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NR/SMTH/Part/09

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INDEX

END

GENERAL

1. These U series “Intermittent and Obscure Failure Guides” have been introduced in the form of check lists to detail the suggested checks and tests which shall be carried out when investigating:

    a) Intermittent or repetitive failures.

    b) Failures where the root cause is not readily apparent.

    c) Where equipment is found to be working correctly upon arrival at the reported fault location.

2. Wrong Side Failures shall always be investigated using the correctly selected Test Guide(s) from the T series.

3. Further faulting guidance can be found within the documents listed in NR/SMTH/Part/10 (Faulting Guides) and in relevant Manufacturer's Documentation.

Intermittent and Obscure Failure Guides

4. The Faulting Guides are presented in a similar style to the Test Plans, with the guide being used to aid when testing/checking on site to determine the potential cause of any failure.

5. The checks listed are not intended to be a comprehensive test sequence or be in the correct order for every circumstance. Checks and tests considered most relevant to the reported failure shall be carried out first.

6. If no cause is apparent after these checks, advise your SM(S) and seek type specific fault-finding information from available sources.

Records

7. Complete the Signalling Intermittent and Obscure Failure check sheet in NR/SMTH/Part02/Form/14. Any measurement results or test records shall be included or attached.

8. If any item is replaced under NR/SMTH the SMTH logbook sheet shall also be included.

9. If you are investigating a SPAD, write down the results of each test that you complete and send it to your SM(S). Remember to identify any root cause as well as the actual cause of the failure.

10. If operating staff decline access to equipment for test/check purposes record this fact on the SMTH logbook sheet and advise your SM(S)

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U002		
Intermittent/Obscure Failure Guide: Point Machines		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Power Operated Points
Excludes:	Clamp locks and EP points, Suspected WSF

GENERAL

Point failure is a common cause of reported signal failure and reported change of aspects. This Test Guide gives you guidance on the checks and tests required.

Signal box and Signaller Checks

1. Check with the Signaller and/or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.

2. Check that no work has been recently completed in the area (e.g. stagework, S&C tamping, new huck bolts or point heater pads fitted).

Point Operation

3. Remove the point machine covers and ask the Signaller to operate the points to the normal and reverse positions.

   If the point motor does not run, the fault is within the point control circuit or the motor (see Steps 10 to 19).

   If the point motor runs but the points do not move, the fault might lie in the clutch mechanism (see Steps 20 to 22).

   Observe point operation and look for:

   a) Excessive time of operation

   b) Erratic operation

   c) Loose or obstructed fittings

   d) Movement of the point machine

   e) Poor supplementary drive operation, condition and adjustment

   f) Arcing contacts.

   NOTE: *If the points correctly operate, the facing point or detection mechanisms could still be out of adjustment (see Steps 23 to 36).*

General Checks

4. Check security and condition of point machine (was it locked upon arrival at fault location?).

5. Check the security of the point machine on its base / mountings – does it move when points are operated?

6. Check that all internal components are secure and lubricated.

7. Check tail cables, glands and terminations.

8. Check heaters.

9. Examine any snubbing contacts or diodes and check snubbing is effective.

Motor does not operate / weak operation

10. Check the crank handle reset contact (adjustment, condition).

11. Ask the Signaller to operate the points and measure the motor voltage and current (each affected end).

    This might identify a fault in the tail cable or the power supply.

12. Check the clutch slip current.

13. Check the motor brushes and commutator.

    Make sure the brushes are secure, not worn or jammed and that the commutator is not high resistance.

14. Check the motor control contacts (sparks, arcing, adjustment, condition).

15. Check that the point control relays operate when the Signaller controls the points.

    If the relays do not operate, the fault lies in the line-side circuit or interlocking controls. Using the record diagrams, identify the control circuit and trace any fault.

16. Check the point control relays and bases.

17. Measure the line circuit voltages at the incoming links and the relay coils.

18. Check the security of links and terminations in the location, any disconnection box and in the point machine.

19. Check that the point drive bar does not run back after completing its stroke.

Motor operates but the points do not move

20. Is the clutch slipping?

    Look for obstructions within the machine and in the points.

21. Check the clutch assembly and fixings.

22. Check the wiring and clutch control circuit.

Points move but do not lock

23. Carry out NR/SMS/PartB/Test/001 Facing Point Locks Tests (Machine).

    If the FPL has to be adjusted, the route cause for it shall be investigated.

24. Check the lock slide, throw bar and lock rod.

    Check that the lock rod is not damaged, and nuts and lock nuts are tight.

Points are locked but not detected.

25. Carry out NR/SMS/PartB/Test/011 (Detector Tests (Electrical Detectors)).

    If the detection has to be adjusted, the route cause for it shall be investigated.

26. Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

27. Measure the detection voltage at outgoing and incoming links (each affected end).

28. Check the detection rods, nuts and lock nuts.

    Check that the detector rods are not damaged, and nuts and lock nuts are tight.

    Also check that the rods are not obstructed.

29. Check the detection contacts and detection assembly (high resistance).

    Check that the contacts are clean, correctly aligned and that the required spring pressure is present.

30. Check the wiring, links and terminations in the location, any disconnection box and in the point machine.

31. Check that the detection relays operate when the Signaller controls the points.

    If the relays correctly operate, the fault lies in the line-side circuit or interlocking controls. Using the record diagrams, identify the control circuit and trace any fault.

32. Check the detection relays and bases.

33. Check the relay spades and wiring.

34. Measure the line circuit voltages (or line levels) at the busbar and outgoing links.

35. INSULATION TEST the tail cable.

36. Carry out NR/SMS/PartB/Test/052 Dynamic Earth Tests.

Supplementary Detector

37. Carry out NR/SMS/PartB/Test/016 Detection Test (Supplementary Detectors).

38. Measure the incoming and outgoing detection voltages.

39. Open the detector and check:

    a) The equipment is clear of obstruction or metallic objects.

    b) Internal cables and wiring (including insulation).

    c) Cable terminations are tight.

    d) Detector contacts are correctly adjusted.

    e) Sufficient spring tension and correct alignment.

    f) Contact surfaces are clean and in satisfactory condition.

    g) Tappets, sliders, rocker mechanisms.

    h) Micro-switches and tappets.

Lineside Location or Equipment Room

40. Check whether a data logger is fitted to the affected points – what information is available regarding the current failure?

    (In SSI areas, check Technician's Terminal).

41. Measure voltage and current at points supply battery when under load.

42. EARTH TEST (DC) or EARTH TEST (AC) relevant busbars.

43. Check that fuses and links are secure within clips/holders (and that contact areas are clean).

44. Check for signs of overheating (touch/smell) in supply T/Js, control, indication and proving relays.

45. Check security of other related equipment (e.g. SSI modules, interlocking units/modules).

46. Check condition of control, indication and proving relays (cracked casing, internal moisture, insects, foreign matter, contact arcing, internal cloudiness, silver sulphide, metal flakes, bent or broken contact springs, or corroded terminals).

47. Check condition of point contactor relay.

48. Test insulation and continuity of tail & lineside cables.

    If necessary, advice should be obtained from the Section Manager (Track).

Track

49. Where possible, fit a void meter and measure the vertical movement of the track following the passage of a train.

    Report as corrective maintenance if voiding exceeds 5mm.

50. Check for evidence of run through.

51. Is there any obvious damage to the track components and stretcher bars? (loose stretchers, bolts, blocks etc).

52. Note the stock rails and switch rail profiles.

    Are the points fitting up correctly?

    Is there any lipping?

53. Measure the track gauge and switch openings at the switch toes and back-drive positions.

54. Is there anything that could prevent the point blades from correctly operating? Obstructions, kicking ends, rail creep etc.

55. Check the slide chairs and chair (huck) bolts.

    a) All bolts shall be fitted, intact and tight (front slide chair bolt not fouling, sole plate/gauge stops, excessive voiding, kick shoes not binding).

    b) Switch rails shall be properly supported on slide chairs and rollers.

    c) Metal slide chairs shall be lubricated.

    d) Teflon or plastic slide chairs shall not be lubricated.

56. Check switch rollers are properly adjusted NR/SMS/PartC/PF03 (Point Fittings: Switch Rollers).

57. Check the security of external mechanical fittings.

58. Check additional drive adjustment (5 – 8mm clearance).

59. If a supplementary drive is fitted:

    a) Are cranks, fittings and “A” frames secure?

    b) Does the heel of the switch meet the stock rail before the toe?

    c) Does the heel of the switch prevent the toe from fitting up properly?

60. Check that back drive cranks are ‘in action’.

61. Check for excessive wear on the switch rail (if excessive, this can cause the toe to fit under head of stock rail).

62. Check that any point machine or detector box stabilisation plates are secure and undamaged.

63. Check for lost motion/excessive wear in supplementary drives.

64. Check adjacent rail joints are correctly packed and free from excessive vertical movement.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U003		
Intermittent/Obscure Failure Guide: Rail Clamp Point Lock		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Mk 1, Mk 2 and Mk 3 Clamp Locks
Excludes:	Suspected WSF

GENERAL

Point failure is a common cause of reported signal failure and reported change of aspects. This Test Guide gives you guidance on the checks and tests required.

Signal Box and Signaller Checks

1. Check with the Signaller and/or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.

2. Check that no work has been recently completed in the area (e.g. stagework, S&C tamping, new huck bolts or point heater pads fitted).

Point Operation

3. Remove the lock body covers and ask the Signaller to operate the points to the normal and reverse positions.

   Inspect pump unit. Look and listen for:

   a) Hydraulic leaks.

   b) Unusual sounds.

   Observe point operation and look for:

   a) Excessive time of operation.

   b) Erratic operation.

   c) Loose or damaged lock bodies.

   d) Loose or damaged centre thrust bracket.

   e) Hydraulic leaks.

   f) Poor supplementary drive operation, condition and adjustment.

General Checks

4. Check security of points (were detector box and power pack lids locked upon arrival at fault location?).

5. Check security of lock bodies (do they move when points are operating?).

6. Check security of centre thrust bracket (does it move when points are operating?).

7. Check for any obvious hydraulic pipe or cable damage.

8. Check that all internal components are secure and lubricated.

9. Check tail cables, glands and terminations.

Track

If necessary, advice shall be obtained from the Section Manager (Track).

10. Where possible, fit a void meter and measure the vertical movement of the track where a train pass.

    Report as corrective maintenance if voiding exceeds 5mm.

11. Check for evidence of run through.

12. Is there any obvious damage to the track components or stretcher bars? (loose stretchers, bolts, blocks, etc).

13. Measure the track gauge and switch openings at the switch toes and back-drive positions.

14. Is there anything that could prevent the point blades from correctly operating? Obstructions, kicking ends, rail creep etc.

15. Check the slide chairs and chair (‘huck’) bolts.

    All bolts shall be fitted, intact and tight (front slide chair bolt not fouling, sole plate/gauge stops, excessive voiding, kick shoes not binding). Switch rails shall be properly supported on slide chairs or rollers. Metal slide chairs shall be lubricated.

16. Check the profile of stock rails and switch rails.

    a) Are the points fitting correctly?

    b) Is there any stock rail ‘lipping’?

17. Check adjacent rail joints are adequately packed and free from excessive vertical movement.

18. If a supplementary drive is fitted:

    a) Are cranks, 'A' frames and fittings secure?

    b) Does the heel of the switch meet the stock rail before the toe?

    c) Does the heel of the switch prevent the toe from fitting up properly?

    d) Check additional drive adjustment (5 to 8mm clearance).

Tests

19. Facing Point Lock Test NR/SMS/PartB/Test/003 (Facing Point Lock Tests – Clamp Lock).

    If the FPL or detection has to be adjusted, the route cause for it shall be investigated.

20. Detection Test NR/SMS/PartB/Test/013 (Detection Test – Clamp Lock).

21. Supplementary Detection Test NR/SMS/PartB/Test/016 (Detection Test – Supplementary Detectors).

22. Place an obstruction in the open switch and test the operation of the cut-out.

Supplementary Detector

23. Open the detector and check:

    a) The equipment is clear of obstructions or metallic objects.

    b) Internal cables and wiring (including insulation).

    c) Cable terminations are tight.

    d) Detector contacts are correctly adjusted sufficient spring tension and correct alignment.

    e) Contact surfaces are clean and in satisfactory condition.

    f) Tappets, sliders, rocker mechanisms.

    g) Micro-switches and tappets.

24. Measure the incoming and outgoing detection voltages.

Lineside Location or Equipment Room

25. Check whether a data logger or remote condition monitoring is fitted to the affected points – what information is available regarding the current failure?
(In SSI areas, check Technician's Terminal).

26. or EARTH TEST (AC) the relevant busbars.

27. Detection Loop Test NR/SMS/PartB/Test/019.

28. Measure incoming and outgoing line circuit voltages and remote control system levels.

    This might identify a problem in the line circuits. Consider repeating this test at the interlocking end of the circuit.

29. Measure voltage and current at points supply battery when under load.

30. Check condition of control, indication and proving relays (cracked casing, internal moisture, insects, foreign matter, contact arcing, internal cloudiness, silver sulphide, metal flakes, bent or broken contact springs, or corroded terminals).

    The relays should be secure and the correct retaining clips should be fitted.
    Look for signs of overheating or burned contacts.

31. Check condition of point contactor relay.

32. Check for signs of overheating (touch / smell) in supply T/Js, control, indication and proving relays.

33. Check security of other related equipment (e.g. SSI modules, interlocking units or modules).

34. Check the wiring and terminations.

    Use the record diagrams and check each wire termination.
    Look particularly for loose terminations, loose back nuts and spade connectors, and high resistance soldered joints.

35. Check that fuses and links are correct rating, secure within clips / holders (and that contact areas are clean).

    Consider replacing the fuses.

36. INSULATION TEST the tail cables.

Pump Unit (see also NR/SMS/PartC/PB11 - Clamp Lock Hydraulic Points)

37. Check the hydraulic fluid level and pressure.

38. Look for leaks in the hydraulic rams and hoses.

39. Test for air NR/SMS/PartB/Test/015 (Clamp Lock: Test for Air in the System) and top up fluid as necessary.

40. Check electrical terminations. Check for signs of weakness in the crimps.

41. Measure the motor voltage during operation.

42. Check the normal and reverse valves are not sticking.

43. Check the motor brushes and commutator (security, condition, wear).

44. Manually operate the pump unit and look for incorrect operation.

Lock and Detector Mechanisms

45. Check terminations and wiring. Check for signs of weakness in the crimps.

46. Measure the incoming and outgoing point detection voltage.

47. Check microswitches and tappet settings. Check microswitches are free to move and have a positive snap action (ITW type excepted).

    The cam follower tappet screws shall protrude no more than 25mm.

48. Check the bodies are secured to the stock rail. Fixing bolts 250Nm, locking piece bolts 60Nm.

49. Check for loose bolts or cracked bodies. Check that the body sideplates are not cracked using an approved method. **(Mk 1s ONLY).**

50. Check for excessive wear on mounting studs **(Mk 1s ONLY).**

51. Lock and Detection Test NR/SMS/PartB/Test/014 (Lock and Detector Full Test – Clamp Lock) as necessary.

52. Check that the drive lock slide travels fully.

53. Check the locking piece is tight.

Clamp Lock Mechanism (open switch)

54. Check the switch rail bracket assembly is tight, refer to NR/SMS/PartZ/Z02 (Points Reference Values) for torque values.

55. Check the lock arm is free on the pivot pin and the pivot pin is free to rotate.

    This proves the 3mm clearance between the lock arm and drive lock slide.

56. Check that the lock arm and detection arm are both free to move independently on the brass bush **(Mk 2 ONLY)** or spherical bearing **(Mk3 ONLY).**

57. Check the lock slide cam is solid.

    If it is loose, check the Allen key on the underside of the drive lock slide.

58. Look for wear on the cam follower and fixed cam.

59. Check the lock slide 'Spirol' pin is flush. **(Mk2 only).**

60. Lubricate as necessary (**NOTE**: Mk3 spherical bearing/bush assemblies are dry joints and do not require lubrication).

Clamp Lock Mechanism (closed switch)

61. Check there is 4 to 12mm clearance between the top of the drive lock coupling and the bottom of the lock arm.

62. Check the drive lock slide is fully locked:

    - Mk 1 lock slide flush with the end of the body.
    - Mk 2 lock slide protrudes 25 to 30mm beyond the body.
    - Mk 3 lock slide protrudes > 71mm beyond the body.

Four Foot Fittings

63. Check the rams and hydraulic connections.

64. Check the tie bar is not fouling the thrust bracket assembly or rams (3mm clearance). **(Mk1 and Mk2 only).**

65. Check clearance between front stretcher bar and rail underside.

66. Check points/ram bay not obstructed by ballast/paper.

67. Check clearance between first P Way bolt and lock arm assembly mounting bolt.

68. Check all fittings are secure.

Final Test

69. Carry out NR/SMS/PartB/Test/003 (Facing Point Lock Test (Clamp Lock)).

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U004		
Intermittent/Obscure Failure Guide: Electro-Pneumatic Points		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Electro-Pneumatic Points with Intermittent/Obscure Failures
Excludes:	Suspected WSF

GENERAL

Point failure is a common cause of reported signal failure and reported change of aspects. This Test Guide gives you guidance on the checks and tests required.

Signal Box and Signaller Checks

1. Check with Signaller and/or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.

2. Check that no work has been recently completed in the area (e.g. stagework, S&C tamping, new huck bolts or point heater pads fitted).

Point Operation

3. Remove the machine covers and ask the Signaller to operate the points to the normal and reverse positions.

   Inspect valve chest. Look and listen for:

   a) Air leaks.

   b) Unusual sounds.

   Observe point operation and look for:

   c) Excessive time of operation.

   d) Erratic operation.

   e) Point drive running back after completing its stroke.

   f) Flashes or sparks from electrical contacts.

   g) Movement of the mechanism relative to the bearers.

   h) Poor supplementary drive operation, condition and adjustment.

General Checks

4. Check security and condition of point machine (was it locked upon arrival at fault location?).

5. Check the security of the point machine on its base/mountings – does it move when points are operated?

6. Check that all internal components are secure and lubricated.

7. Check tail cables, glands and terminations.

8. Check heaters.

Track

If necessary, advice shall be obtained from the Section Manager (Track).

9. Where possible, fit a void meter and measure the vertical movement of the track where a train pass.

Report as corrective maintenance if voiding exceeds 5mm.

10. Check for evidence of run through.

11. Is there any obvious damage to the track components or stretcher bars? (loose stretchers, bolts, blocks, etc).

12. Measure the track gauge and switch openings at the switch toes and back-drive positions.

13. Is there anything that could prevent the point blades from correctly operating? obstructions, kicking ends, rail creep etc.

14. Check the slide chairs and chair (huck) bolts.

All bolts shall be fitted, intact and tight (front slide chair bolt not fouling, sole plate/gauge stops, excessive voiding, kick shoes not binding). Switch rails shall be properly supported on slide chairs and rollers. Metal slide chairs shall be lubricated.

15. Check the stock rails and switch rail profiles.

    a) Are the points fitting up correctly?

    b) Is there any stock rail lipping?

16. Check adjacent rail joints are correctly packed and free from excessive vertical movement.

17. If a supplementary drive is fitted:

    a) Are cranks, '"A' frames and fittings secure?

    b) Does the heel of the switch meet the stock rail before the toe?

    c) Does the heel of the switch prevent the toe from fitting up properly?

    d) Check additional drive adjustment (5 to 8mm clearance).

Tests

18. Carry out NR/SMS/PartB/Test/001 (Facing Point Lock Tests (Machine)).

    If the FPL or detection has to be adjusted, the route cause for it shall be investigated.

19. Carry out NR/SMS/PartB/Test/011 (Detector Tests (Electrical Detectors).

20. Carry out NR/SMS/PartB/Test/016 (Detection Test (Supplementary Detectors)).

21. Place an obstruction in the open switch and test the operation of the cut-out.

Supplementary Detector

22. Open the detector and check:

    a) The equipment is clear of obstructions or metallic objects.

    b) Internal cables and wiring (including insulation).

    c) Cable terminations are tight.

    d) Detector contacts are correctly adjusted for correct alignment and spring tension.

    e) Contact surfaces are clean and in satisfactory condition.

    f) Tappets, sliders, rocker mechanisms.

    g) Micro-switches and tappets.

23. Measure the incoming and outgoing detection voltages.

Lineside Location or Equipment Room

24. Check whether a data logger or remote condition monitoring is fitted to the affected points – what information is available regarding the current failure? (In SSI areas, check Technician's Terminal).

25. Carry out an EARTH TEST (DC) or EARTH TEST (AC) on the busbars.

26. Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

27. Measure incoming and outgoing line circuit voltages and remote-control system levels.

    This might identify a problem in the line circuits. Consider repeating this test at the interlocking end of the circuit.

28. Check condition of control, indication and proving relays (cracked casing, internal moisture, insects, foreign matter, contact arcing, internal cloudiness, silver sulphide, metal flakes, bent or broken contact springs, or corroded terminals).

    The relays shall be secure and the correct retaining clips shall be fitted.

    Look for signs of overheating or burned contacts.

29. Check for signs of overheating (touch/smell) in supply T/Js, control, indication and proving relays.

30. Check security of other related equipment (e.g. SSI modules, interlocking units or modules).

31. Check the wiring and terminations.

    Use the record diagrams and check each wire termination.

    Look particularly for loose terminations, loose back nuts and spade connectors, and high resistance soldered joints.

32. Check that fuses and links are correct rating, secure within clips/holders (and that contact areas are clean).

    Consider replacing the fuses.

33. Carry out an INSULATION TEST on the tail cables.

Valve Chest

34. Is the air valve turned up too high?

    This can cause air to escape through the relief valve.

35. Check air pipes and fixings.

36. Check electrical terminations.

37. Are the normal and reverse valves sticking?

38. Check detection and valve coupler contacts.

Point Drive and Detector Mechanism

39. Is the piston correctly adjusted?

40. Are all fixings tight?

41. Are the stroke adjusting screws secure?

42. Are point drive and detector rods secure?

43. Do any moving parts require lubricating?

44. Are electrical contacts contaminated with dirt or oil?

45. Check contact springs and contact surfaces.

46. Measure the incoming and outgoing detection voltages.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U005		
Intermittent/Obscure Failure Guide: Track Circuits		
Issue No: 02	Issue Date: 04/03/2023	Compliance Date: 03/06/2023

Includes:	Right Side Failure due to Intermittent/obscure aspect
Excludes:	Suspected WSF

GENERAL

Track circuit failure is a common cause of reported signal failure and reported change of aspects. This Test Guide gives you guidance on the checks and tests required.

Good record keeping is essential to refer to and review later.

For EBI200 and EBI400 type track circuits use of the ETTCM is recommended. Where this is not available, TTM or MTM is acceptable.

It is not acceptable to test EBI Track 200 or 400 without a TTM, MTM or ETTCM.

Signal Box, Signaller and Remote Checks

1. Check with Signaller and/or Infrastructure Control whether the track circuit affected has shown a similar failure characteristic prior to this fault.

2. Check if any work has been recently completed in the area (e.g. stagework, track maintenance or renewals activities).

3. Check data logger, Technician's Terminal, Remote Condition Monitoring – what information is available regarding the current failure to ascertain the failure mode?

   In DC traction areas, ascertain if recent Thermal Imaging camera footage is available for the line and ask for this to be reviewed.

4. Check with Electrification Control Room (if in AC / DC traction area) whether any nearby traction current circuit breakers have tripped and reset. Also check if there are any known intermittent power supply failures that could be affecting the track circuit.

5. Check whether any associated equipment might have caused the track circuit to drop (e.g. Shunting Treadle / Track Circuit Interrupter / Special Feed)?

Track Circuit Tests

6. Carry out Service A of the relevant track circuit type, see NR/SMS/PartC/TC02 - TC17

   In DC traction area, if practicable to do so, monitor track circuit relay/receiver voltage whilst trains are in section and drawing current.

   If DC traction interference or traction return imbalance is suspected, use DMM (Double Millivolt Meter) to identify fault.

7. Carry out Service A of NR/SMS/PartC/TC30 (Track Circuits: Additional Bonding Check).

   In DC traction areas, at impedance bonds, where fitted, check integrity of all bond-rail connections and advance plate connections. Look for signs of arcing, overheating or corrosion indicating water ingress.

   If practicable, monitor connections using a thermal imaging camera or IR phone adapter whilst trains are in section and drawing current.

   For 50Hz AC and FS2600 Impedance Bonds, INSULATION TEST auxiliary coil to the bond casing. A reading of less than 1MΩ is not ideal but >200kΩ (>0.2MΩ) is acceptable to remain in work and not likely to be the cause of the fault.

8. Test and record track circuit rail voltages using the correct meter (e.g. for EBI types use ETTCM), measuring at regular intervals starting at the Feed/Transmitter through to the Relay/Receiver end (look for an even voltage gradient along the length of the track circuit).

   Voltage should fall linearly through the circuit, except where intermediate impedance bonds or intermediate tuning capacitors are fitted.

9. For 50Hz AC, FS2600, EBI200 and EBI400, measure and record track circuit rail current (e.g. by using a Rocoil or Lemflex in conjunction with the correct meter) in each rail. Measure at regular intervals starting at the Feed/Transmitter end through to the Relay/Receiver end (look for loss or unexplained variation). Pay particular attention to rail connections (look for fluctuation when the connection is subject to vibration or movement).

   Current should remain at a constant level throughout the track circuit, except where intermediate impedance bonds or intermediate tuning capacitors are fitted.
   In a double-rail configuration, track circuit current in each rail should be equal (+/- 2%).

10. For DC Track Circuits, carry out NR/SMS/PartB/Test/041 (Insulated Rail Joint (IRJ) Test).

11. For 50Hz AC, HVI, EBI, Reed and FS2600 Track Circuits, refer to RIA 021 Issue 4 Section 7 and carry out IBJ Electrical Fault Finding.

12. Check on metal structures, that the signalling rail is insulated from structure that the line passes over (e.g. wheel-timber bridges). Look for loose or misaligned timber straps, tie bars, walkway fittings, etc.

13. Track Circuit Full Test NR/SMS/PartB/Test 251 - 263. Compare results with previous readings and investigate any significant variations.

14. CONTINUITY TEST the tail cables.

15. INSULATION TEST the tail cables.

16. Compare the resistance of duplicate tail cables using a current clamp. For further details see NR/SMS/PartC/TC00 (Track Circuits General) - Section 8.

17. Check relevant TCAIDs and connections for security and damage (if fitted), and that TCAID is switched on and that its battery is working within specification.

18. Check any disconnection boxes for water ingress or contamination and for integrity of connections and terminations.

19. Check the rail clip insulations on concrete and metal sleepers (using the rail clip tester where available).

20. Check other insulations throughout TC length (rail foot, point fittings) for security and damage.

21. Check that rail clip insulations are correctly installed (i.e. right way up) and correct type.

22. Check height and condition of ballast through track circuit length (dirty, damp, other contamination).

23. Check for short circuits through signal wires, point rodding, point heater leads/strips and clamp lock hoses.

24. Check condition and drainage of track (particularly in tunnel areas) for ‘wet spots’, etc.

25. If track circuit is over a Level Crossing, check for salt contamination in Bowmac units.

Lineside Location or Equipment Room

26. EARTH TEST (DC) or EARTH TEST (AC) the busbars.

27. Check terminations on track links, surge arrestors, and fuse-holders.

28. Check main and tail cable terminations, crimps, links and back nuts.

29. Check power supplies, fuses and fuse-holders.

30. Examine the track circuit feed units, relays (TR, TPR, etc.) and bases. Look for signs of overheating or burned contacts. Check that wire terminations and straps are secure.

    The equipment should be secure and the correct retaining clips should be fitted to plug-in units.

31. Check front and rear of relay/receiver base for silver migration.

32. Measure the voltages at the busbar and across the TPR contacts. Look for a volt drop, which might indicate a high resistance contact.

    Whilst monitoring the outgoing TPR voltage, lightly tap the relay which might indicate an intermittently high resistant contact or low contact pressure.

33. Measure incoming and outgoing line circuit voltages and remote control system levels.

    This might identify a problem in the line circuits. Consider repeating this test and checking the equipment at the interlocking end of the circuit.

Follow Up steps if root cause not identified

34. Plot the readings taken in Steps 6 and 7 on a graph to draw a voltage (and current where applicable) vs distance profile of the track circuit, identify areas of concern to investigate further.

35. In DC Traction areas, disassemble, clean and re-make every rail and impedance bond connection.

36. On EBI Single-Rail types, renew any Surge-Protected ETU (SPETU) for ETU.

37. On TI21 / EBI types, change Tuning Units at both ends of the track circuit and any abutting zero-pole TUs at tuned zones.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U006		
Intermittent/Obscure Failure Guide: Colour Light Signals		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	All types and styles of both filament and LED signal
Excludes:	Alleged SPAD or change of aspect, Suspected WSF

GENERAL

This Test Guide gives you guidance on the checks and tests required, in the event of signal failure not associated with point, track circuit or barrier failure.

Signal Box and Signaller Checks

1. Check with the Signaller and / or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.
2. Check that no work has been recently completed in the area (e.g. stagework).
3. Check with Signaller if any other signals were replaced when signal failed.

Signal Head Checks

4. Measure signal lamp / module voltage compare results with last reading on record card.

   For LED Modules this voltage is taken in the location case.

   If the voltage requires adjustment, the reason shall be determined.

5. Check security and condition of signal head (was it locked upon arrival at fault location?).
6. Check security of all electrical terminations (including back nuts, crimps) in signal head.
7. Check any Plug and Play cable connections are secure and locked into position.
8. Check security of filament test crimps (if fitted).
9. Check the lamp is seated correctly in the lamp holder.
10. Check security of filament changeover relays (ERs) and that they are correctly fitted.
11. Check that all ER terminal pins are intact.
12. Check security and condition of lamp holders, contacts, base of lamps.
13. Check security and condition of signal head transformer.
14. Check for signs of overheating in ERs or head transformer.

15. If signal affected is an 'auto', check Emergency Replacement Switch for correct operation.

16. Replace lamps and retain for investigation if required.

17. Replace ERs and retain for investigation if required.

18. Test lineside and tail cables for INSULATION / CONTINUITY.

19. Carry out an ASPECT TEST signal.

20. Carry out Full Test to appropriate NR/SMS.

Lineside Location or Equipment Room

21. Check whether a data logger or remote condition monitoring is fitted to the affected signal – what information is available regarding the current failure?
(In SSI areas, check Technician's Terminal).

22. Measure ECR/HR/DR line voltages.

23. Carry out EARTH TEST (DC) or EARTH TEST (AC) on the relevant busbars.

24. Check security of all electrical connections (including back nuts / crimps) of internal wiring, tail and lineside cable connections.

25. Check that relevant fuse and links are secure within clips and holders, and that contact areas are clean.

26. If signal is fitted with flashing aspects, check condition of FECR.

27. Check condition of ECR/ECROJ/HR/DR/TPR and aspect proving relays.

28. Check for overheating (touch / smell) in ECR/ECROJ/HR/DR/TPR and aspect proving relays.

29. Check security of relays and plug-in units and that retaining clips are correctly fitted.

30. Check relay spade connectors are secure.

31. Check security of other related equipment (SSI Modules / Westpac units).

32. Check that ECROJ is correctly adjusted, if fitted.

33. Test Lineside and tail cables for Insulation / Continuity.

34. If signal is operated from a mechanical signal box, check relevant circuit controller bands for security and condition.

35. Consideration shall also be given to checking the signal ahead of the one affected (e.g. for intermittent ECPR fault) and any points in the route to the next signal for bobbing detection.

36. Look for possible read through, signals on adjacent lines or other possible sources of visual interference or distractions, e.g. traffic lights, street lamps or advertising hoardings.

END

GENERAL

This Test Guide sets out the procedure to be adopted for dealing with a reported SPAD where no allegation is made against the signalling system.

If the driver (or other responsible person riding in the cab) admits passing the signal at danger, staff shall attend to the signal and check or determine the following features (within 48 hours of the initial report), but the signal need not be treated as defective. Where remedial actions are taken, these shall be noted on the SMTH logbook sheet.

If the correct operation of any equipment is doubted it shall be treated as defective and fully tested.

Signal Not Alleged Defective

1. Where evidence of the SPAD might have been recorded on a data logger, see NR/SMTH/Part05/Module/S07 (Evidence - Data Loggers and Condition Monitoring Systems), the recording shall be requested regardless of whether an allegation has been made against the signalling system.

2. Using a digital camera, take a photograph of the signal from a position 20m on approach, from the left-hand rail in direction of travel.

3. Check the signal asset is correctly aligned to the information on the Signal Sighting record, or the signal head record card, see NR/SMS/PartC/SG00 (Signals: General) - Signal Visibility and Beam Alignment.

4. Check the Signal Light Modules (SLM) are the correct type (Range / Beam), where specified on the Signal Sighting Record (**DORMAN LED SIGNALS ONLY**).

5. Using a digital camera, take a photograph through the alignment device and where the signal asset is misaligned, make adjustment to correct the alignment to the position stated on the Signal Sighting Record.

6. Check the seal on the lamp holder is intact (where fitted).

7. Check the signal head, lens hoods, backgrounds and anti-vandal guards (where fitted). Check the signal back board is not discoloured or faded (where fitted).

8. Check backlights, where provided. Backlights on elevated position light signals shall be blanked off.

9. Check all lenses/glasses are clean, both inside and out (where applicable), not damaged or discoloured and not obstructed. On multi-aperture signals, pay particular attention to the red aspect.

10. Check the close-up segment is correctly aligned according to the position of the signal.

11. Check if the lenses are polycarbonate. If so, they shall be in good condition i.e. not opaque or excessively scratched.

12. Check the interior of the signal head/indicator for deterioration, moisture ingress or contamination. Check that the seals on the door(s) are effective. Take remedial action if required.

13. Check where fitted the signal/indicator lamp voltage is correct (main and auxiliary) and adjust as necessary.

14. For semaphore signals, check that the arm, spectacle and, if fitted, the sighting board are clean and fit for purpose.

15. Carry out NR/SMS/PartB/Test/302 (Signal Visibility Check) for the signal asset. Note the permissible speed approaching the signal may be required for this task.

16. Carry out NR/SMS/PartB/Test/302 (Signal Visibility Check) for any associated banner repeater or co-acting signals.

17. Check whether any identified obscurations of the driver's visibility of the signal asset or associated banner repeater/co-acting signals are recorded on the signal sighting record.

18. If an obscuration of driver visibility is found, assess if this can be safely removed, e.g. vegetation growth, if safe to do so, remove it, noting any material removed.

19. Check that the signal structure is sound and upright. Measure the height of the red aspect above rail level and its lateral displacement from the running edge.

20. Check all signal identification plates. These shall be secure, correctly aligned, clean, legible, and displaying the correct number.

21. Using a digital camera, take a photograph of:

    a) The signal from the required reading distance on approach to the signal, and

    b) The signal from the minimum reading distance, and

    c) The signal from the AWS, where positioned at less than minimum reading distance, and

    d) The track approaching the signal, from the signal, as near as possible to the most restrictive aspect, and

    e) The track approaching the signal, from the signal through the alignment device.

22. Carry out NR/SMS/PartB/Test/302 (Signal Visibility Check) for the cautionary aspect of the signal in rear of the signal that was passed at danger.

Additional Testing requirements at Signals where TPWS and TPWS+ are Fitted

On the TSS grids

23. To check the grids have not been transposed carry out the following:

a) NR/SMS/PartB/Test/230 (Train Protection and Warning System (TPWS) Tests) Sections 1, 2 & 3.

b) NR/SMS/PartC/TP11 (Train Protection & Warning System (TPWS) Clause 3.2.

c) Measure and record the distance between the signal post and the leading edge of the trigger grid.

d) Check the arming and trigger grids are fitted without a gap between them.

On the OSS grid and OSS+ grid (if fitted)

24. Carry out the following:

a) NR/SMS/PartB/Test/230 (Train Protection and Warning System (TPWS) Tests) Sections 1, 2 & 3.

b) NR/SMS/PartC/TP11 (Train Protection & Warning System (TPWS) Clause 3.2

c) The distance between the signal post and the leading edge of the trigger grid shall be measured and recorded.

d) The distance between the leading edge of the arming grid and the leading edge of the trigger grid shall also be measured and recorded.

Other Considerations

The rail head surface shall be examined from the AWS to the signal for contaminants such as leaf mulch or excessive grease from automatic grease applicators.

Low Sunlight

If the driver alleges aspect degradation by sunlight, then Test Guide NR/SMTH/Part08/T036 (Wrong Side Failure Test Guide: Colour Light Signal – Degraded by Sunlight) shall be followed.

If there is reason to believe that low sun, or any other lighting interference, is a possibility, the following checks shall be performed:

a) As far as possible confirm that interference from the sun, or other light source is in fact the cause of the difficulty to read.

b) Carry out the checks in steps 1 to 22, above.

c) Then adjust the lamp voltage on the red aspect to the maximum level that just prevents 12.1V being exceeded at the time of day when the voltage is highest (when power demand is least). Record the details of the reason for lamp voltage adjustment on the signal record card so the maintainer is aware of the issue **(EXCLUDES LED SIGNALS).**

d) If the signal is one of a group of signals that are adjacent to each other (such as on a gantry) then the red aspect voltage of all signals in the group are to be similarly adjusted. This is to avoid one signal appearing brighter than the others, which in itself can cause misreading.

e) Where applicable, and after consulting with the Signal Sighting Engineer, consider fitting long hoods to the main aspects and any junction indicator which is read in conjunction with the main aspects.

Other Obscuration

If the driver alleges physical obscuration, then Test Guides NR/SMTH/Part08/T037 (Wrong Side Failure Test Guide: Colour Light Signal – Obscured by Obstruction) or NR/SMTH/Part08/T038 (Wrong Side Failure Test Guide: Mechanical Signal – Obscured by Obstruction) shall be followed.

NOTE: *Permitted obscurations between the RRD/MRD and asset position are defined on the Signal Sighting Record*.

If there is other reason to believe that obscuration is a possibility, carry out the checks in steps 1 to 22, above. Under these circumstances, if it can be confirmed that the obstruction is intermittent (as is often the case in vegetation), then the signal need not be treated as defective, but the situation shall still be attended to as quickly as possible.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U008		
Tests Following an Alleged Change of Aspect (COA)		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	SPADs where an allegation is made against the signalling system
Excludes:	SPADs where no allegation is made against the signalling system, Suspected WSF

GENERAL

This Test Guide sets out the procedure to be adopted for dealing with a reported change of signal aspect (COA) or SPAD where a cause is not obvious at the commencement of investigation.

It applies when a colour light signal reverts to a more restrictive aspect, or a COA is observed by a Driver or Signaller, provided it can be confirmed that the signal concerned, or the signal in rear, was displaying the correct aspect prior to the reported incident (either by the Signaller or by a data logger).

If this cannot be confirmed, or the Signaller disputes the driver's alleged aspect sequence, a WRONG SIDE FAILURE shall be assumed, which shall be investigated using the Test Guide(s) in the T series.

Most signalling equipment failures have the potential to cause a COA. A SPAD is dependent on the position of trains at the time of the COA.

A SPAD is classified as Category B if a signal returns to danger in front of a train because of a signalling fault, and the train runs past the signal.

NR/SMTH/Part05/Module/S16 (Signals passed at danger (SPADs)), tells you how SPADs and COA failures are managed.

Records

Where a COA has resulted in a SPAD, you shall record the results of each check and send them to your SM(S). Remember to identify any root cause as well as the actual cause of the failure.

Signal Box and Signaller Checks

1. Check with Signaller and/or infrastructure fault control whether there is a history of COAs or SPADs at this signal.

2. What signal aspect was displayed before the signal returned to danger?

3. Is the expected aspect displayed?

4. What was the aspect sequence leading up to this signal?

   If the signal aspect was less restrictive than expected, you shall report that a wrong side failure has occurred and then apply testing in accordance with NR/SMTH/Part08 (WSF Test Guides).

   If the train driver reported a change of aspect, you shall continue with this Test Guide.

5. Did the Signaller control the signal to danger in front of the train?

6. If yes, the SPAD shall be reported as a Category C or a non-technical Category B SPAD. You do not need to do any more testing.

7. Did the Signaller receive any indication or information that could be the cause of the COA?

8. Check with Signaller if any other signals were replaced when signal failed.

9. Is there any evidence of an irregular train movement, which could have caused an irregular aspect sequence?

10. Check that no work has been recently completed in the area (e.g. stagework).

Signal Location or Equipment Room

Following a SPAD, the signal might have been signed out of use. An unauthorised 'OFF' aspect shall not be displayed to the driver of a train while you are carrying out tests.

11. Check whether a data logger, Technicians Terminal or remote condition monitoring is fitted – what information is available regarding the current failure?

    Where the data logger indicates a momentary failure of a relevant track circuit, or a loss of point detection, then the Test Plan for that equipment shall be used to find the cause of the intermittent failure.

12. Appendix 1 provides a defined list of failure modes. Select the failure mode and then apply relevant checks.

13. EARTH TEST (DC) or EARTH TEST (AC) relevant busbars.

14. Using the signalling record diagrams, identify the signal control circuit.

15. Check relays and bases (secure spades, retaining clips in place). Look for damaged or burned contacts.

16. What is the position of the signal aspect controlling relay, i.e. DR (2 aspect), HR, GR, or UR, if reverting to red (HHR or DR, if reverting to yellow or double yellow)?

    a) If the relay is energised and the signal is displaying more restrictive aspect, look for a fault in the signal aspect circuit (go to Step l).

    b) If the controlling relay is energised and the signal is showing the correct OFF aspect, there might be an intermittent fault in the relay control circuitry.

    This might include:

    c) Low voltage in the line circuits.

    d) Transmission system levels out of specification (FDM, TDM).

    e) Loose wire termination (including back nuts).

    f) High resistance termination point.

    g) High resistance contact or spade.

    Intermittent failure of:

    h) Point detection.

    i) Track circuit.

    j) Level crossing barrier detection.

    k) Any other controlling function.

    l) If the aspect controlling relay is de-energised, when it ought to be energised, trace the circuit through to find the cause.

This might include:

m) Fuse failure (blown, loose, dirty).

n) Power supply failure (main, battery).

o) Lamp out in the signal ahead.

p) Disconnected cable core or wire.

q) High resistance or disconnected cable termination point.

r) High resistance or disconnected contact spade.

s) Relay or plug-in unit failure.

t) Failure of a controlling function (relay position).

In this case the cause of the failure might be indicated to the Signaller (point detection, track circuit failure etc).

Signal Head

17. Carry out NR/SMS/PartB/Test/054 (Cable insulation Test) on the signal tail cable.

18. Are the signal lamps intact (both filaments) and correctly fitted to their lamp holders?

19. Are there any loose or disconnected wires or cable terminations? (internal and tail cables).

20. Is there anything that could have caused a short circuit?

21. Are there any signs of vandalism?

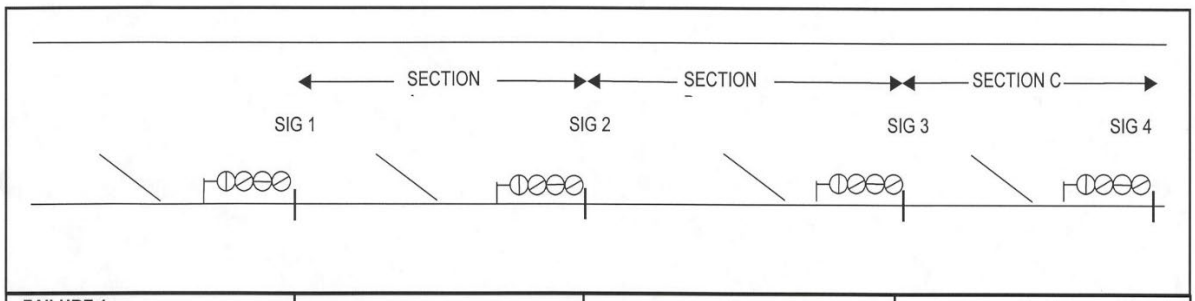
22. ASPECT TEST this signal and any related signals.

23. Carry out NR/SMS/PartB/Test/021 (Filament Signal Lamp Tests). Including standing voltages on unlit aspects.

24. Carry out NR/SMS/PartB/Test/022 (Signal Lamp and Light module Proving Tests).

25. Check the lamp filament proving relays (condition, security).

APPENDIX A - Defined Failure Modes



FAILURE 1: SIG 1 CHANGES G to YY CHECK: • SIG 1 DR LINE	CHECK: • SIG 2 HHR LINE	CHECK: • SIG 3 HR LINE	CHECK: • POINTS IN SECTION C • TRACK CIRCUITS IN SECTION C • SIG 4 FOR BLACK ASPECT
FAILURE 2. SIG 1 CHANGES G to Y: CHECK • TOP Y IF BLACK FOLLOW 1 • SIG 1 HHR LINE	CHECK: • SIG 2 HR. LINE	CHECK: • POINTS IN SECTION B • TRACK CIRCUITS IN SECTI0N B • SIG 3 FOR BLACK ASPECT	
FAILURE 3 SIG 1 CHANGES G to R CHECK: • SIG 1 HR LINE	CHECK: • POINTS IN SECTION A • TRACK CIRCUITS IN SECTI0N A • SIG 2 FOR BLACK ASPECT		

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U009		
Right Side Failure Test Guide: Automatic Warning System (AWS)		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	AWS Right Side Failures
Excludes:	Suspected WSF

GENERAL

AWS equipment shall be repaired as quickly as possible. AWS is a primary safety system.

Whilst AWS is repaired, signal aspects shall be restricted for a maximum of 48 hours if authorised by a Level 3 SFI Engineer.

If the apparatus cannot be restored to normal working within 48 hours, the issue shall be escalated to the Signal & Telecoms Maintenance Engineer.

The Signal & Telecoms Maintenance Engineer shall arrange that resources necessary to rectify the defect are given a high priority.

If AWS is unable to be repaired within 48 hours and cannot be fully functional for a period of time, the aspect shall be returned to normal operation and train drivers advised about the defective AWS by means of a published notice.

1. Introduction

Table 1 summarises the AWS Failure Codes that can be reported to Signalling Technicians.

Required Audible Indication	Actual Audible Indication	Fault Code
CLEAR	HORN AND BELL	1
CLEAR	HORN INSTEAD OF BELL	2
CLEAR	NONE	3
WARNING	BELL AND HORN	4
WARNING	BELL INSTEAD OF HORN	5
WARNING	BRAKE WITHOUT HORN	6
WARNING	NONE	7
WARNING	INDICATOR DID NOT CHANGE TO YELLOW & BLACK (this is not a fault if it occurs after cancelling the AWS indication received when setting a driving cab into service)	7A
NONE	HORN	8
NONE	BELL	9
UNABLE TO CANCEL		10
INDICATOR NOT CHANGING TO ALL BLACK		11
AWS FAILS TO ARM		12
AWS FAILS TO DISARM		13

Table 1 – AWS Faults

Codes 5 and 7 could be infrastructure related and are Wrong Side Failures. Testing required after report of Code 5 or 7 failure is covered in NR/SMTH/Part08/T011 (Wrong Side Failure Test Guide: Automatic Warning System (AWS)).

2. Testing after Code 1 AWS Failure

This is likely to be a trainborne equipment fault. A train passing over an AWS magnet that is supposed to be present at very slow speed can cause the failure, but that is due to operating the AWS outside its design criteria.

When an AWS Code 1 is reported, determine from the Signaller/Driver where the train was and how fast it was going.

a) Train travelling at more than 5mph, fault occurred at AWS magnet. Trainborne problem, no further action necessary. Advise Signaller fault is not an infrastructure related issue.

b) Train travelling at less than 5mph or speed unknown, fault occurred at AWS magnet. Advise the Signaller that the fault is likely to be trainborne. No further action is necessary other than to advise your SM(S) that a code 1 AWS fault has occurred.

3. Testing after Code 2 AWS Failure

This could be an infrastructure failure or a trainborne equipment fault. This failure shall necessitate fault finding on site unless it is proven to be a trainborne fault (i.e. unit reports a string of code 2 failures at ‘clear’ signals (colour lights showing green or semaphore distant signals showing ‘off’).

If it is decided not to go to site because the same unit has reported several AWS failures, advise the Signaller that it is unlikely to be an infrastructure fault and request advice of further incidents.

If a site visit is required, undertake right side failure testing of the AWS installation, paying particular attention to the positioning, height and field strength (S&P meter) of the electro-magnet.

4. Testing after Code 3 AWS Failure

This could be infrastructure failure or a trainborne equipment fault. This failure shall necessitate fault finding on site unless it is proven to be a trainborne fault (i.e. unit reports a string of code 3 and 7 failures at ‘clear’ signals and signals displaying a caution/red aspect).

When an AWS Code 3 is reported, it could be a Code 7 failure waiting to happen. On arrival at site, concentrate on the permanent magnet.

Determine whether the Permanent magnet is effective by undertaking NR/SMTH/Part08/T011 (Wrong Side Failure Test Guide: Automatic Warning System (AWS)) - tests N01 to N05; N20 to N24. Test the Signal's permanent magnet for correct strength and polarity using an S&P meter.

If satisfied that everything is correct, this is likely to be a trainborne fault.

If the permanent magnet is a suppressor, and appears to be producing correct magnetic fields, undertake the remaining parts of NR/SMTH/Part08/T011 (Wrong Side Failure Test Guide: Automatic Warning System (AWS)). If nothing is found, check that the electro magnet is correctly operating, then advise the Signaller and offer the equipment back for service.

5. Testing after Code 4 AWS Failure

This is likely to be a trainborne equipment fault. It may be reported as either a bell and horn together or as a horn after bell – both are Code 4.

A train passing over an AWS magnet that is supposed to be present at very slow speed can cause the failure, but that is due to operating the AWS outside its design criteria.

When an AWS Code 4 is reported, determine from the Signaller/driver where the train was and how fast it was going.

a) Train travelling at more than 5mph, fault occurred at AWS magnet. Trainborne problem, no further action necessary. Advise Signaller fault is not an infrastructure related issue.

b) Train travelling at less than 5mph or speed unknown, fault occurred at AWS magnet. Advise the Signaller that the fault is likely to be trainborne. No further action is necessary other than to advise your SM(S) that a code 4 AWS fault has occurred.

6. Testing after Code 5 AWS Failure

Refer to NR/SMTH/Part08/T011 (Wrong Side Failure Test Guide: Automatic Warning System (AWS)).

7. Testing after Code 6 AWS Failure

This is likely to be a trainborne equipment fault. No further action necessary. Advise Signaller fault is not the infrastructure.

8. Testing after Code 7 AWS Failure

Refer to NR/SMTH/Part08/T011 (Wrong Side Failure Test Guide: Automatic Warning System (AWS)).

9. Testing after Code 7A AWS Failure

This is likely to be a trainborne equipment fault. A train passing over an AWS magnet that is supposed to be present at very slow speed can cause the failure, but that is due to operating the AWS outside its design criteria. There is also a very remote chance that another magnet too close or an extraneous strong magnetic field might lead to this failure.

When an AWS Code 7A is reported, determine from the Signaller/driver where the train was and how fast it was going.

Train travelling at any speed, fault occurred at AWS magnet. Determine from Signaller if any other trains have reported similar AWS problems.

If not, advise the Signaller that the fault is likely to be trainborne and request to be advised of any further occurrences in the area.

If Signaller reports further instances, go to site and examine the line seeking for extraneous magnets or sources of strong magnetic field.

10. Testing after Code 8 or Code 9 AWS Failure

This could be an infrastructure failure or a trainborne equipment fault. The only conceivable infrastructure causes are a right side failed suppressor or the train passing over a strong magnetic field that is not supposed to be present.

When an AWS Code 8 or 9 is reported, determine from the Signaller/driver where the train was and if other reports of code 8 or code 9 AWS failures have been received.

If the site is of a suppressor, go to site and test the suppressor for a right side failure.

If the site is away from an AWS installation, and the report is a one off, request the Signaller to advise you of any further instances of Code 8 or Code 9 failures in the area.

If Signaller reports further instances, go to site and examine the line for extraneous magnets or sources of strong magnetic field.

11. Testing after Code 10 AWS Failure

This can only be a trainborne equipment fault, a traction unit stopped with its receiver over an AWS magnet, or passing extremely slowly over a source of strong magnetic field.

When an AWS Code 10 is reported, determine from the Signaller/driver where the train was. If the train was over an AWS magnet, the AWS is operating outside its parameters and there is no fault. An extremely slow train could have the same symptom.

If the site is away from an AWS installation, and the report is a one off, request the Signaller to advise you of any further instances of Code 10 failure in the area. If Signaller reports further instances, go to site and examine the line seeking for extraneous magnets or sources of strong magnetic field.

12. Testing after Code 11 AWS Failure

This is can only be a trainborne equipment fault. Advise the Signaller that this is not an infrastructure fault.

13. Testing after Codes 12 and 13 AWS Failures

These can only be trainborne equipment faults. Advise the Signaller that they are not infrastructure faults.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part09/U011		
Intermittent/Obscure Failure Guide: Automatic Half Barrier Crossings		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Automatic Half Barriers
Excludes:	MCBs, ABCLs, Suspected WSF

GENERAL

This Test Guide gives you guidance on the checks and tests required in the event of one or more barriers lowering without a train or failing to rise after the passage of a train.

Signals are not required to protect an AHBC.

If one or more barriers fail to lower with a train approaching within the strike-in point (unless an intervening signal is at red), the failure is regarded as a WRONG SIDE FAILURE and shall be investigated using the Test Guide(s) in the T series.

Signal Box and Signaller checks

1. Check with the Signaller and/or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.

2. Check that no work has been recently completed in the area (e.g. stagework).

GENERAL

Much can be learned from observing the barriers during their normal operation.

3. Observe the operation of the crossing on ‘auto’:

    a) Time taken for the barriers to fall and raise (any particular barrier slower than the others).

    b) Any moving parts snagging or falling off.

    c) Any signs of loose pedestal mountings.

    d) The 24V battery supply is recovering after each operation.

    e) Test the battery under load with the power off.

    f) The boom damping is effective (approx. 10° from horizontal).

    g) The above observations might lead you to an intermittent or potential barrier failure.

4. Check whether a data logger or remote condition monitoring is fitted – what information is available regarding the current failure? (in SSI areas, check Technician's Terminal).

Power Supply

5. Measure the battery voltage during the lower and raise cycle. Confirm that the battery charger power is on.

   The voltage during operation should not dip below 20V to 24V, depending on the battery type.

   When the barrier has raised, the battery charger should bring the battery voltage back up to 26V to 29V.

6. Test the battery under load with the power off.

7. Check electrolyte condition and levels of 24V standby battery.

8. Check electrolyte condition and levels of 24V standby battery.

9. Check 'Power Off' circuit works correctly.

On-Track checks

10. Check correct operation of treadles, including damper timing and gauging (maintenance instruction/specification).

11. Check security of treadle electrical terminations including tail cable and internal wiring.

12. Check security/condition of treadle tail cables.

13. INSULATION TEST and CONTINUITY TEST of tail cables to treadles.

14. Carry out a track circuit Full Test (NR/SMS/PartB/Test/251 to 263) on relevant up and down line.

For each Barrier Pedestal and Boom

15. Measure voltage and current at pump unit motor when under load.

16. Check booms are free from obstruction.

17. Check the security of electrical terminations (including internal and tail cable connections).

18. Check that circuit controller contacts are clean, free from excessive wear and correctly adjusted.

19. Check that the circuit controller is free from metallic dust and moisture.

20. Check the circuit controller linkage is free from excessive mechanical wear.

21. Check hydraulic fluid levels are correct.

22. Check for evidence of fluid leakage around hoses, unions and rams.

23. Check the motor brushes and commutators are in good order and free from dust.

24. Check all the pedestal mountings and fixings are intact and secure.

25. Check that boom counterweights are correctly adjusted and secure.

26. Check 'Local Control Switch' position and connections.

Hand Pump (BR843)

27. Hand pump each barrier to the raised position.

    The barriers should not drop between each pump.

28. Lift the pump handle and check that the barrier lowers.

    When you release the handle, the barrier should stop.

29. Check the shock absorber cannot be depressed by more than 3mm by finger pressure.

30. Check the operator's door micro-switch, wiring and terminations.

    Confirm that when you turn the key, the Yale lock is fully operated.

Barrier Location or Equipment Room

31. Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Tests).

32. Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

33. Check the security of electrical terminations (including internal and tail cable connections).

34. Check the security of back nuts on terminal blocks.

35. Check that fuses and links are clean and secure within their holders.

36. Measure incoming and outgoing line circuit voltages and remote-control system levels.

    This might identify a problem in the line circuits. Consider repeating this test at the interlocking end of the circuit.

37. Examine the control and detection relays and bases.

    Confirm the relays and spades are secure and the correct retaining clips are fitted.

38. Measure current in control circuit when under load.

39. Check condition of control, timer, indication and proving relays (for burnt contacts, condensation, silver migration, etc.).

40. Check for signs of overheating (touch/smell) in supply T/Js, control, timer, indication and proving relays.

41. Check relay base spade connectors are secure.

42. Check treadle stick and proving circuits operate correctly.

43. Check that relevant up/down road TPRs operate correctly.

44. Check ‘Another Train Coming’ circuit operates correctly.

45. Check RECR circuit is operating correctly.

46. Test insulation and continuity of tail and lineside cables.

47. Observe the passage of a train on both the up and down lines and confirm that the crossing functions correctly.

48. If no cause is apparent after these checks, advise your SM(S) and seek type specific fault-finding information from available sources. Also consider the fitting of a data logger.

END

Includes:	Manually Controlled Barriers
Excludes:	AHBCs, ABCLs, Suspected WSF

GENERAL

Barrier failure is a common cause of reported signal failures. This Test Guide gives you guidance on the checks and tests required in the event of one or more barriers failing to lower/raise.

If one or more barriers fail to lower and the crossing protecting signals can be cleared, the failure shall be regarded as a WRONG SIDE FAILURE and shall be investigated using the correct Test Guide(s) from the T series.

Signal Box and Signaller Checks

1. Check with the Signaller and/or infrastructure fault control whether the equipment affected has shown a similar failure characteristic prior to this fault.

2. Check that no work has been recently completed in the area (e.g. stagework).

Barrier Operation

3. Ask the Signaller to operate the barriers.

If the crossing equipment operates correctly, observe the following:

a) The time taken for barriers to raise and lower (any particular barrier slower than the others).

b) Erratic operation of a barrier.

c) Loose or obstructed barrier fittings.

d) Movement of the level crossing pedestal or base.

e) Correct damping of the boom during the last 10 degrees.

f) Arcing contacts.

If the crossing equipment fails to operate correctly, the fault is within the level crossing control circuit.

4. Check whether a data logger or remote condition monitoring is fitted. If it is, check what information is available regarding the current failure? (In SSI areas, check Technician's Terminal).

Power Supply

5. Measure the battery voltage during the lower and rise cycle.

   Is the battery charger power on?

   The Voltage during operation should be in the region of 20V to 24V, depending on the type of battery.

   When the barrier has raised, the battery charger should bring the battery voltage back up to 26V to 29V.

6. Test the battery under load with the power off.

7. Check the 24V standby battery for both electrolyte level and condition.

For each Barrier Pedestal and boom

8. Check that nothing is obstructing the operation of the boom, skirt, side arm or counterweights.

9. Check the boom counterweights are correctly adjusted and secure.

10. Examine internal wiring and terminations.

    NOTE: *Look particularly for loose terminations and connectors.*

11. Test the continuity of the (BOOM)CR circuit wiring and its connectors.

    If this is the cause, you may temporarily strap out the faulty section. You shall report this to you SM(S).

12. Check Local Control Unit for signs of tampering or forced entry.

13. Test the operation and continuity of the pedestal door micro-switches.

14. Check the circuit controller linkage is correctly fitted and has not excessively worn.

15. Examine the circuit controller contacts. Look for the following:

    a) Out of adjustment contacts.

    b) Loose or worn contacts and springs.

    c) Metallic dust.

    d) Moisture or contamination.

    e) Damaged wiring or loose terminations.

16. Measure the resistance of the contacts in the closed position.

17. Check the pump unit. Look for signs of:

    a) Low hydraulic fluid.

    b) Fluid leakage around hoses, joints and rams.

18. Check the pedestal mounting bolts and fixings.

19. Check the motor brushes and commutators are in good order and free from dust.

20. Measure the voltage and current at the motor during operation.

Hand Pump (BR843)

21. Hand pump each barrier to the raised position.

    NOTE: *The barriers should not drop between each pump.*

22. Lift the pump handle and check that the barrier lowers. When you release the handle, check that the barrier motion stops.

23. Check the shock absorber cannot be depressed by more than 3mm by finger pressure.

24. Check the operator's door micro-switch, wiring and terminations.

    Make sure that when you turn the key, the Yale lock is fully operated.

Barrier Location or Equipment Room

25. Carry out, NR/SMS/Test/PartB/052 (Dynamic Earth Tests).

26. Carry out, NR/SMS/Test/PartB/019 (Detection Loop Test).

27. Check the security of electrical terminations (including internal and tail cable connections).

28. Check the security of back nuts on terminal blocks.

29. Check that fuses and links are clean and secure within their holders.

30. Measure incoming and outgoing line circuit voltages and remote-control system levels.

    NOTE: *This might identify a problem in the line circuits. Consider repeating this test at the interlocking end of the circuit.*

31. Examine the control and detection relays and their bases.

    Confirm that the relay retaining clip is fitted and that the relay spades are secure.

32. Check the condition of control, timer, indication and proving relays (for burnt contacts, condensation, silver migration, etc.).

33. Check for signs of overheating (touch/smell) in supply T/Js, control, timer, indication and proving relays.

34. Check that the RECR circuit is operating correctly.

35. Test the insulation and continuity of tail and lineside cables.

36. Observe the passage of the train and check the crossing functions correctly.

37. If no cause is apparent after these checks, advise your SM(S) and seek type specific fault-finding information from available sources; also consider the fitting of a data logger.

END