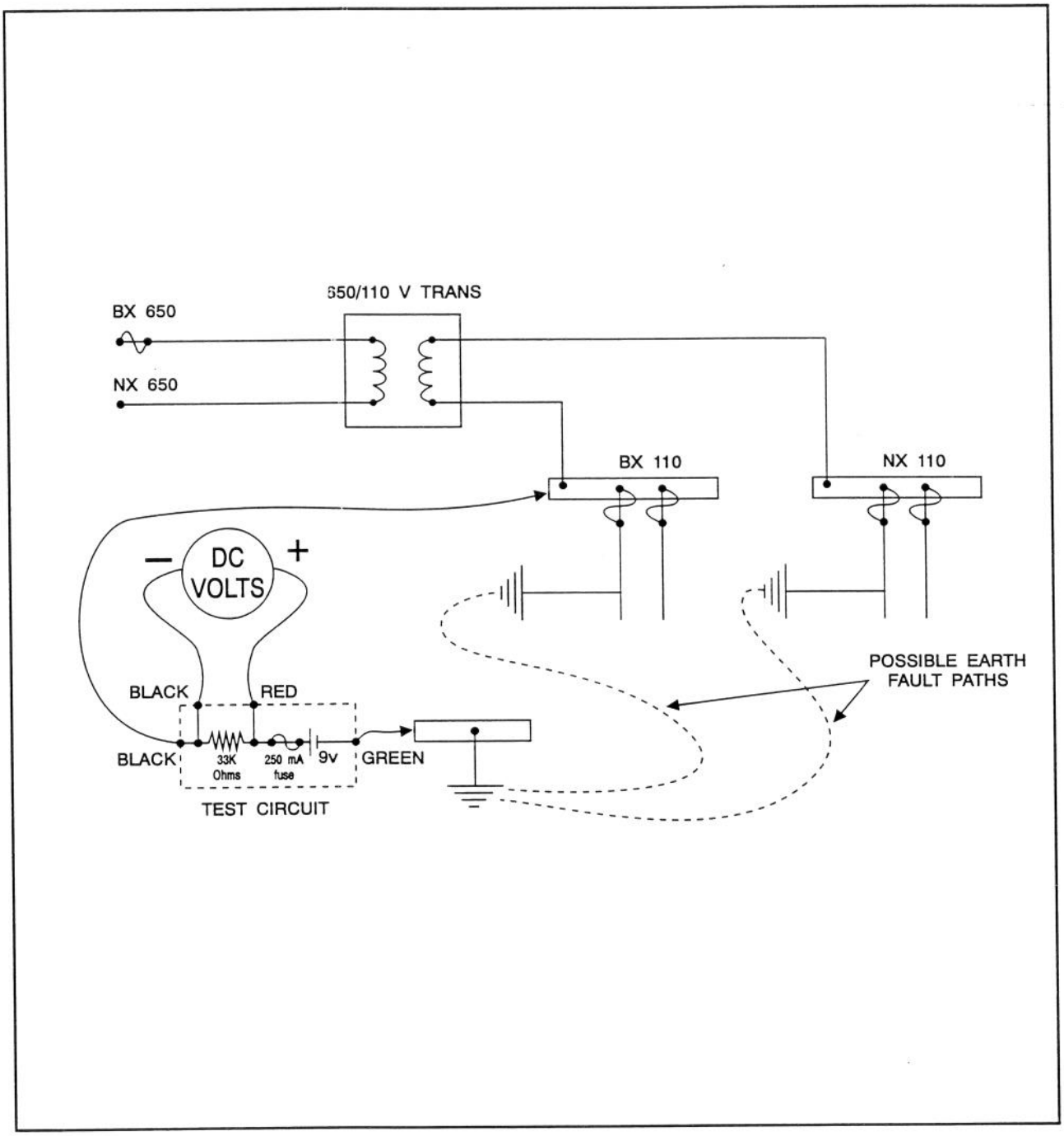

Figure 5. A.C. Earth Test Indicating Possible Earth Fault Paths

Acceptable Readings

These can be found on B 010 page A01 and page A02.

Unacceptable Readings

If an unacceptable reading is found, then the Handbook will direct you on how to proceed. Look at Step 3 of the D.C. Earth Test and Step 4 of the A.C. Earth Test.

Using your Handbook check the readings in Figures 6. and 7. and state your action below.

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Check your answers with your instructor.

Example Earth Test readings

DC (LINEMAN's METER)

BUSBAR VOLTAGE	V1	V2	V1 + V2
12V	0.8	0.9	1.7
12V	2.3	2.6	4.9
12V	0.7	1.4	2.1
12V	1.5	0	1.5
120V POINT MACHINE (INTERNAL)	12	12	24
	8	8	16
	3	4	7
120V POINT MACHINE (EXTERNAL)	-	-	36
	-	-	7
50V POINT DETECTION	-	-	17
	-	-	5

Figure 6. Example Earth Test Readings - D.C. (Lineman's Meter)

Example Earth Test readings

AC (ELECTRONIC METER)

AC (EXCLUDING POINT DETECTION)

VB	V1 + V2
9	18
8.6	3
8	12

AC (POINT DETECTION)

VB	V1 + V2
9	1.25
8.2	7.38
9.1	17.6

Figure 7. Example Earth Test Readings - A.C. (Electronic Meter)

Instruments

The values in your Handbook are given for either a Lineman's Type Meter or Electronic Multimeters. This may seem confusing at first, but remember the resistance of the Lineman's Type Meter changes with the scale, for example, on the 75 volts scale the meter resistance is 75K ohms whereas the Electronic Multimeter will be a lot higher. It is important to use the correct instrument.

Notes

Notes

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Aspect Testing

Student Notes

Section 5

Aspect Testing

Introduction

This section deals with the following competency:

- Carry out an Aspect Test.

What you should be able to do at the end of this section:

- Identify occasions when an Aspect Test is required.
- Explain the meaning of:
  - Aspect Test,
  - Correspondence,
  - Adequate Sighting,
  - Extraneous Lighting,
  - Carry out an Aspect Test in according with the Signalling Maintenance Testing Handbook.

When To Do The Test

Many Test Plans require certain defined tests to be carried out. In this case look at Test Plan D SG01 (Figures 1 and 2) Step 20, *ASPECT TEST*. (Also a "*" item refers to Section 2 of the notes.)

The test is known as a defined test because it is in capitalised italics.

D SG01

REPLACE A SIGNAL HEAD

Includes: Colour light, position light, junction indicator, stencil indicator, theatre type indicator, all fibre optic signals.

Excludes: Searchlight, electro-mechanical banner.

BEFORE INSTALLATION WORK

1 *Check* replacement signal head *not damaged* and is *correct type.*

2 *Check* replacement signal head internal wiring corresponds to the internal wiring of the existing signal head.

3 *WIRE COUNT* existing signal head to the wiring diagram.

4 *Check* existing wiring has *safe insulation.*

5 *INSULATION TEST* replacement signal head (Minimum 2M Ohm terminals to case).

6 *Check* existing wiring is *correctly labelled.*

7 *Check* supply to existing signal head is isolated from the supply.

Figure 1. Test Plan D SG01 - Before Checks

D SG01

AFTER INSTALLATION WORK

8 *Check* replacement signal head is *correctly installed.*

9 *Check* filters are of *correct type* (colour) and are *correctly installed.*

10 *Check* wiring is replaced as labelled.

11 *WIRE COUNT* replacement signal head to the wiring diagram.

12 *Check* any links and red dome nuts are secure and correctly replaced.

13 *Check* terminations are secure and suitably protected.

14 *Check* correctly rated lamps are installed.

15 *Check* entry cable is secured and signal head wiring is not liable to mechanical damage.

16 *Check* correct hoods fitted.

16 *Check* no extraneous light enters signal head.

17 *EARTH TEST* circuits if designed to be earth free.

*18 *Test* each signal lamp [Signal lamp test (SMS)].

19 *Check* for correct beam alignment [Beam alignment (SMS)].

*20 *ASPECT TEST* signal.

21 *Check*, or arrange for, *correct labelling* of unit.

22 *Check* signal head door fits correctly (door seal in tact, no case damage, no extraneous light enters)

Note: Sighting forms, where provided, include specific details on signal alignment and configuration.

Figure 2. Test Plan D SG01 - After Checks

What It Achieves

In the space below write down the purpose of the Aspect Test.

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How did you do? Check your answer to your Handbook, Section B 006.

Terms

Using your Handbook find the definitions of the following items and write them in the space below.

Correspondence

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Adequate Sighting

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Extraneous Lighting

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How The Test Is Applied To Typical Signal Circuitry

Refer to your Handbook Section B 006 Aspect Test and work through the steps using Figure 3. Assume that the signal head has been changed.

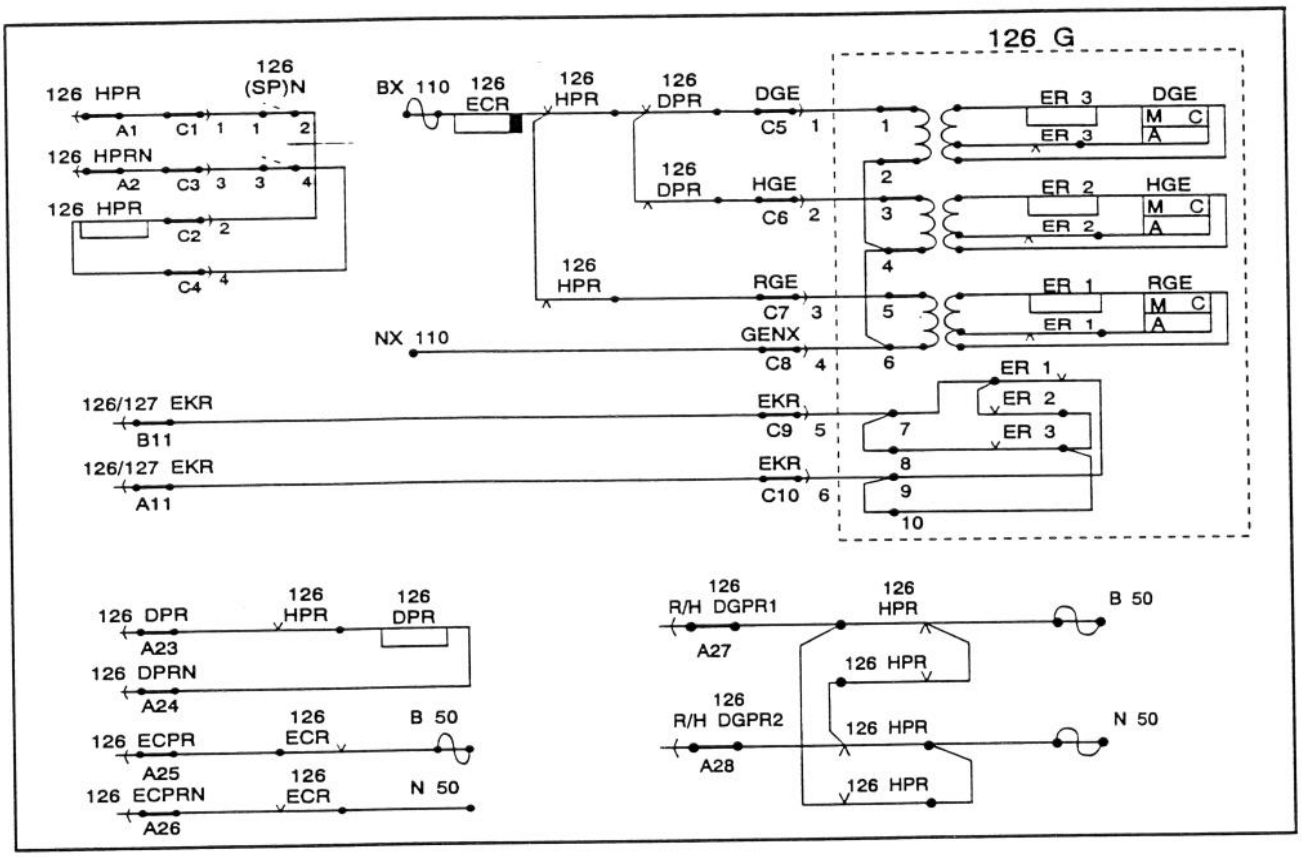

Figure 3. Typical Signal Circuitry

Exercise

Study Figures 4 and 5. By referring to your Handbook Section B 006 Aspect Test, write down in the space below what steps would reveal each of the 4 errors in the circuitry. Also write down how each error would show up, e.g. no light.

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Check your answers with your instructor.

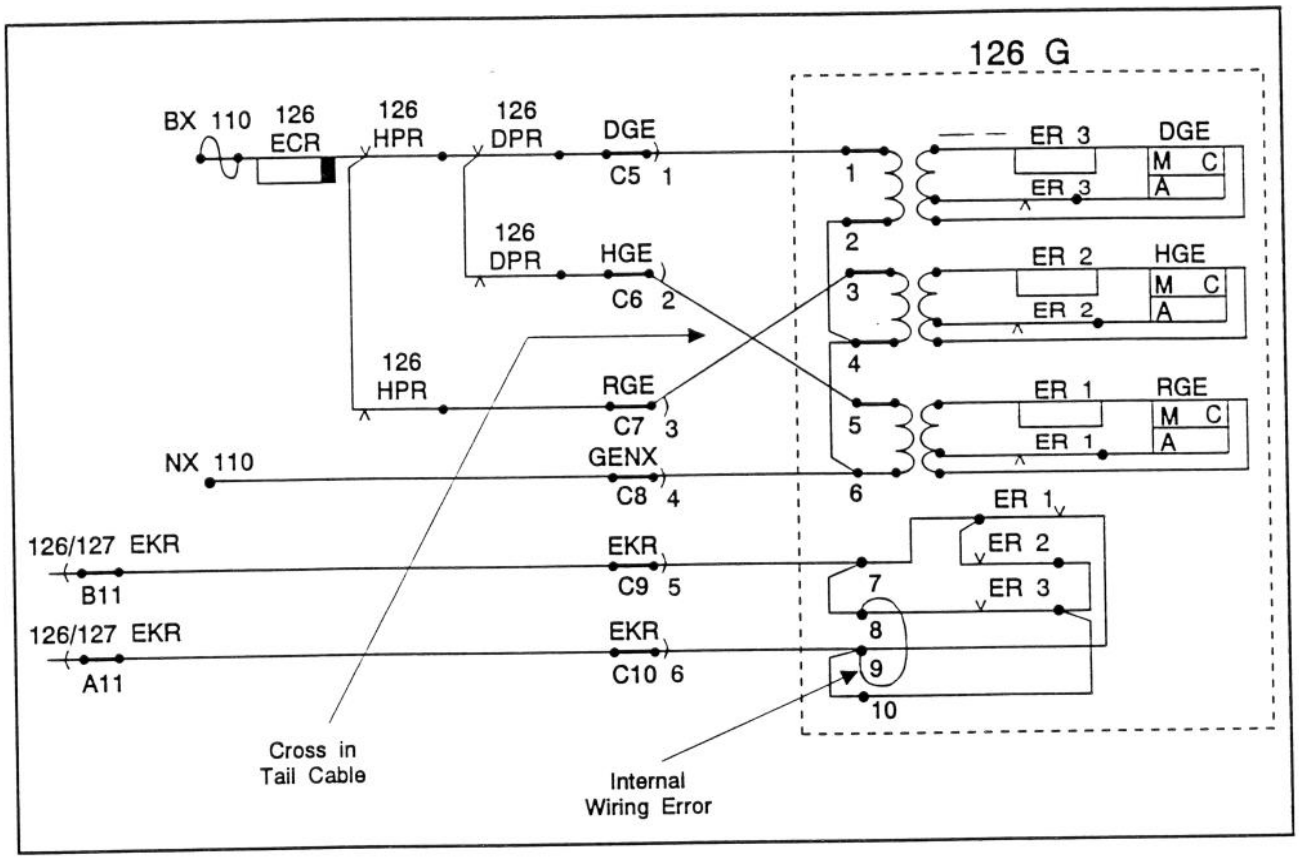

Figure 4. Typical Errors

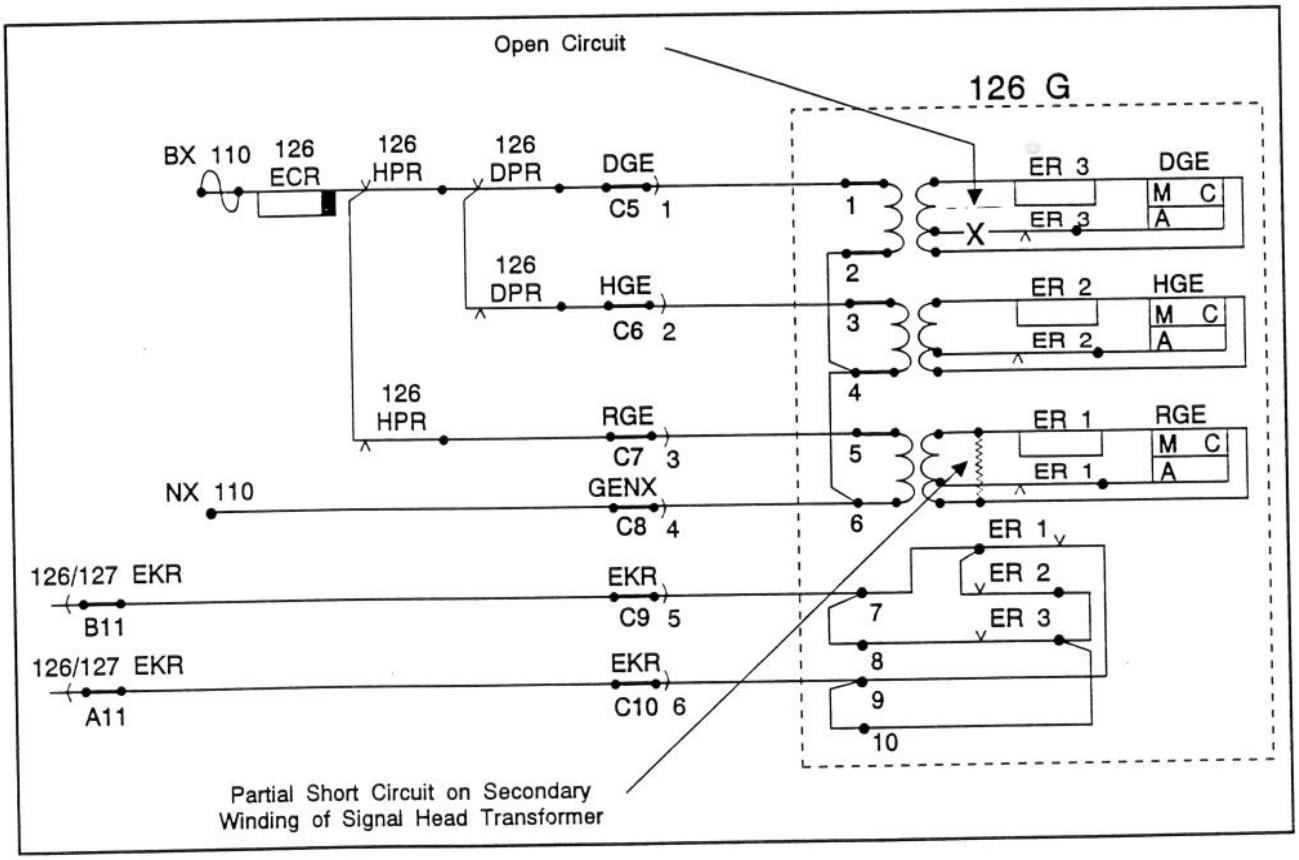

Figure 5. Typical Errors

Notes

Notes

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Block Testing

Student Notes

Section 6

Contents

Block Testing

Block Testing

Introduction

Below is the element of competence which this section deals with:

- Block Testing

What you should be able to do at the end of this section:

- Outline the function of:
  - Absolute Block.
  - Block Release winder.
- Outline the operation of a B.R.3 Position Block
- Define
  - Home normal proving.
  - Distant on proving.
  - Compulsory train on line.
  - One acceptance block.
  - Line clear release.
  - Berth track.
- Identify occasions requiring:
  - Block Control test.
  - an Emergency Block Recovery Test.
- Demonstrate the method of operating a Block Release Winder.
- Carry out the block controls and emergency block controls test in accordance with the Signalling Maintenance Testing Handbook.

The B.R. 3 Position Block

The B.R. standard block instrument is of the three position type. Indications being: Line Clear, Normal, Train On Line. The block indicator works on the change of polarity principal. Positive to line gives Train On Line (T.O.L.), negative to line gives Line Clear (L.C.). With no voltage to line the indicator stands at Line Blocked (Normal) (Figure 1).

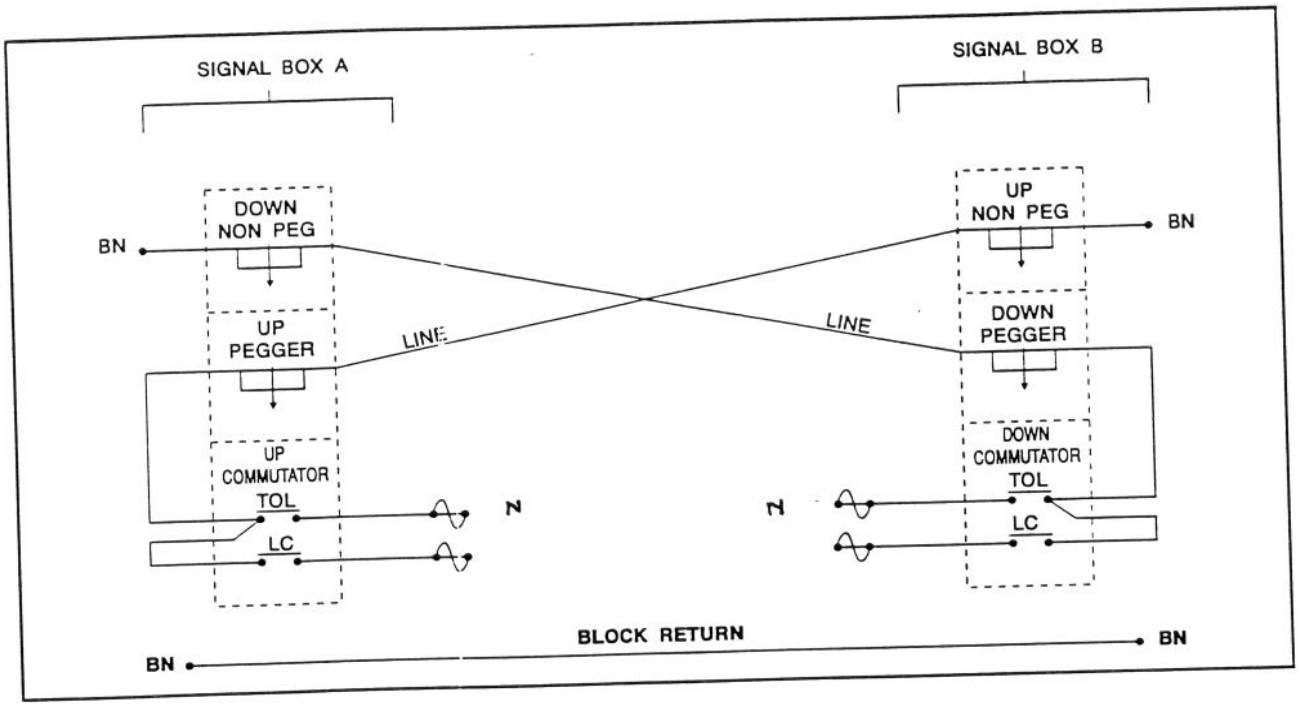

Figure 1. Basic Block Circuitry

Figure 2 shows a typical 3 position block arrangement. In this case Signalbox A controls a section of line known as the 'Block Section'. The block section extends from the starting signal of Signalbox B to the home signal of Signalbox A. The entrance to the block section is controlled by Box A. This means that before a train can enter the block section, the starting signal has to be released by Box A by giving Box B a line clear.

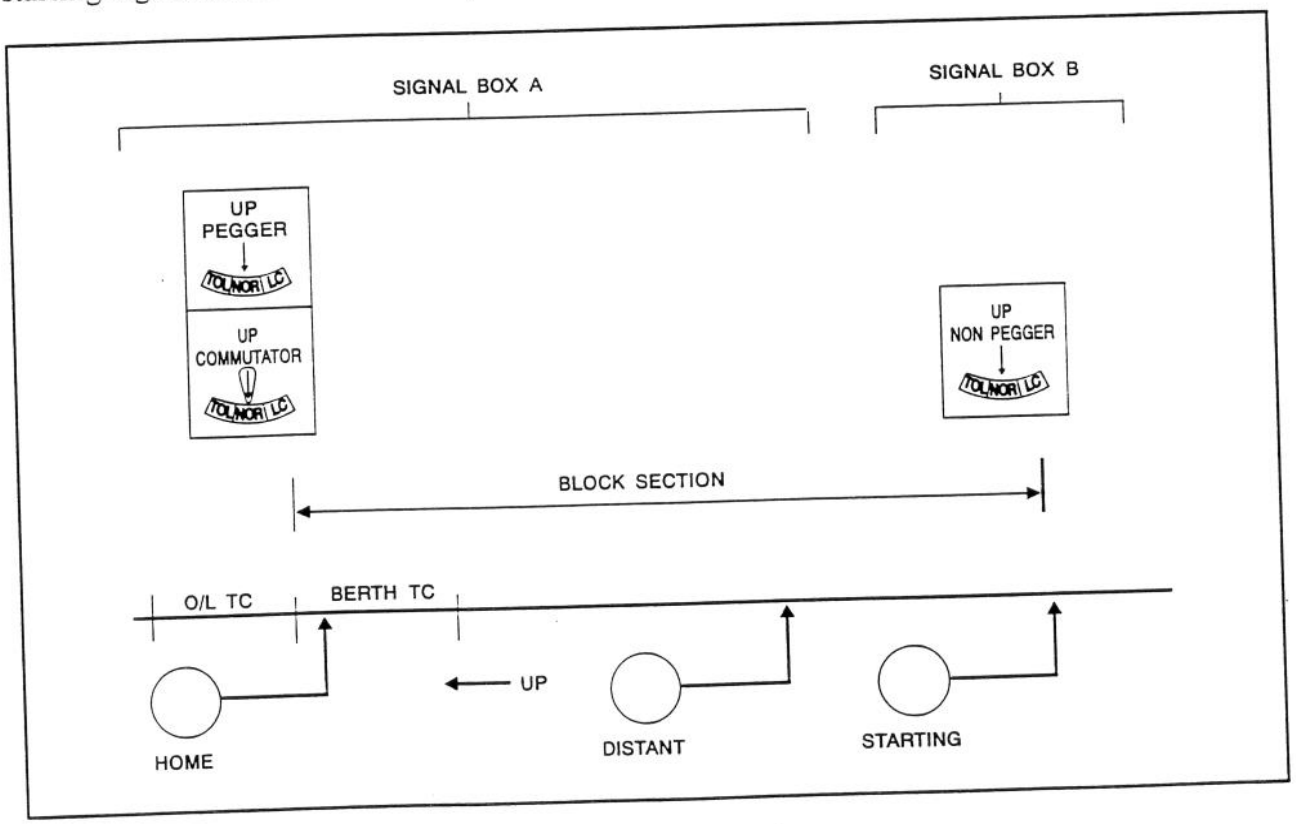

Figure 2. Block Section

So in principle, by using the polarity changing circuit as in Figure 1. indications can be given to the Signalbox in rear as to the state of the line, for example, (normal), (L.C.), or (T.O.L.)

- Normal - no train in section or accepted.
- L.C. - able to accept a train.
- T.O.L. - train in section.

The principle behind 'Absolute Block' is that 'At any one time, only one train is allowed to enter a block section'. Essentially this stops trains running into the back of one another. By inspection of the circuitry in Figure 1 to achieve this, certain other features need to be included.

Controls

In Figure 3. it can be seen that two extra controls have been added in the Line Clear path of the basic block circuitry. These are:

- Home Normal Proving
  - Ensures home signal levers are 'normal' before a line clear can be given.
- Distant on proving
  - Ensures the distant signal is 'on' before line clear can be given.

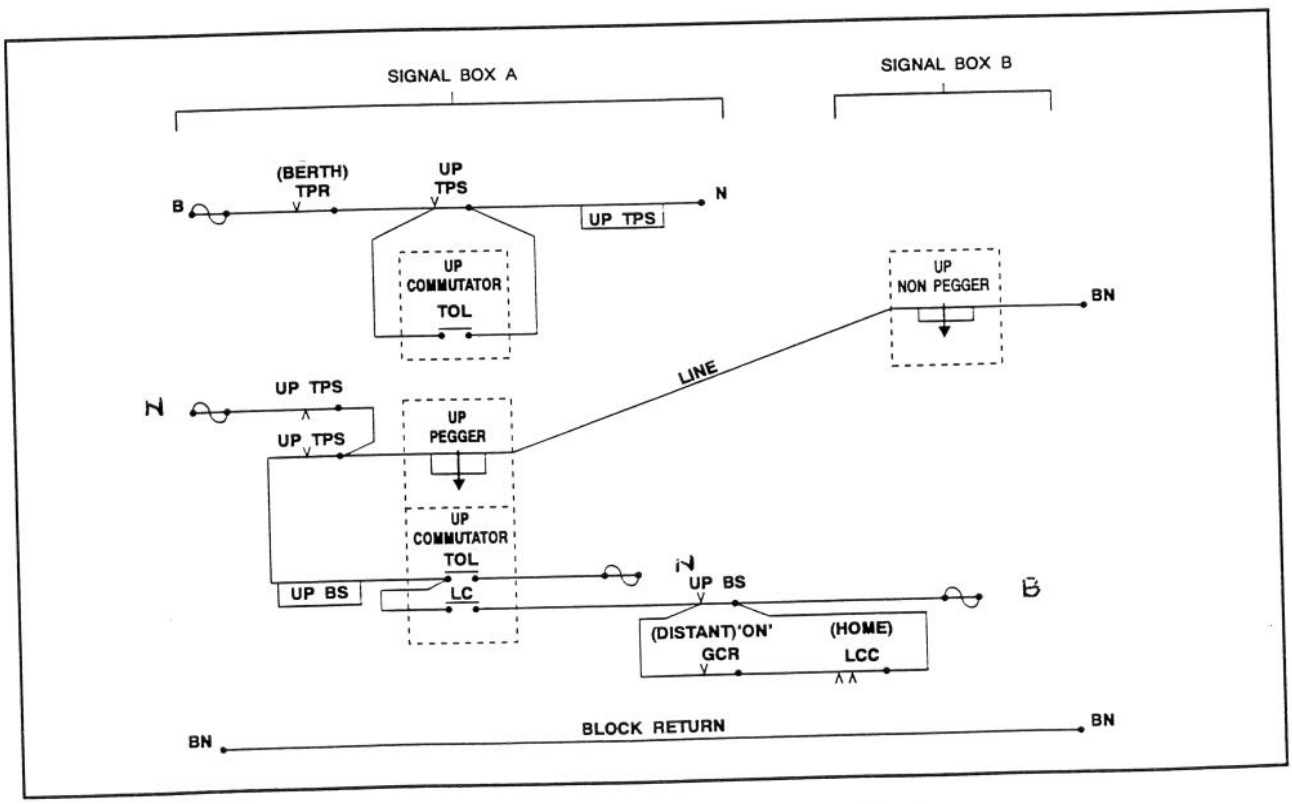

Figure 3. Compulsory Train On Line Block

Compulsory Train on Line

This is defined in your Handbook in Section B007 page 01. This can be related to Figure 3. When the berth track is occupied if T.O.L. has not been pegged, the T.P.R. would drop and consequently drop the T.P.S. and send positive feed to line, giving T.O.L. at both boxes. The block has to be restored by pegging T.O.L. (Thus picking the T.P.S.)

One Acceptance Block (Welwyn Control, One Train Control)

This is also defined in Section B007 page 01 of your Handbook

This can be related to Figures 4, 5 and 6.

As you can see the One Acceptance Block (O.A.B.) has the same features as Compulsory Train On Line Block (C.T.O.L.B.) and also has the added feature that once a Line Clear has been given, certain conditions are required before another Line Clear can be given. For example, until the track circuit in advance of the home signal (overlap track circuit) has been cleared, and the signal restored, or the signalman has operated a time release.

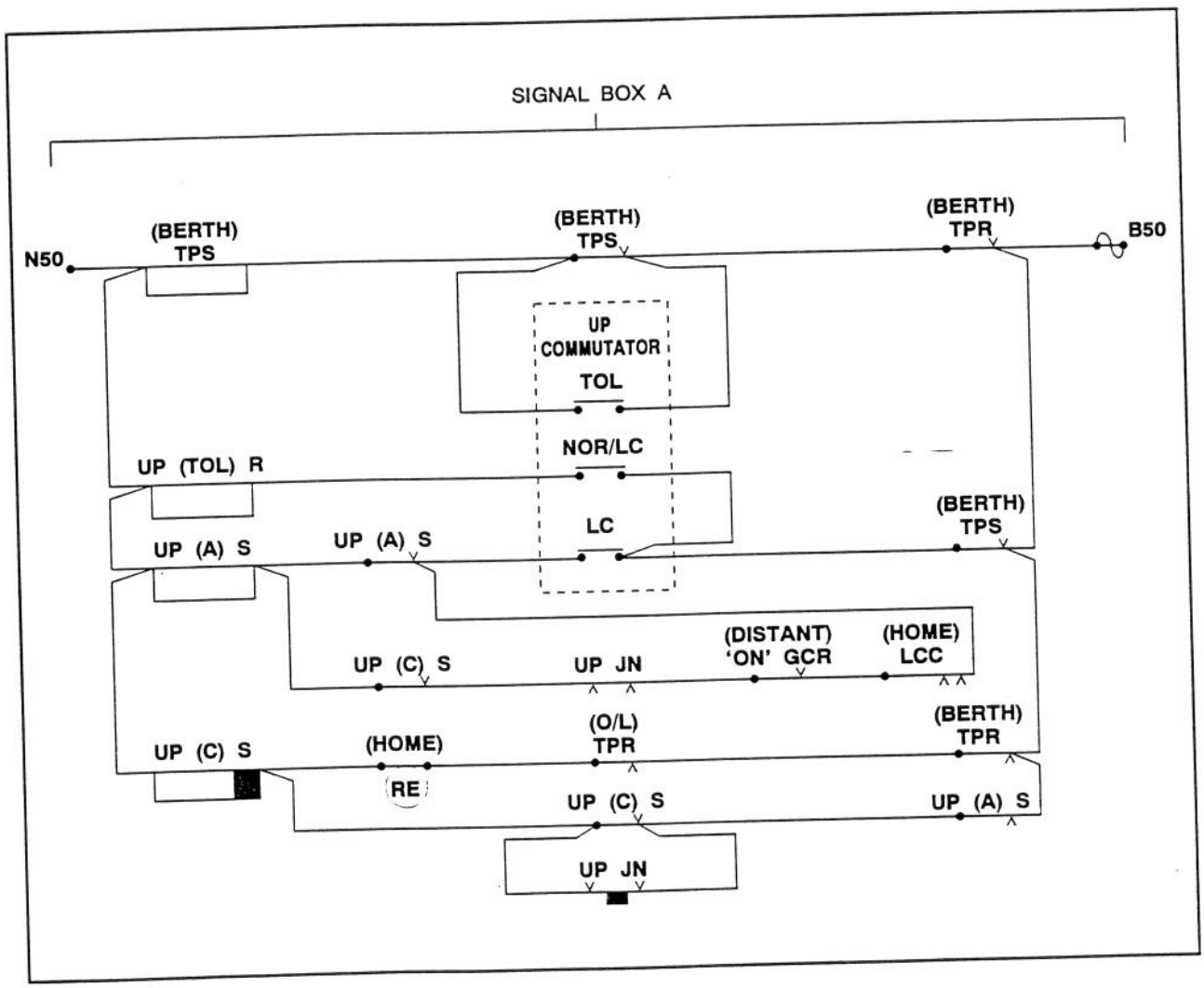

Figure 4. One Acceptance Block

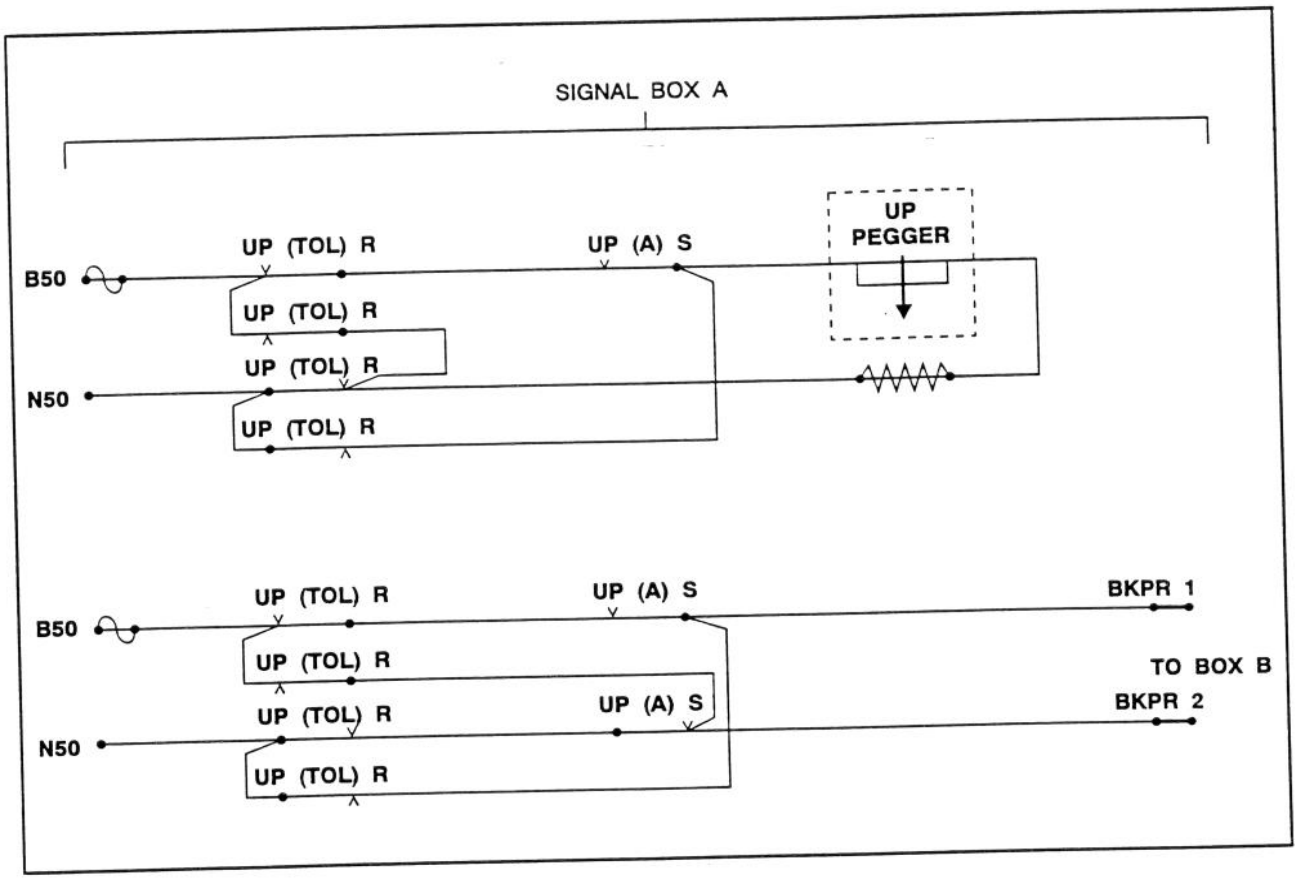

Figure 5. Pegger Indicator And Line Circuits

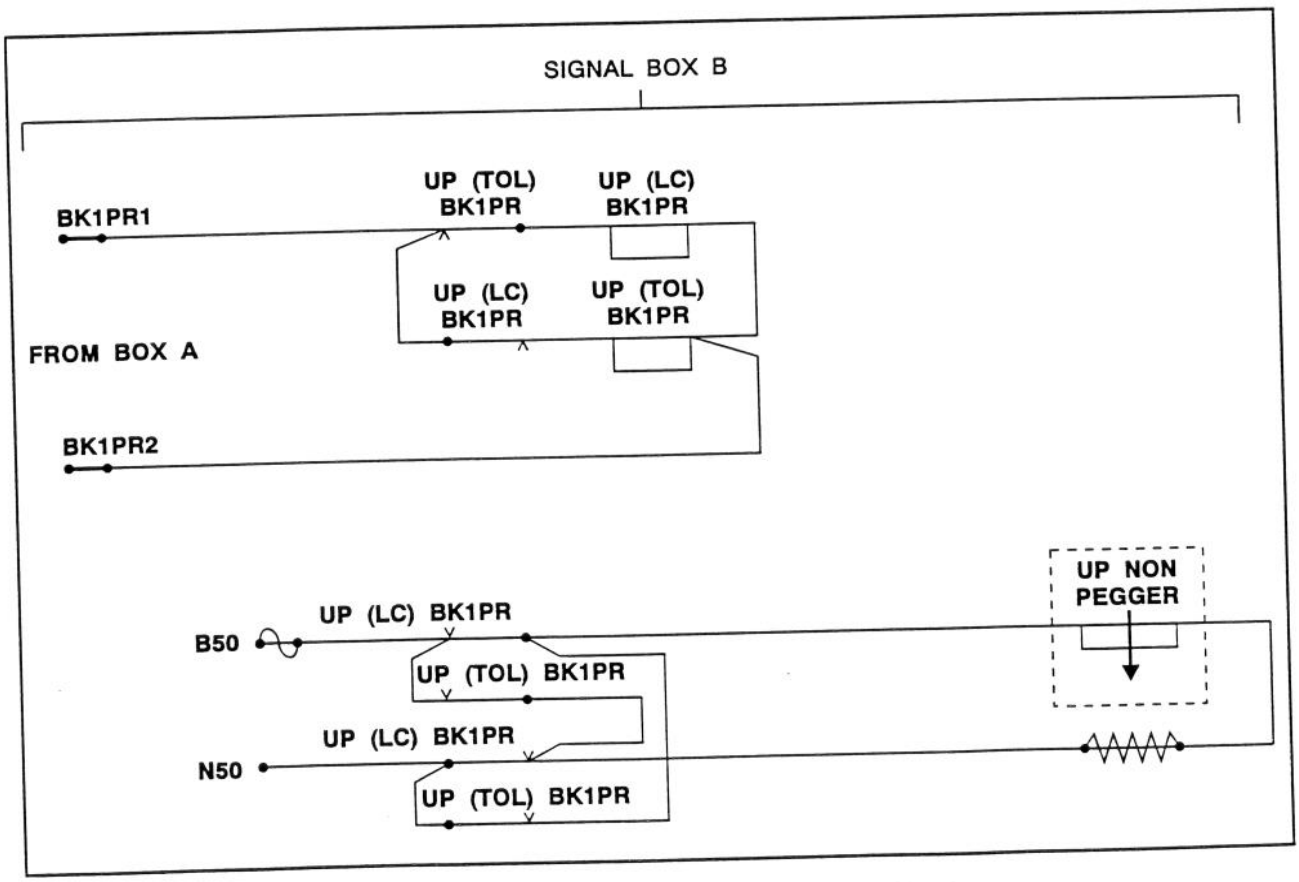

Figure 6. Non Pegger Indicator And Line Circuits

Time Release

As mentioned on page 4 a time release is provided to restore the block if a Line Clear has been given by mistake, or a train is cancelled. The timer allows C relay to pick. This may take the form of a winding mecnanism or a button to operate a timing sequence. (See Emergency Block Recovery Test, Section B 011 page 01 and 02).

Action/State		Relays Drop	Relays Pick	Line Voltage
1.	Line Blocked.	A	C TPR TPS	O
2.	Line clear pegged home lever normal and distant on.	C	A	+VE (LC)
3.	Home and distant pulled off.			
4.	T.O.L. Pegged.	A		-VE (TOL)
5.	Train arrives (T.P.S. ensure T.O.L. sent if not pegged at step 4)If home lever is not reverse relay C would not pick.	TPR, TPS		
6.	Train passes.		TPR	
7.	Distant to home resoterd to on (only if T.O.L. has been pegged).		TPS	
8.	Pegger is turned to Normal.			

Figure 7. Breakdown Of The Operation Of The O.A.B.

Line Clear Release

The circuit in Figure 8 shows another feature of block circuitry the 'one line clear one pull'.

In this circuit the starting lever release is controlled by the starting BS and the Up 'LC' BKR. The Up 'LC' BKR proves the block circuit in the Line Clear Position, the BS provides the "one pull only" feature.

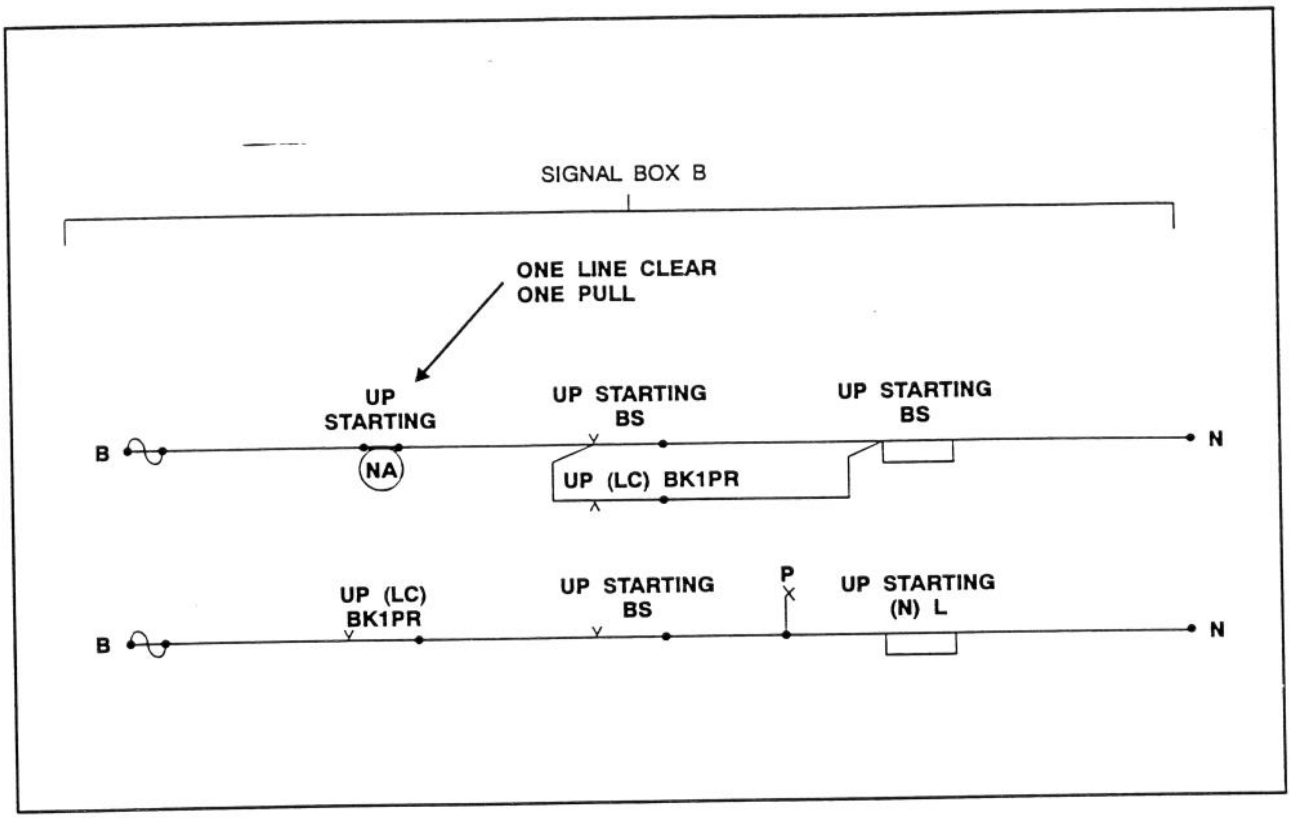

Figure 8. Line Clear Release - One Line Clear, One Pull

Tests

There are 2 basic elements to block testing:

- Block Controls Test.
- Emergency Block Recovery Test.

These tests will be called for within a Test Plan as shown in Figures 9. and 10. and will be in capitalised italics, Steps 11, 12.

Block Controls Test

This test will be called for, when for example, a block instrument or block switch has been changed (This only applies to Absolute block).

Emergency Block Recovery Test

This test will be called for, when for example, a block winder is changed. It can also be used to restore O.A.B. Block following the replacement of a block instrument, for example, in conjunction with a Block Controls Test.

D BL01

REPLACE A BLOCK INSTRUMENT

Includes: Block bell.

Excludes: Token block, tokenless block.

BEFORE INSTALLATION WORK

1 *Check* replacement block instrument is *not damaged* and is *correct type.*

2 *Check* that internal wiring of the replacement block instrument corresponds to the internal wiring of the redundant block instrument.

3 *WIRE COUNT* existing block instrument to the wiring diagram.

4 *Check* existing wiring has *safe insulation.*

5 *Check* existing wiring is *correctly labelled.*

Figure 9. Test Plan D BL01 - Before Checks

D BL01

AFTER INSTALLATION WORK

6 *Check* replacement block instrument is *correctly installed.*

7 *Check* wiring is replaced as labelled.

8 *WIRE COUNT* replacement block instrument to the wiring diagram.

9 *EARTH TEST* circuits where designed to be earth free.

* 10 *Check* correct correspondence of block instrument with adjacent signal box (Pegger, local indicator, remote indicator) for all indications.

* 11 *BLOCK CONTROLS TEST* equipment (NOT PERMISSIVE OR FREE BLOCK).

* 12 *EMERGENCY BLOCK RECOVERY TEST* equipment (WELWYN AND ONE ACCEPTANCE BLOCK CONTROLS ONLY).

13 *Check*, or arrange for, *correct labelling* of unit.

Figure 10. Test Plan D BL01 - After Checks

Purpose

The Block Controls Test ensures the correct operation of all absolute Block equipment.

The Emergency Block Recovery Test ensures that the block restoration circuitry is effective.

It can also be used to restore the block following replacement of block equipment, or during or following a Block Controls Test.

These tests are defined in Section B 007 pages 01 and 02 (Block Controls Test) and in Section B 011 pages 01 and 02 for the Emergency Block Recovery Test.

Exercise

Using your Handbook study Figures 11. and 12. and note down the steps and tests that would find the errors.

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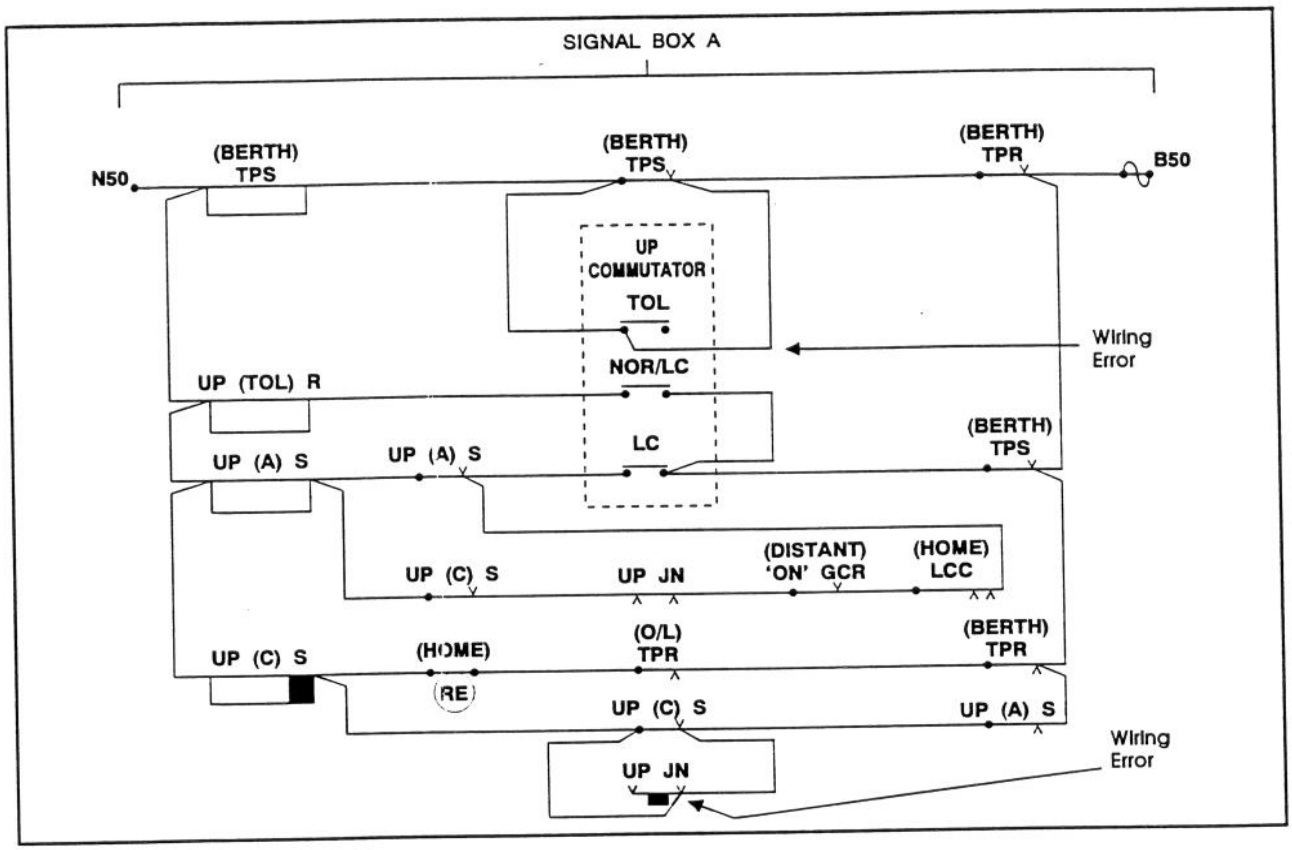


Figure 11. Typical Faults

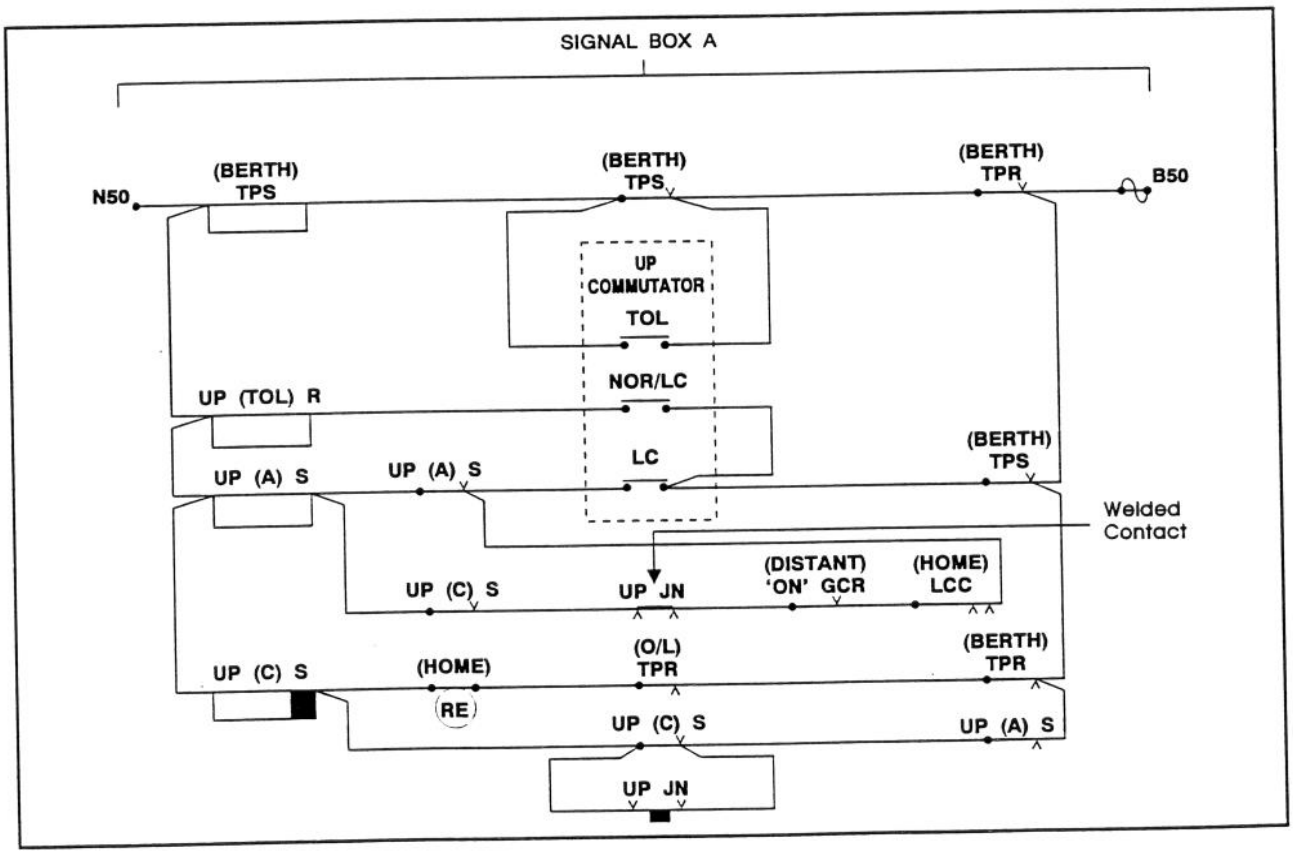
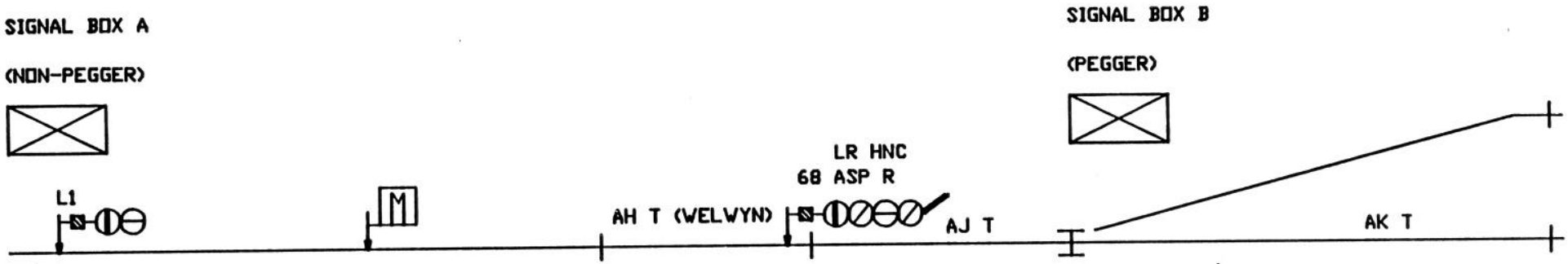


Figure 11. Typical Faults

Notes

Notes



Activity	Initial	Date	Remarks
Equ'pt type/profile			
Wire count			
Continuity test			
Strap and function			
Cable cores			
External equipment			
Timers set & sealed			

Drg. No.				
Produced	GPWM			
Checked				
Scale				
Issued				

REGIONAL RAILWAYS NORTH EAST
S & T ENGINEER DONCASTER

SMTH COURSE.

BLOCK CIRCUIT

SCHEMATIC LAYOUT.

British Rail

S & T ENGINEER DONCASTER

Sht.No. 1

STOOD AT LINE BLOCKED

A DOWN
B UP
C UP

Up when AH clear

The passage of the last train will have cut the feed to AH TPR A1 A2.

This will cause 'B' Relay to drop.

The 'LC' Contact will cut the feed off to 'A' Relay.

With A and B Relays down this will allow 'C' Relay to pick (BN12 at T6).

<u>When B picks again C will stick over its own contact</u>

To Peg line clear

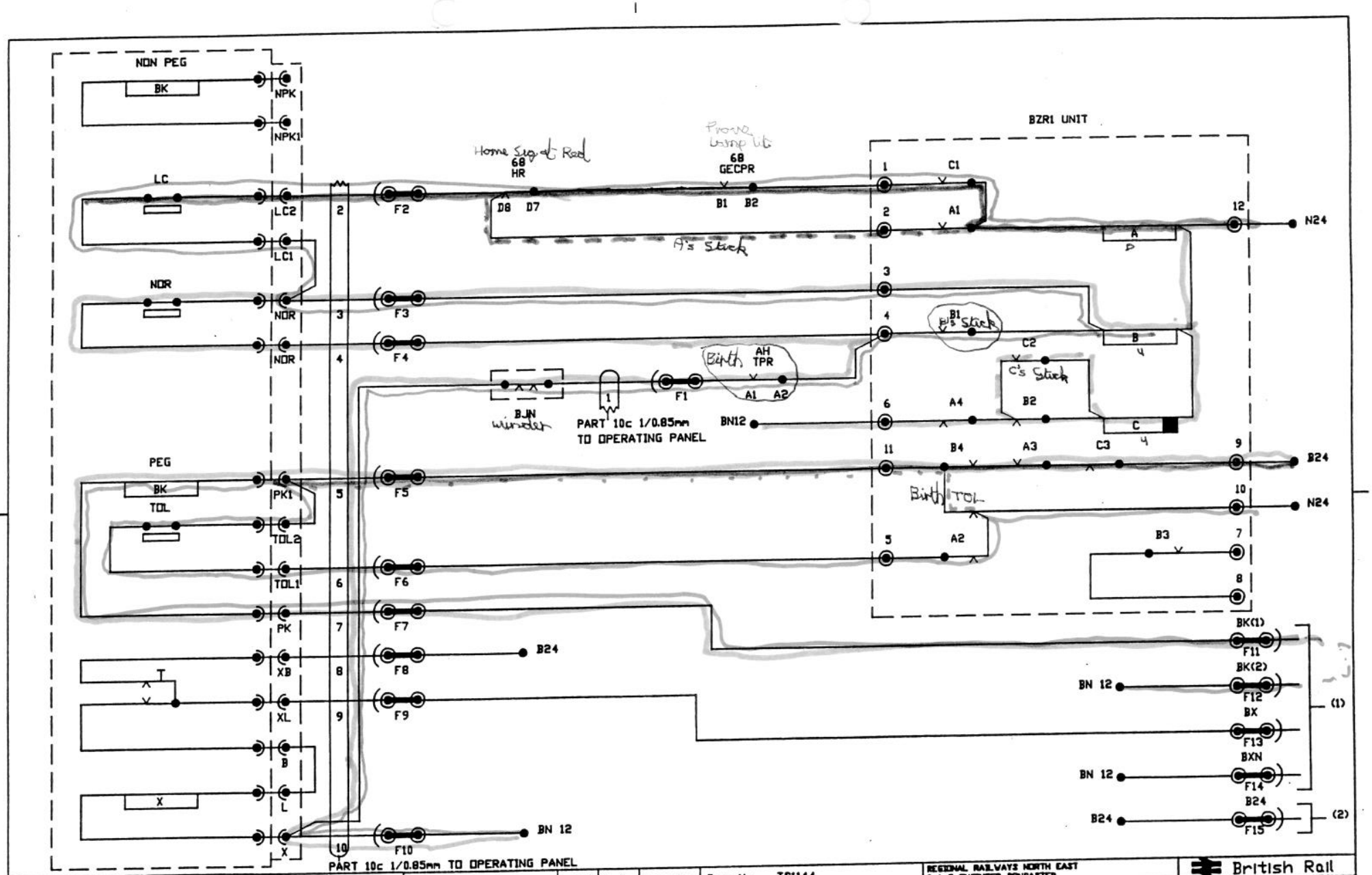
BN12 at Link F10 over contacts of BJN and AH TPR.

B Relay will be already picked over its own top contact (B12 in at T4 BZR out at T3) so the feed to peg L.C will be link F3, Nor. Term. LC1
Through line clear contact link F2. Now we must prove the home signal normal and light in, also no routes set from LG 68G.

All okay 'A' Relay will pick and stick over its own top contact.

With 'A' up 'B' up 'C' down

A line clear will be sent, ('C' Relay will drop when 'A' picks) via term 9 B24.



Activity	Initial	Date	Remarks
Equ'pt type/profile			
Wire count			
Continuity test			
Strap and function			
Cable cores			
External equipment			
Timers set & sealed			

Drg. No. TS1144

Produced	KRGA	hf	01.10.92
Checked			
Scale			
Issued			

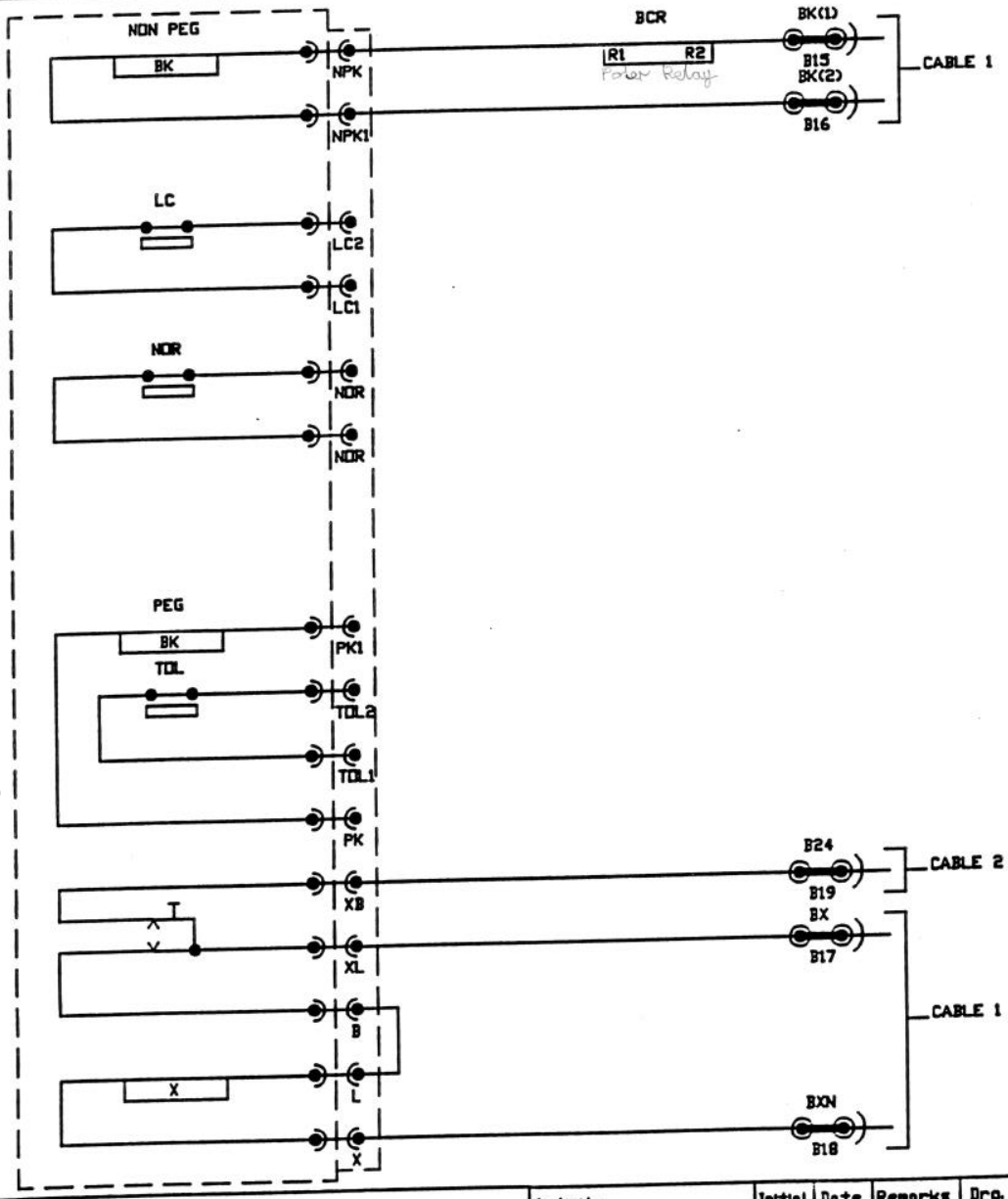
REGIONAL RAILWAYS NORTH EAST
S & T ENGINEER DONCASTER

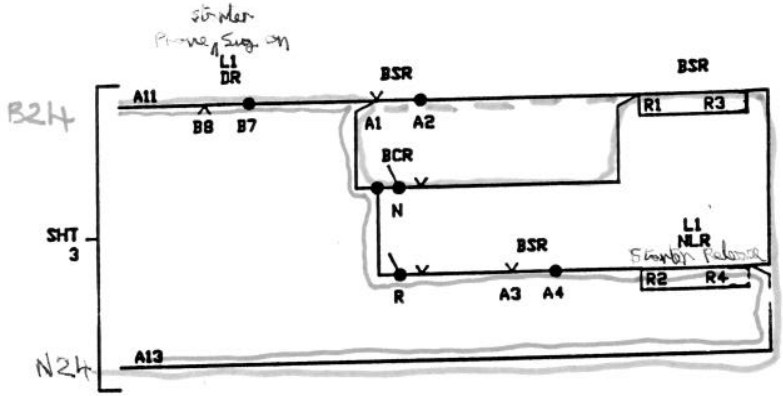
LAITHGATE S.B. INTERLOCKING PEGGER CCT.

British Rail

S & T ENGINEER DONCASTER

Sht.No. 8 OF 8





Activity	Initial	Date	Remarks
Equ'pt type/profile			
Wire count			
Continuity test			
Strap and function			
Cable cores			
External equipment			
Timers set & sealed			

Drg. No. TS1145

Produced	KRGA		01.10.92
Checked			
Scale			
Issued			

REGIONAL RAILWAYS NORTH EAST
S & T ENGINEER DONCASTER

LAITHGATE S.B.
LOCATION 64/48
NON PEGGER CCT.

British Rail

S & T ENGINEER DONCASTER

Sht.No. 6 OF 8

STOOD AT LINE BLOCKED

A DOWN
B UP — Up when AH clear
C UP

The passage of the last train will have cut the feed to AH TPR A1 A2.

This will cause 'B' Relay to drop.

The 'LC' Contact will cut the feed off to 'A' Relay.

With A and B Relays down this will allow 'C' Relay to pick (BN12 at T6).

<u>When B picks again C will stick over its own contact</u>

To Peg line clear

BN12 at Link F10 over contacts of BJN and AH TPR.

B Relay will be already picked over its own top contact (B12 in at T4 BZR out at T3) so the feed to peg L.C will be link F3, Nor. Term. LC1 Through line clear contact link F2. Now we must prove the home signal normal and light in, also no routes set from LG 68G.

All okay 'A' Relay will pick and stick over its own top contact.

With 'A' up 'B' up 'C' down

A line clear will be sent, ('C' Relay will drop when 'A' picks) via term 9 B24.

TO PEG TOL

Turning the block commutator will break the LC contact between LC1 and LC2. This will cause 'A' relay to drop, "A" dropping will cut the B24 LC feed from Term 9, but will allow the N24 TOL feed from Term 10 over "A" relay down through Link F6, TOL contact through indicator out to line.

AUTOMATIC TOL

Signalman not pegging TOL.

Block will peg over to TOL with AH track occupied.

AH track dropping will cut feed from BZR Term 4, this will drop A and B relays. A and B down will cut B24 LC feed from BZR T9, and allow N24 TOL feed on T10 over "A" relay down.

PEGGED LC TRAIN CANCELLED ONE LINE CLEAR ONLY

If LC is sent and then not required it will not be possible to send another, unless the BJN is operated to reset the block.

INSTRUMENT AT LC IS A AND B UP C DOWN

1. Signalman unpegs.
2. This will cause "A" relay to drop, "B" relay will remain up because AH track has not been occupied.
3. If the signalman operates the BJN this will cut the feed to ' ' 'B' relay and allow 'C' to pick.

   When BJN is fully reset 'B' relay will pick. This will unpeg the TOL indication and the BZR unit will be at its normal condition 'A' down 'B' up 'C' up.

NON PEGGER END

One line clear one pull of starter the BCR is a two position normal BIAS relay (arm and normal contacts made when pegged TOL or LB) (Arm and Reverse made when pegged LC). L1 signal is the starter.

The starter will be released by LC POS 24V on A11 with BCR 'N' contact made will pick BSR when picked will stick over its own top contact A1 and A2. When LC is pegged BCR Arm/Rev contacts are made the BSR will remain up for one pull over its stick path. BCR Arm and Rev made and the BSR up this will release L1 NLR.

Signal and
Telecommunications
Engineering

Signalling Maintenance Testing

Point Testing

Student Notes

Section 7

Contents

Point Testing

Point Testing

Introduction

This section deals with the following competency:

Point Detection and Correspondence Testing.

What you should be able to do at the end of this section:

- Identify occasions when a Point Detection and Correspondence Test is required.
- State reason for Detection Test.
- State reason for a Correspondence Test.
- State reason for an Out of Correspondence Test.
- Define:
  - Affected End,
  - Place,
  - Line,
  - Turnout Direction,
  - Lie of points.
- State number of times point detection contacts should be broken.
- Carry out a Point Detection and Correspondence Test in accordance with the Signalling Maintenance Testing Handbook.

When To Do The Test

This test is a Defined Test and will be shown on a Test Plan. It will be required, for example, when point detection circuitry is altered. (See Figures 1. and 2.)

D PC01

REPLACE A COMPLETE POINT MACHINE

Includes: Electric and electro-pneumatic point machines, chair locks.

Excludes: Clamp locks

BEFORE INSTALLATION WORK

1 *Check* replacement point machine is *not damaged* and is *correct type.*

2 *WIRE COUNT* existing point machine to the wiring diagram.

3 *Check* existing wiring has *safe insulation.*

4 *Check* existing wiring (and hoses for EP machines and chair locks) are *correctly labelled.*

5 *Check* existing point machine is *isolated* from the electrical supply.

6 *Check* air supply is disconnected (ELECTRO PNEUMATIC MACHINES AND CHAIR LOCKS ONLY).

Figure 1. Test Plan D PC01 - Before Checks

D PC01

AFTER INSTALLATION WORK

NOTE: Where any plug coupler is used check that no metallic dust exists between the two halves before reconnecting the plug couplers.

7 *Check* replacement point machine is *correctly installed.*

8 *Check* wiring (and hoses for EP machines and chain locks) are replaced as labelled.

9 *WIRE COUNT* replacement point machine to the wiring diagram.

10 *Check* any links and red dome nuts are secure and correctly replaced.

11 *Check* terminations are secure and suitably protected.

12 *Check* wires and cables are secure and clear of moving parts.

13 *EARTH TEST* circuits and supplies if designed to be earth free.

14 *Test* (gauge) point detection [(SMS)].

15 *Test* facing point lock [Facing point lock test (SMS)].

*16 *POINT DETECTION AND CORRESPONDENCE TEST* affected ends.

Figure 2. Test Plan D PC01 - After Checks

Tests

The Point Detection and Correspondence Test comprises of three separate tests: Detection Test, Correspondence Test, and Out of Correspondence Test.

In the space below write down what you think is the purpose of each test.

Compare your definitions to Section B 013 of your Handbook. How do they compare?

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Terminology

The Point Detection and Correspondence Test uses certain terms that you must understand in order that you may carry out the test properly. (Refer to Section B 013 in your Handbook.)

Place

This is the actual place where the work is carried out, for example, the place in Figure 3. would be Exwall Junction.

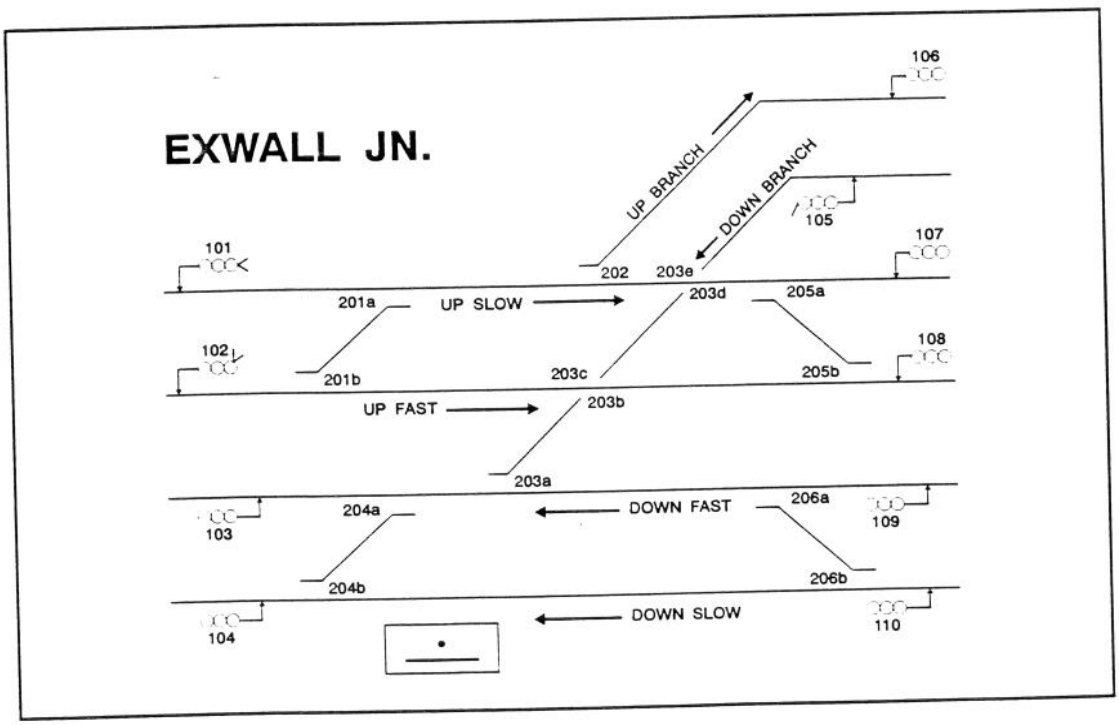

Figure 3. Complex Layout of Points

Line

If you were working on 206A points (Figure 3), the line you would be on is the Down Fast. In the space below write down what line would you be working on for each of the other ends of points.

Discuss your answers with your Instructor.

Turnout Direction

Consider 202 points. The straight route through the points in a facing direction and would take the train along the Up Slow. Therefore the Turnout Direction would be through the points in a facing direction and would take the train along the Up Branch. So for 202 points the Turnout Direction can be described as 'to the left onto the Up Branch'.

Write down below the Turnout Direction for each of the other ends of points.

Discuss your answers with your instructor.

Lie of Points

This is described as Left Hand Switch Normally Closed (LHSNC)or Right Hand Switch Normally Closed (RHSNC) as illustrated in Figures 4. and 5.

To determine this, first, look at the points when they are in the normal position, second, check which switch blade is closed, whichever that is, is the Normally Closed Switch.

Points are shown on the Layout or Track Plan in the normal position, this is indicated by a continuous line; the broken line shows the reverse direction

Reporting The Position Of Points

When reporting the position of points it is essential that you do not lead the person you are reporting to. Therefore, you should use the terms Left Hand Switch Closed and Right Hand Switch Closed. Don't forget to face the toe of the points when viewing the switch blades.

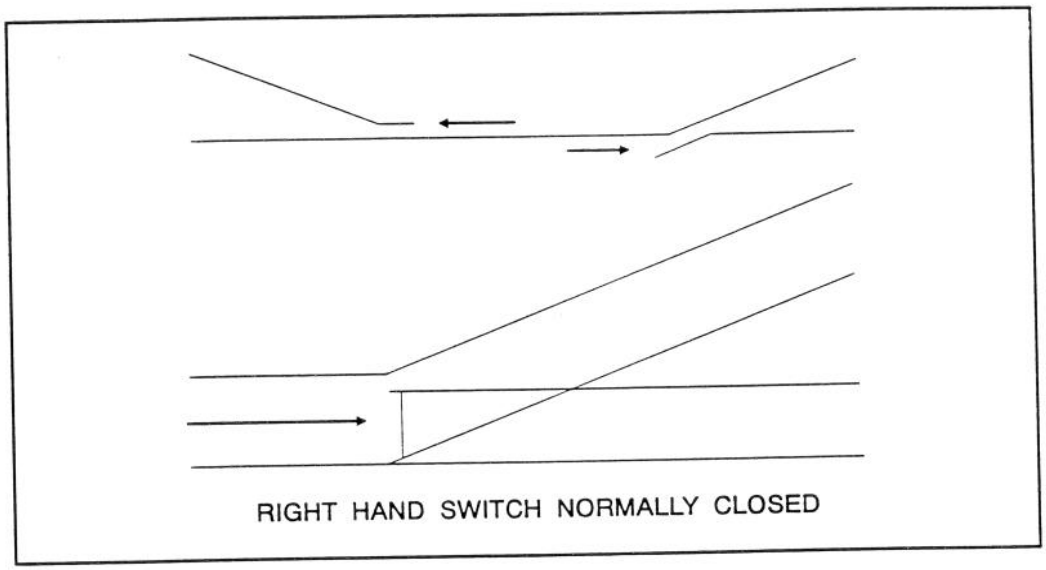

Figure 4. Points Layout - Right Hand Switch Normally Closed

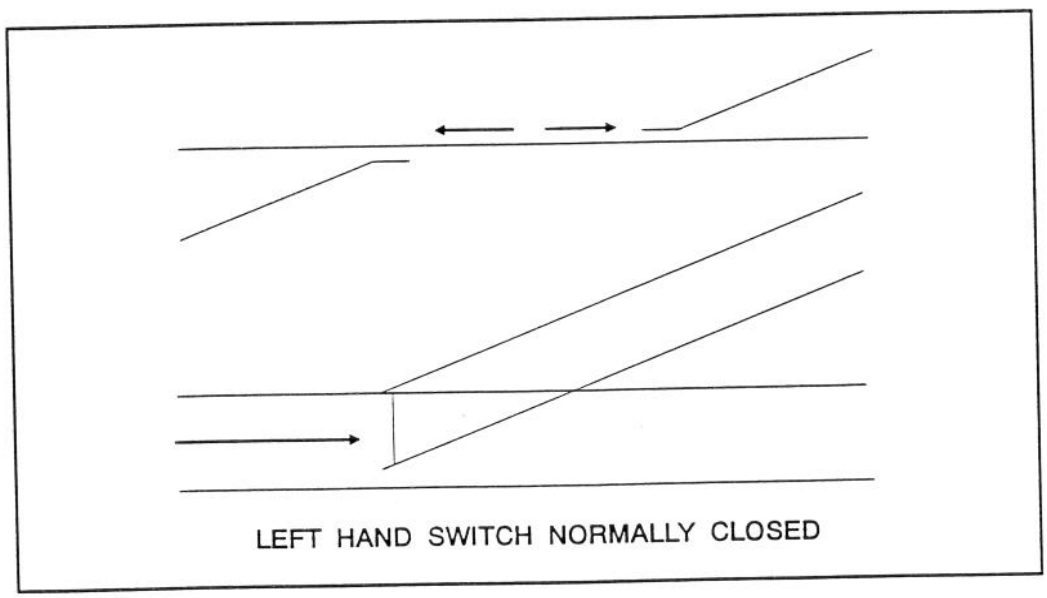

Figure 5. Points Layout - Left Hand Switch Normally Closed

Affected End

When testing points it is essential you know what ends of points you should test. In order to determine this, you must understand the term 'Affected End'. Look up in your Handbook Section B 013, 'Carrying out the Test' and Appendix A of the same Section, 'Point Permutation Chart Examples'.

Study Figures 6. and 7.

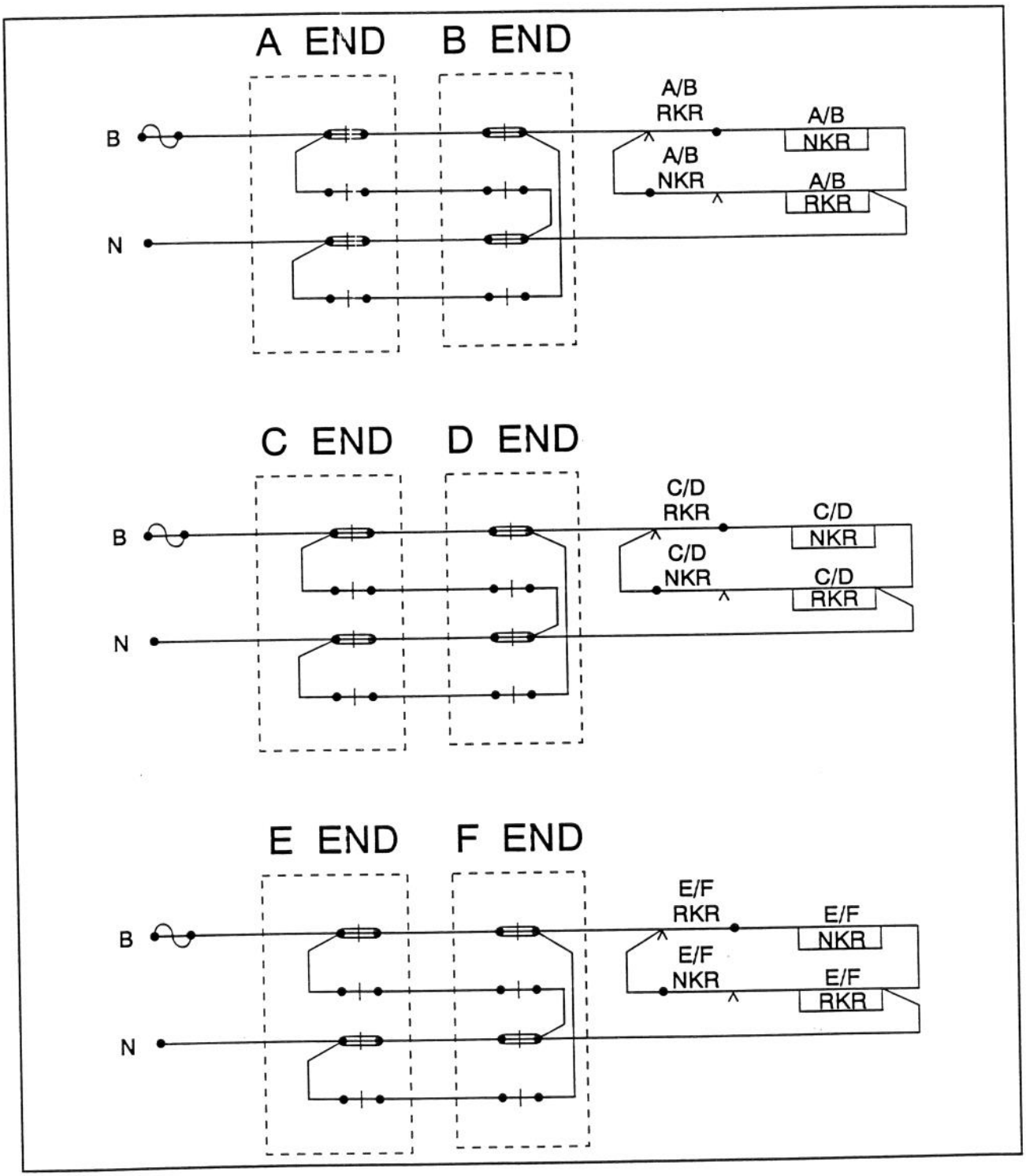

Figure 6. Six Ended Points Layout - 3 Detection Circuits

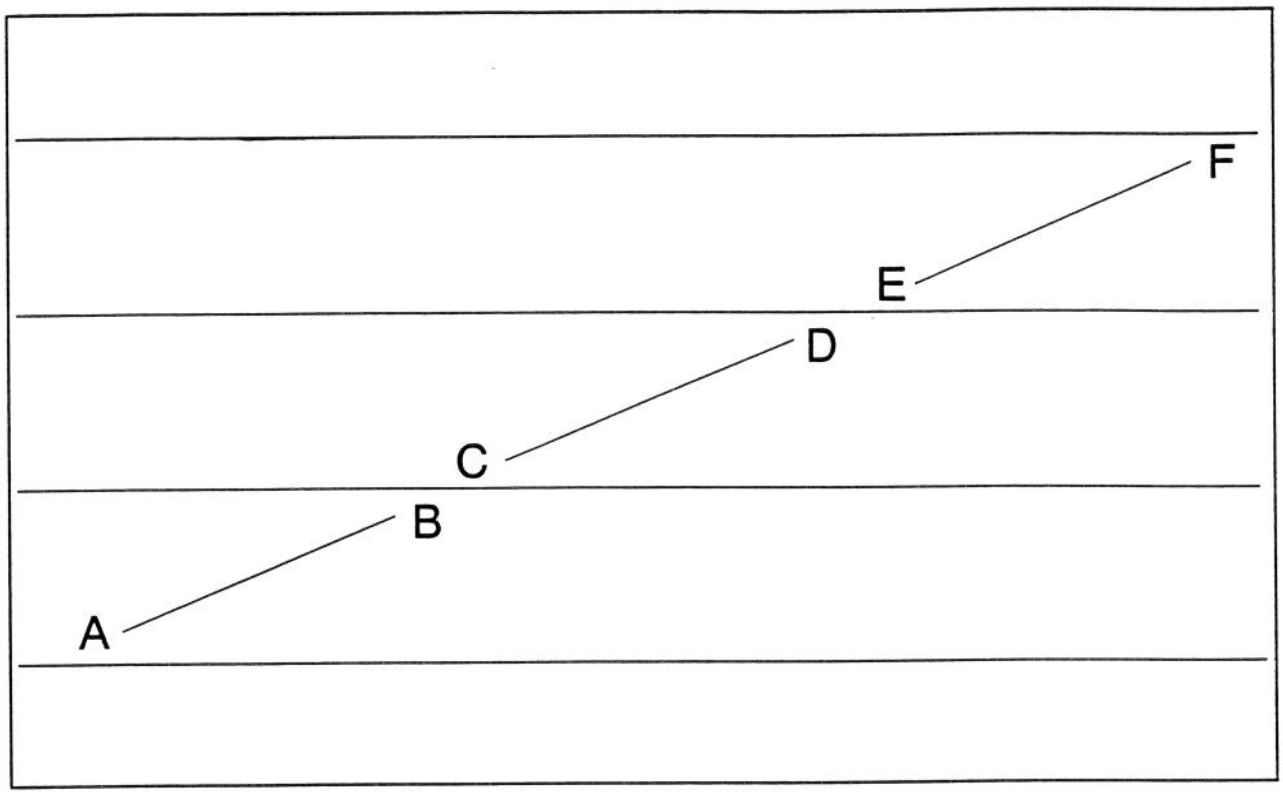

Figure 7. Six Ended Point Layout

For the following examples write down: the affected ends, the ends that require testing, and the tests carried out.

1) Point Machine on A end has been renewed.

2) Detection between C and D end has been renewed.

3) 2 core cable from B and N supply to E end.

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Check your answers.

Exercises

Record your answer to the following exercises below.

1) The B end point machine in Figure 8. has been renewed.
   How many ends are effected?
   What tests would you carry out?
   Which Permutation Chart would you use?

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2) What would be the effect of the extra internal straps in Figure 9?
   What test(s) would identify them?

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3) What would be the effect of the extra internal straps in Figure 10?
   What test(s) would identify them?

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.....

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4) The detection cables between B & C, and, C & D end in Figure 11. have been changed.
   Which are the affected ends?
   Which tests would you carry out?
   Which Permutation Chart would you use?

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5) What would be the effect of the wiring error in Figure 12?
   Which test(s) would identify it?

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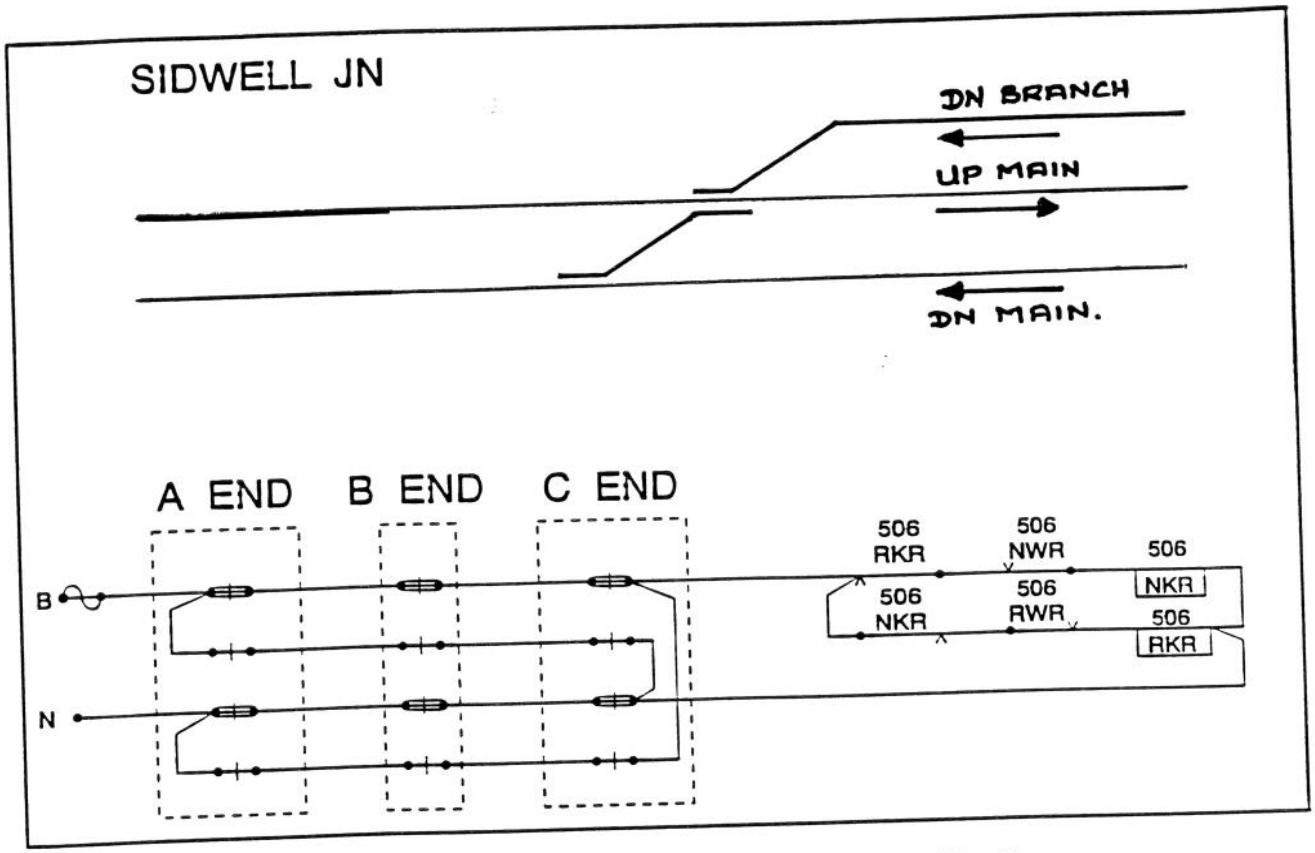


Figure 8. 3 Ended Point Layout - 1 Detection Circuit

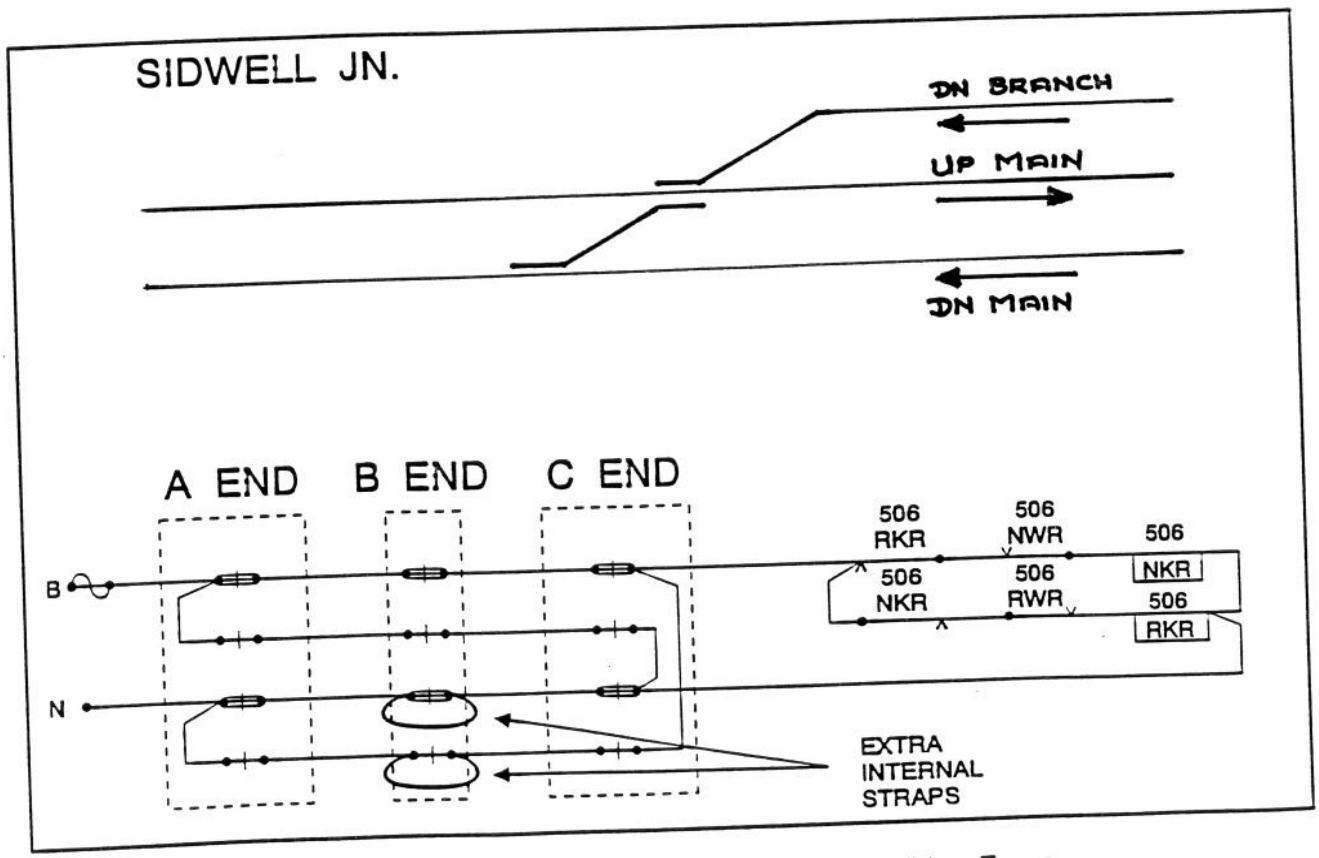


Figure 9. Detection Circuit With Short Circuit Wiring Errors

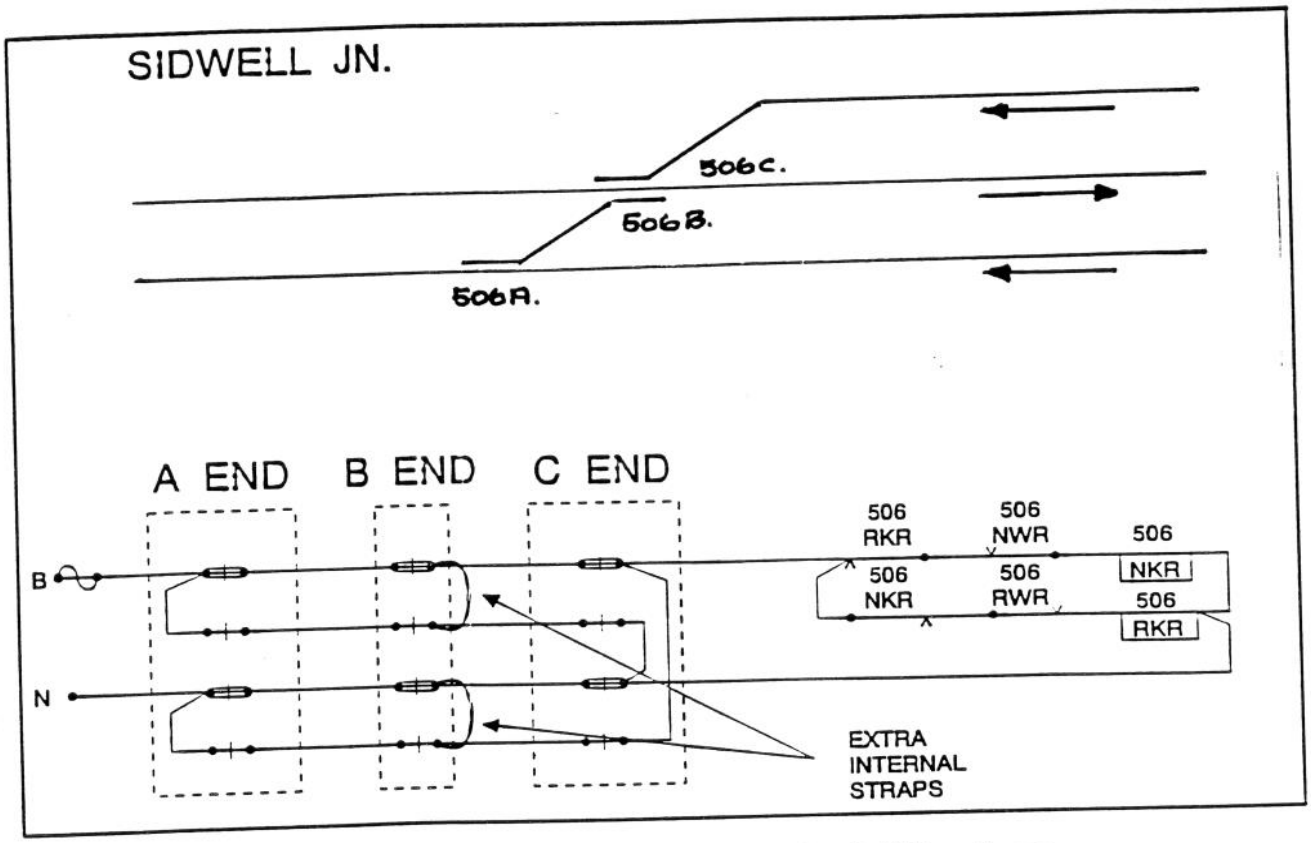


Figure 10 Detection Circuit With Short Circuit Wiring Errors

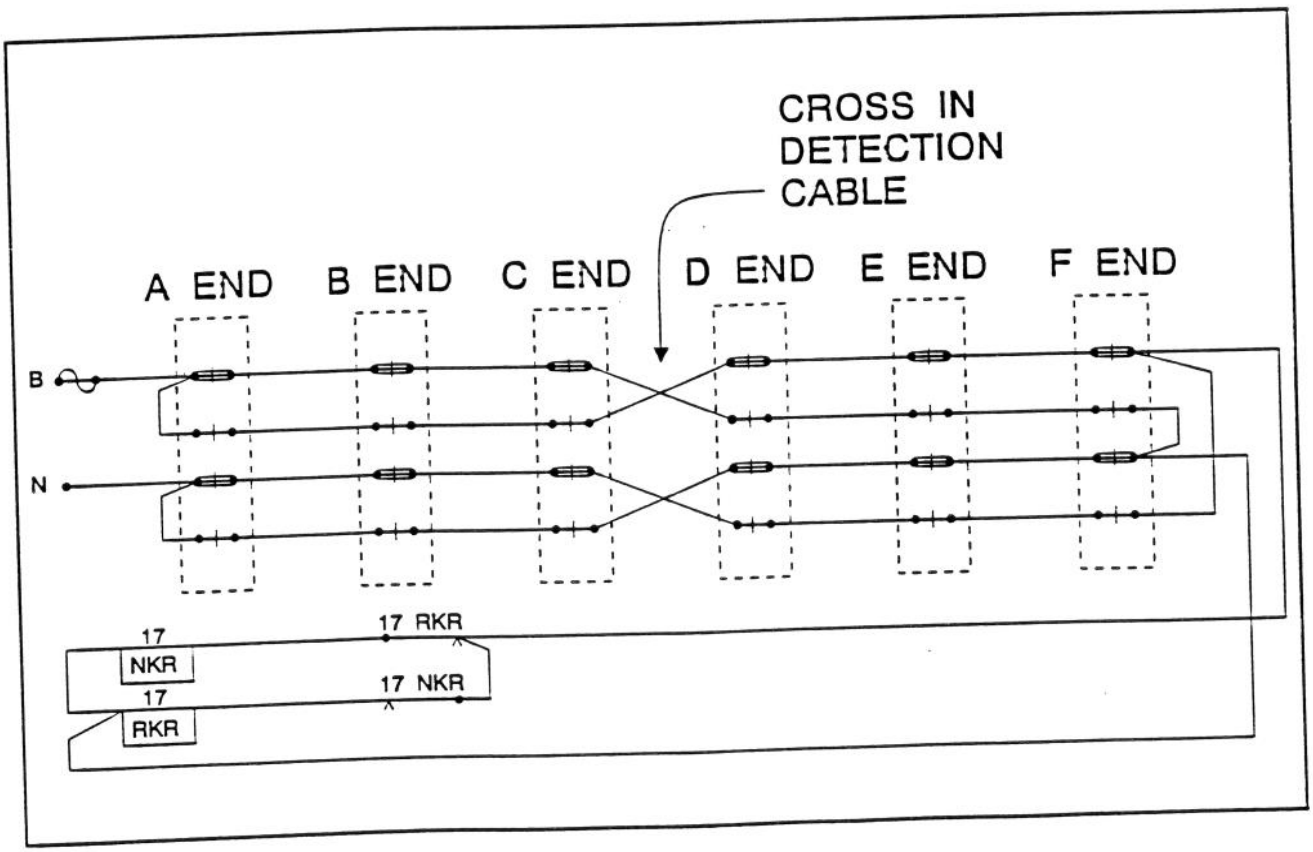


Figure 11 Detection Circuit With Wiring Crosses

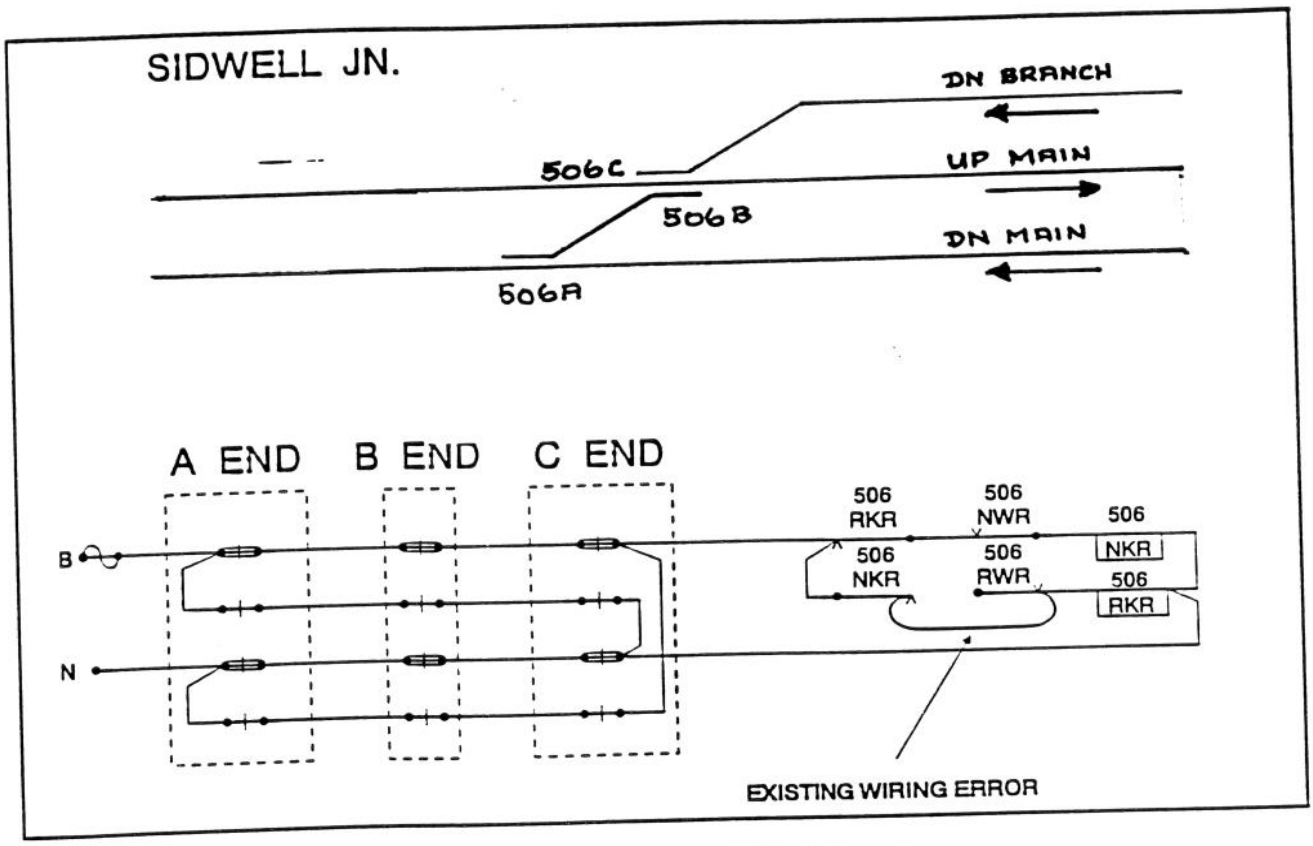


Figure 12 Detection Circuit With Wiring Error

Permutation Charts

These charts should be used in conjunction with the defined tests once you have decided the Affected ends etc. These are provided in your Handbook as tick sheets.

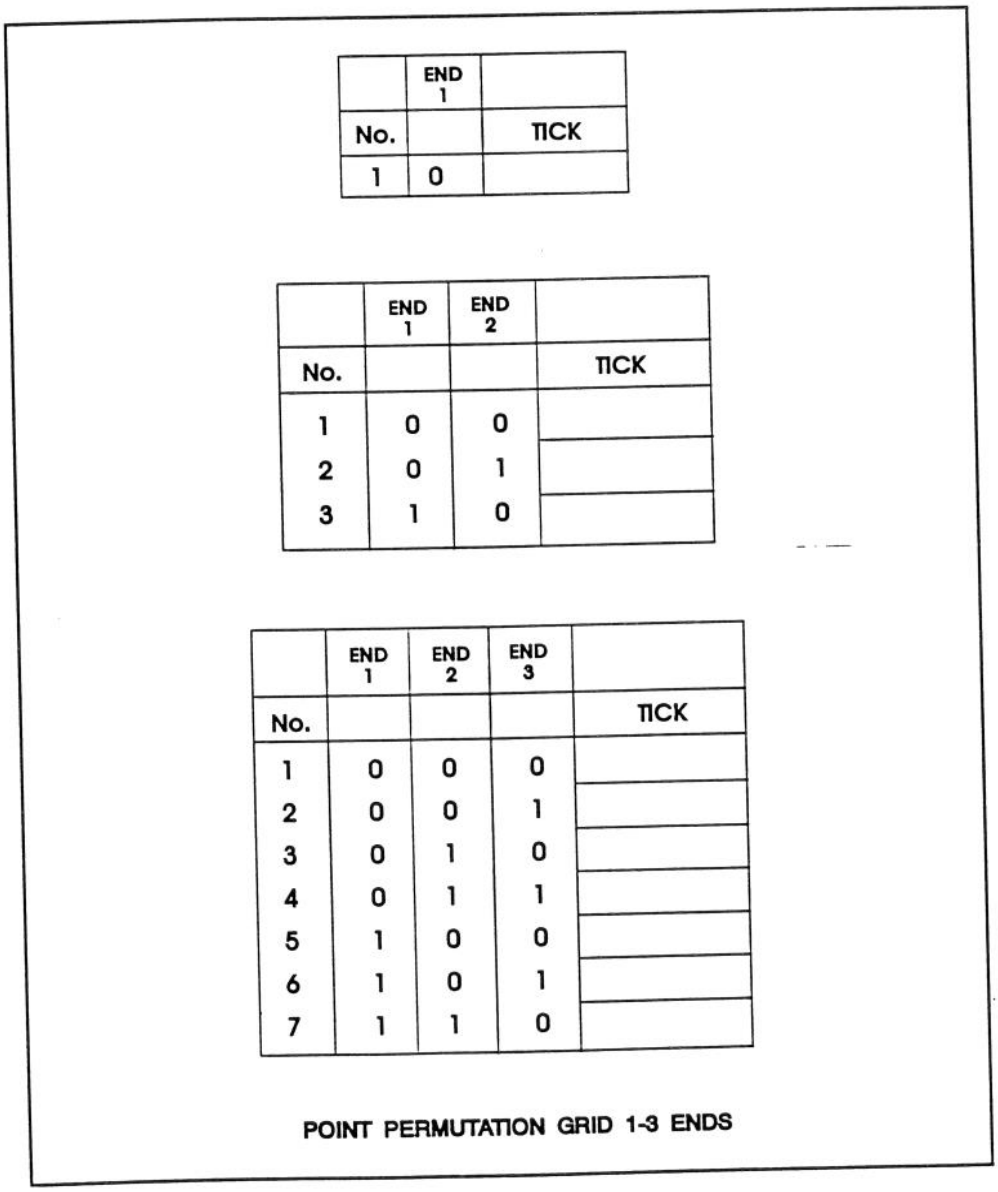
A completed example of a tick sheet is shown in your Handbook in Section B 013 page A01.

Using the Permutation Charts

These charts are used in conjunction with the Out of Correspondence Test.

You will always start by normalising all ends of points and then for each step in the permutation chart you will carry out the checks in Steps 2 to 6 of the defined test. Step seven tells you to move on to the next step in the permutation chart, and again carry out the checks in 2 to 6 of the defined test.

As you can see you will carry out steps 2 to 6 for each step in the permutation chart. It is straight forward if you take your time and use the permutation chart.



	END 1	
No.		TICK
1	0	

	END 1	END 2	
No.			TICK
1	0	0	
2	0	1	
3	1	0	

	END 1	END 2	END 3	
No.				TICK
1	0	0	0	
2	0	0	1	
3	0	1	0	
4	0	1	1	
5	1	0	0	
6	1	0	1	
7	1	1	0	

POINT PERMUTATION GRID 1-3 ENDS

Figure 12. Point Permutation Grid 1-3 Ends

Notes

Notes

RIGHT FIRST TIME?

In recent months four potentially serious incidents have occurred as a result of incorrectly carried out maintenance renewals or replacement of signalling equipment. The consequence of any of these incidents could have been serious. The common factor is that the checking carried out after the work was inadequate.

Wiring error on set of points

A clamp lock microswitch unit was changed and incorrectly connected. The wiring was not checked to the diagram after the replacement to ensure that the work had been carried out correctly. As a result, the points incorrectly gave detection. A derailment could have easily resulted.

SIGNAL ERROR

It was necessary to replace a searchlight mechanism. The mechanisms come in at least two types - stop and distant. The stop unit has red, yellow and green filters with red showing when the unit is de-energised. The distant unit has a yellow and two green filters with the yellow showing when it is de-energised.

No check done

A distant mechanism was put in place of the stop unit. As a result the signal showed yellow instead of red. When the work was completed, the technician who installed it did not check that the signal was showing the correct aspect. There was no independent check that the work had been carried out correctly.

CROSSING THE TRACKS

Following some renewal work two track circuits on the up line were crossed with two on the down. Testing was not carried out properly after the work was done. This resulted in the incorrect operation of the signalling on a busy main line.

Bypass Incident

A cable core was diagnosed to be faulty and the function was diverted into another core. In doing so the contact of a relay in the circuit was bypassed. There was no independent check of the work.

The fundamental requirement of Signalling Maintenance Testing Handbook is that the work is done by one person and checked by another. In all cases this independent check was omitted. The independent check is necessary because it is all too easy to convince yourself that the work that you have done is right. If you make a mistake and then check the work yourself, it is all to easy to make the same mistake again.

None of the staff involved thought that they had made a mistake. They were happy that the work they had just completed was correct. *How confident are YOU about YOUR work?*

Follow the simple rule - *Do it - Check it - See it Works*

then it won't be *YOUR* mistake being described here.

Produced on behalf of the Business S&T Engineers

by Signalling Maintenance Group, Paddington 1994

SIGTECH

BRITISH RAILWAYS - Signal and Telecommunications Engineering

SIGNAL WORKS TESTING

TEST CERTIFICATE – CABLE

TC 3/2

Sheet

PLACE/CONTROL CENTRE _____

SCHEME/PROJECT _____

MASTER TEST CERTIFICATE NUMBER _____

SECTION UNDER TEST/FROM: _____ TO: _____ NO. OF JOINTS: _____

CABLE NAME/NO: _____ TYPE/SIZE: _____ NO OF CORES: _____

WEATHER: _____ VOLTAGE TESTED TO: _____

METER SERIAL NO: _____ MEGGER SERIAL NO: _____

1st REFERENCE CORE NO.				2nd REFERENCE CORE NO.			
CORE NO:	CONTIN–UITY LOOP RES:	INSULATION RESISTANCE		CORE NO:	CONTIN–UITY LOOP RES:	INSULATION RESISTANCE	
		CORE/~~EARTH~~ core	CORE/~~CORE~~ Earth			CORE/EARTH	CORE/CORE
1	OC	∞	Short	25			
2	~~OC~~ ✓	∞	∞	26			
3	OC	short	∞	27			
4	~~OC~~ 19.	∞	∞	28			
5	~~OC~~ ✓	∞	∞	29			
6	✓	800 K	∞	30			
7	✓	∞	∞	31			
8	✓	∞	∞	32			
9	✓	∞	800K	33			
10	✓	400K	∞	34			
11	123 Ω	20M	∞	35			
12	✓	∞	∞	36			
13	✓	20M	∞	37			
14	✓	400K	400K	38			
15	✓	800K	∞	39			
16	✓	∞	∞	40			
17	✓	∞	20M	41			
18	✓	short	∞	42			
19	~~OC~~ 4	∞	∞	43			
20				44			
21				45			
22				46			
23				47			
24				48			
				POLARITY CORRECT			

NAME: (CAPITALS) SIGNATURE: DATE:

TESTED BY: _____ _____ _____

END

CONTINUITY TESTING - FAULT FINDING.

Continuity test all cores to find out which are good and which are apparently disconnected (faulty). Make a note of the loop resistance of the good cores.

To check whether faulty cores are disconnected (open circuit) or crossed:-

Step 1. Connect one end of the meter and one end of the test strap to a known good core.
LEAVE THEM THERE.

Step 2. Connect the other meter lead to the first faulty core.
THIS IS THE CORE UNDER TEST.

Step 3. Connect the other end of the strap to each other faulty core in turn whilst observing the meter.

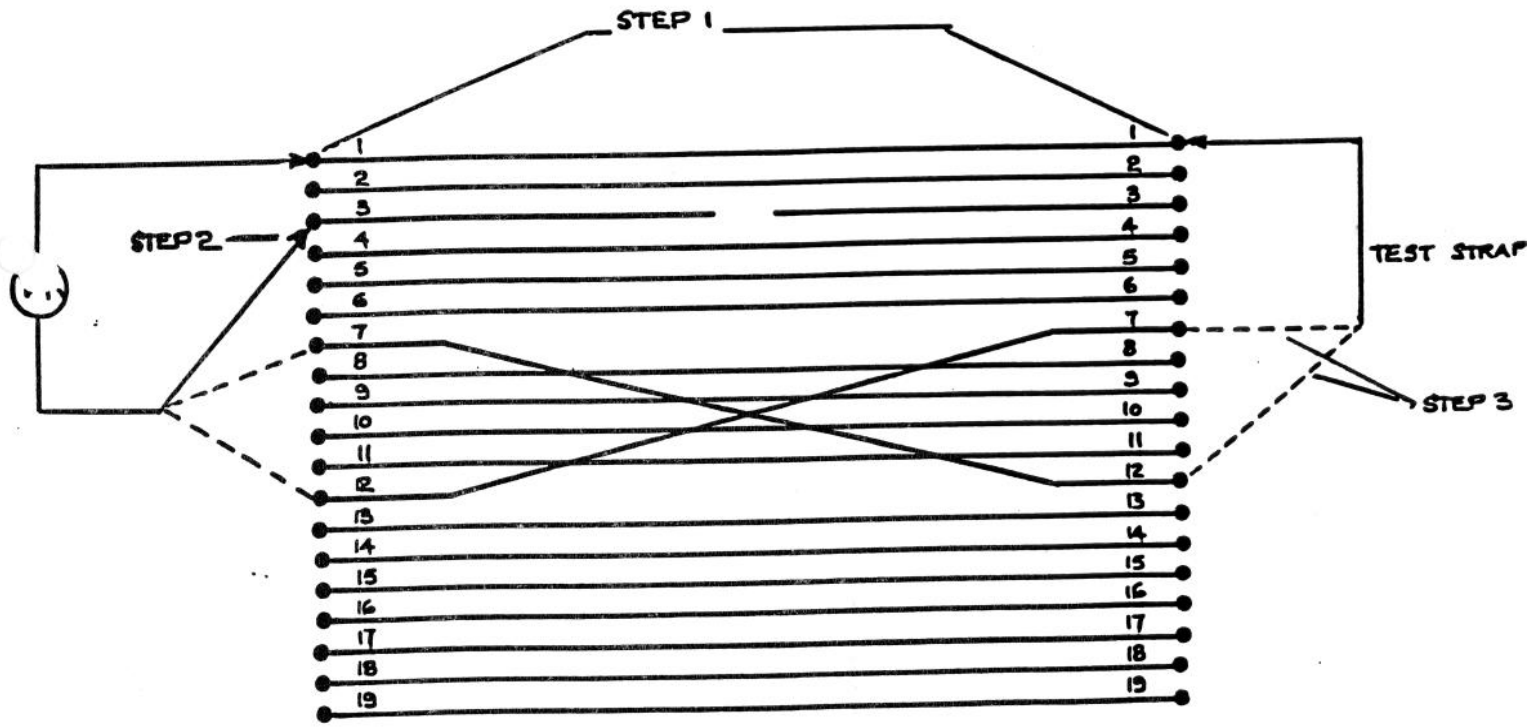
If we get the loop resistance then the faulty core connected to the test strap is crossed with the core under test.

If all readings are open circuit, then the core under test is disconnected.

Repeat steps 2 and 3 for all other faulty cores.

Meter Lead (Step 2)	Test Strap (Step 3)	Reading	Result
c.3	c.7 c.12	Open circuit) Open circuit)	Core 3 dis.
c.3	c.7	Loop res.	c.3 X c.7
c.3	c.12	Loop res.	c.3 X c.12

After proving core 3, move the meter lead to core 7 (as Step 2).



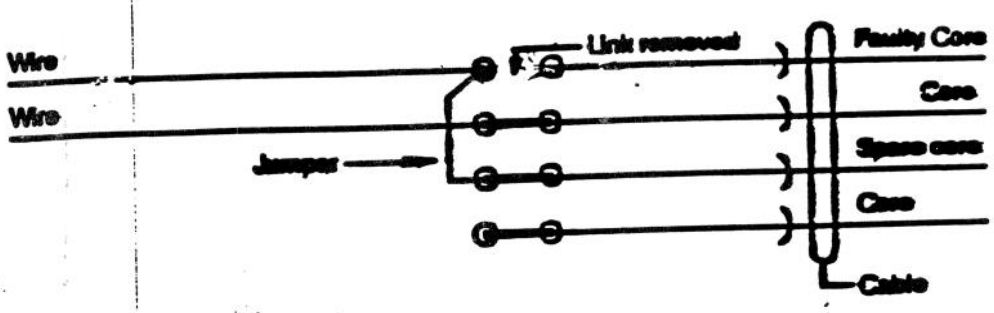
FAULTY CORES IDENTIFIED AS CORES 3, 7 AND 12.

CABLES - FAULTY CORES

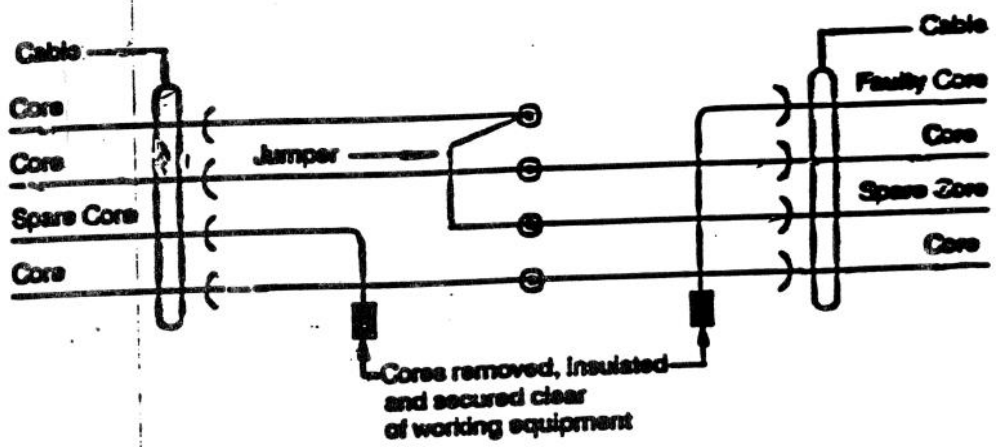
SKETCH - TYPICAL ARRANGEMENTS

(To be used in conjunction with the REQUIREMENTS)

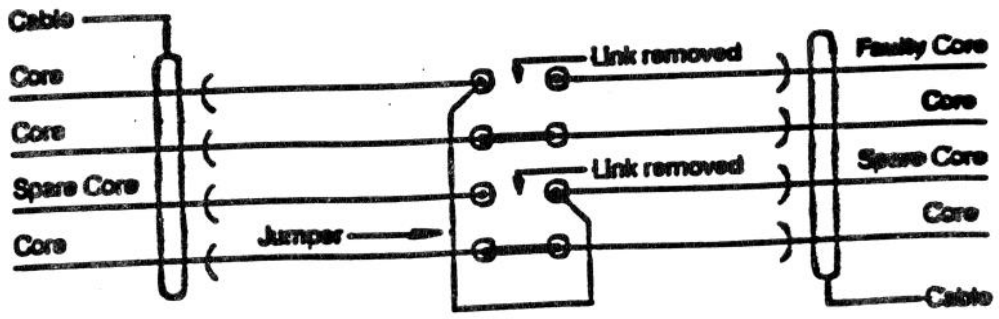
WIRE TO CABLE VIA LINKS



CABLE TO CABLE VIA BINDING POST



CABLE TO CABLE VIA LINKS



END