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Level 2

The Verification and Validation of Relay Based Interlockings

Endorsement and Authorisation

For endorsement, authorisation and issue record of this document, please refer to NR/L2/SIG/30014

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Issue record

Issue	Date	Comments
01	March 2010	Initial Issue
02	September 2014	Re-issued for relay based interlockings only. Electronic interlockings now detailed in F210.

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 7 March 2015.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

Reference documentation

NR/L2/SIG/11201	Signalling Design Handbook
NR/L2/SIG/30014	Signalling Works Testing Handbook
NR/L2/SIG/30014/A100	Selection of Standards for Signalling Testing
NR/L2/SIG/30014/A110	Signalling Works Testing
NR/L2/SIG/30014/B410	Signalling Works Testing Staff Competence Assessment
NR/L2/SIG/30014/C120/TP01	Test Plan form
NR/L2/SIG/30014/C310	Test Certificates and Check Marking and Recording on Test Copies
NR/L2/SIG/30014/E110	Signalling Works Testing Glossary

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1 Purpose

This document is part of the suite of documents contained within the Signalling Works Testing Handbook, NR/L2/SIG/30014, which together detail the requirements for signalling works testing activities.

The document NR/L2/SIG/30014/D120/TS11-01 “Test Specification for Control Tables and Principles Testing” references this document specifically for Relay Based Interlockings.

This Level 2 document sets out the requirements for the Verification and Validation of Relay Based Interlockings to be used during signalling works testing. It has been produced as a “best practice” relating specifically to Route Relay Interlocking. Testing of other types of Relay Based Interlocking may vary.

2 Scope

This Level 2 standard applies to work that meets the selection criteria for NR/L2/SIG/30014/A110 or NR/L2/SIG/30014/A210 as defined in NR/L2/SIG/30014/A100.

3 Flowchart

None

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4 Procedure

4.1 Control Table Testing

Where the Principles Tester has been involved in the development of the interlocking and control system data over several iterations, this could compromise the independence of his position. To confirm this is prevented, a second principles tester shall review the involvement of the original Principles Tester to determine whether his independence has been compromised.

Preparatory Notes:

It is essential when testing Route Interlocking Controls (particularly point controls) to confirm that approach locking or other controls do not mask the tests. In such cases or where any doubt exists measures should be taken to prevent the signal for the route under test becoming approach locked.

The Control Table Test verifies the correct inclusion of the safety-critical and safety-related controls required in the Interlocking system under test. It is imperative that the testing of the one is not masked by the other. For example: where the safety Interlocking system controls are operated from and indicated into the Operators Signalling Display facility via an electronic interface (e.g. ERSE, Panel Processor etc.), such interfaces often include non-safety electronic processing between the operating display facility and the Safety interlocking. It is essential in systems using these interfaces that the electronic processing is bypassed or removed during the Control Table test, since the electronic processing often duplicates the safety interlocking and may compromise the integrity of the testing.

4.1.1 Point Interlocking Controls

4.1.1.1 Preparation

In order to simplify the test of Point Interlocking Controls the anti pre-selection feature may be made ineffective where the interlocking design permits this to be easily achieved although it is not essential to do so. Removal of the anti pre-selection enables a call to move locked points to be made and stored such that the points should move to the called position immediately they become free.

For interlocking systems which do not allow the simple removal of anti pre-selection controls, it may be necessary to key the locked points after each phase of the interlocking test (remembering to allow sufficient time for the pre-selection to reset). In these circumstances the attempt to key the locked points should be repeated to double check that the points are not free.

4.1.1.2 Point to Point Locking

The following sequence of tests should be carried out to confirm that any point-to-point locking provided is effective:

- Operate points under test normal to reverse and back to normal to prove points are free to move.
- Move the locking points to the position required to apply lock to points under test.
- Check point under test is now locked.
- Move the locking points back to original position.
- Check that the point under test is now free and operate into reverse position.
- Test similarly for converse if it applies, repeating the above commencing with points under test in reverse position.

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4.1.1.3 Point Locking by Train Detection

The following sequence of tests should be carried out to confirm that the points are locked when required by the separate occupation / operation of the direct and foul track circuits or other train detection devices. This test applies equally to points in an overlap. The test should check that the overlap hinge points do not swing with the track circuit occupied over these overlap points, also with any foul track circuits to the overlap being occupied or any other track circuits that could cause the signal to be replaced, such as those provided in overrun controls:

- Operate points under test normal to reverse and back to normal to prove points are free to move.
- Occupy / Operate track circuit or train detection device.
- Check that the points under test are locked and observe points remain in normal position by placing and retaining the key in the reverse position.
- Clear track circuit or train detection device.
- If anti pre-selection has been disabled then points under test should immediately move to reverse position.
- If anti pre-selection is operational points under test should remain normal with key in reverse position. To verify points are free in this case, move key to centre position, pause to allow anti pre-selection to reset, then move key back to reverse position and observe points move reverse.
- Test similarly if the converse applies repeating above commencing with points under test in reverse position.

The above tests should be repeated separately for both normal to reverse and reverse to normal locking of points under test for each specified track circuit and train detection device.

4.1.1.4 Point Direct Locking by Setting of Signalled Route

Tests should be made to confirm that every signalled route reading over the points under test when set directly locks the points in the position required for the set route.

The following tests covering all points in the route should be carried out with the interlocking fully operational and no routes set and all point keys in the centre (free) position:

- Set all points in the route (including overlap) to the position opposite to that required for the route to be set, returning the key to centre position to leave the points free.
- Set the route and confirm all the points in the route (including overlap) move to the position required by the route and opposite to that set above.
- Check that all the points in the route that moved above are now locked by keying each one to the opposite position and observe that they do not move.

The above tests should reveal any timing problems that may exist with the setting of the route. (With all points in the route requiring to be moved, the maximum time to complete the setting of the route will be taken).

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Tests should be carried out separately on each set of points in the route to confirm that the route set directly locks the points (i.e. the points are locked whenever the route is not proved normal/unset).

Some Route Relay Interlocking Systems apply both direct route locking and maintained route locking to the points when the route is set. In such cases action should be taken to remove the maintained route locking from the points in systems where this can be easily achieved in order to maintain the integrity of the testing of the direct locking.

For systems where the maintained route locking can be removed the following tests should be carried out to verify the route direct locking of points:

- With no routes set and all point keys in centre position operate the set of points in the route to be tested normal to reverse and back to normal to prove they are free to move.
- Set the route and check that the points under test are now locked by applying a call to the opposite position using the point key.
- Remove the maintained route locking by falsely energising the first route stick relay of the cascade associated with the first track circuit in the route ahead of the entrance signal. Observation that the route lights for the set route have extinguished on the signalling display system verifies that the false energisation has been correctly applied.
- Confirm that the points under test are still locked by applying a call to the opposite position using the point key.
- Cancel the set route by pulling the entrance button and check route has returned to normal and is not approach locked.
- Check that the points under test are now free by applying a call to the opposite position using the point key. Observe points move and place key in centre position.
- Set again the same route as used above, observe the route sets by checking points under test move to correspond with the position required by route. (Note the route lights do not illuminate when route is reset.)
- Remove the false energisation of first route stick relay applied above and observe that the route lights illuminate for set route.

Carry out above test sequence separately for each set of points required by the set route, including trailing points in the overlap.

For Relay Interlocking systems where the maintained route locking cannot easily be removed by false energisation or where the design makes such removal inappropriate, the existence of the direct locking should be verified by examination of the circuit design details.

4.1.1.5 Point Maintained Locking by Setting of Signalled Route

Tests should be made to confirm that:

- All points in a signalled route are maintained locked after the train has entered the signalled route and the direct locking has been removed by the route having been returned to normal (e.g. Signaller cancelling the route by pulling the entrance button or by ‘TORR’ facility automatic normalisation).

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- The points are maintained locked until the train has passed clear of the points.
- The section of route over the points releases and the points become free immediately the train has passed clear.

It is essential to confirm by a positive check that the set route has been returned to normal before commencing the testing of the maintained locking. This confirms that where the approach locking had been applied when the signalled route was set it has been returned to normal.

The following tests should be carried out to verify the route maintained locking of points.

- With no routes set and all point keys in centre position operate the points to be tested normal to reverse and back to normal to prove they are free to move.
- Set the route and check that the points under test are now locked by applying a call to the opposite position using the point key. Leave point key in the position applying the call if the anti pre-selection is disabled, or place point key in centre if the anti pre-selection is operational.
- Occupy the first track circuit beyond the entrance signal to simulate a train moving through the set route.
- Cancel the set route by pulling the entrance button and check the route has normalised.
- Check points under test have not moved to correspond with call on point key (anti pre-selection disabled) or call points to opposite position using key and check points are locked then place key back to centre position (anti pre-selection operational).
- Occupy the next track circuit in the direction of the set route and then clear the previously occupied track circuit. (Note: to confirm the validity of this test it is essential to maintain continuously a track circuit occupied in the route throughout this test until the simulated train movement has passed clear of the points under test).
- Repeat the last three tests detailed above for each separately occupied track circuit in the direction of the set route as far as the track circuit for the section of route containing the points under test.

When carrying out the tests for the track circuit through the points under test it is essential to confirm that the point maintained locking is carried through to include this track circuit. Confirm that the maintained locking of the points is not masked by the direct locking by the occupied state of the points track circuit. This can be achieved simply by applying a shorting strap across the direct track circuit contact in the point lock circuit for the duration of this test only.

When the above series of tests for each track circuit in the route reaches the stage where the points track circuit is cleared, confirm that the points under test are now free. Either the points should move immediately to the opposite position (anti pre-selection disabled) or the points can be moved to the opposite position using the point key (anti pre-selection operational).

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Tests should also be made where required to confirm that the points under test are only route locked and not directly locked by the track circuits between the entrance signal and the points track circuit of the set route. This is verified by the following series of tests:

- With the signalled route not set, for the above point maintained locking tests, check the points under test are free to move using the point key. Return point key to centre position.
- Occupy each track circuit separately between the entrance signal and, but not including, the track circuit through the points under test.
- Confirm for each separate track circuit occupation as above the points are not locked by use of the key and observe the points are free and move when operated.

The above series of tests for maintained locking should be repeated for each set of points required by the signalled route including trailing points in the overlap.

If a preset / preceding shunt position light signal is present in the set route, it is essential that this signal is prevented from clearing throughout all the above detailed point maintained locking tests. Also throughout these tests attempts should be made to check that the preset route cannot be cancelled (by pulling up the preset shunt entrance button) and that any points in that route cannot become free.

Maintained locking of trailing points in the overlap of the set route should be tested exactly in accordance with the above. Additionally, tests should be carried out to confirm such locking of trailing points is released when the train passing through the route is proved to be at a stand at the exit signal at red. Such proof is usually achieved by occupation of the berth track circuit of the exit signal for a time period determined from the length of the berth track circuit and stated in the control tables.

The following requirements should be proved before locked trailing points in the overlap become free:

- The berth track circuit of the exit signal at red has been occupied for the time stated in the Control Tables.
- The set route up to the exit signal at red has been returned to normal (by signaller cancelling the route by pulling entrance button or by ‘TORR’ facility having operated).
- All track circuits in the overlap of the set route are clear.
- All track circuits between the entrance signal and the occupied berth track circuit at the exit signal for the set route are clear (no long train facilities provided – i.e. berth track circuit of exit signal is of a greater length than the longest train operated).

or

- Where ‘long train overlap release’ facilities are provided, the conditions for such release are present as stated in the control tables.

*It is necessary to provide **Long Train Overlap Release** facilities in the following situations:*

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- *When the exit signal berth track circuit is shorter than the maximum length of train operated plus 30 yards to allow for the train stopping short of the signal post.*
- *When the entrance and exit signals of the route are closely spaced such that the maximum length train, when at a stand at the exit signal at red, does not clear the track circuits at the entrance signal that permit the route to normalise. Without these track circuits clear the set route should not return to normal when the entrance signal button is pulled. This would prevent the release of the route locking of the overlap trailing points when the train had timed to stand at the exit signal.*
- *The 'long train overlap release' provision allows for further track circuit(s) to be occupied in rear of the exit signal short berth track.*

For closely spaced entrance and exit signals the 'long train overlap release' provision enables the approach locking to be specially released on the entrance signal after the berth track circuit of the exit signal has been occupied the time required to bring the train to a stand and all track circuits are occupied between and including the entrance signal approach locking release track and the exit signal berth track.

Long train overlap release provision should be provided only as stated in the approved Control Tables.

The provision should only be made to those routes where it is necessary to permit operating flexibility and extended to the minimum required to cater for the longest train permitted to operate over the line of route.

Where 'time released overlaps' are provided a further test should be made to confirm that the release of the overlap does not occur if the train enters the overlap passing the exit signal at red. This is particularly important where the overlap consists of more than one track circuit and where the overlap trailing points are not within the first track circuit beyond the exit signal.

4.1.1.6 Time of Operation Locking of Facing Points

This point locking occurs where facing points exist in a main signal route overlap a short distance in advance of the exit signal. Where such points exist within the defined distance tests should be made to confirm these facing points are locked in either position when the exit signal berth track circuit is occupied by a train approaching that signal at red.

Such point locking is called 'Time of Operation Locking' and is included to prevent a train overrunning the red exit signal reaching the points in mid-position when called to move.

Time of Operation Locking should not be applied when shunt, calling-on or 'Warning' class routes are set up to the protecting signal.

The period of time that the berth track circuit shall be continuously occupied before the facing points become free should be as specified in the Control Tables.

Verification of 'Time of Operation' locking on facing points should be made by carrying out the following series of tests:

- Confirm the facing points are free when no signalled route up to the exit signal is set and the berth track circuit of that signal is occupied.
- Set a main route up to the exit signal and check facing points remain free.
- Simulate passage of train through the set route and check that the facing points remain free for separate occupation of each track circuit up to but excluding the berth track circuit of the exit signal.
- Check that the facing points become locked immediately the exit signal berth track circuit becomes occupied and remain locked with only that track circuit occupied.

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- Check that the facing points do not become free until the specified time occupation of the berth track circuit has elapsed.
- Repeat the above series of tests for the same facing points to verify the lock preventing the points being moved to the opposite position to that used initially.

The above tests should be separately repeated for all other main routes reading up to the exit signal protecting facing points in the overlap to which time of operation locking is applied.

Routes reading up to the exit signal which are not main routes (e.g. shunt, calling-on or Warning class) should also be set and similar tests carried out as above to verify that these routes do **not** apply time of operation locking of the overlap facing points.

4.1.1.7 Special Controls – Locking of Points Not Directly in the Route

Special controls should be included to lock points that are not directly in the line of the set route to provide the following:

- Overrun Protection by point setting.
- Operating flexibility to permit the setting of parallel moves (e.g. through points which are directly locked by an occupied track circuit in the set route and would be prevented from moving to the position required by the permitted parallel route. Such points should be set to and locked in that position by the set route).

Tests should be carried out to confirm that **all** the required special setting and locking of points outside the line of the route is included to provide the above protection and flexibility.

4.1.1.8 Self-Restored Point Controls

Tests should be made to confirm points fitted with self restoration controls automatically revert to the designated position when the specified restoration conditions as stated in the Control Tables apply correctly.

The tests carried out should confirm self restored points only drive automatically to the designated position whenever all the following conditions apply:

- The points are not lying detected in the designated position.
- The points are free of locking.
- The specified required time has elapsed since the points became free.

For points where the designated self restored position is Normal, the following tests should be carried out to confirm that:

- After a signal has cleared, the train runs over the points but the route fails to TORR, the route lights are flashing (try for all routes)
- The track circuits that inhibit the flashing indications do not prime the indications to start for another route (train should traverse the points to initiative flashing)
- The points have auto normalised but failed to detect normal

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- Following keying the points reverse, break normal detection, key points normal, there is no flashing indication
- The flashing indication is inhibited when 15 second bobbing protection is in place if going onto an untracked line

Indications may have to be inhibited depending on what the TORR conditions are.

- If flashing starts, it can only be stopped by normal detection being made or
- Points route locked reverse
- Points should auto normalise when free after 10 seconds but should move immediately if held by 15 second bobbing protection when a train runs onto an untracked line
- Points should auto normalise if keyed normal & lying reverse
- If points are keyed normal before auto normalising starts (within 10 seconds) if detection fails to make normal, the flashing indication is inhibited

Similar tests would be required if the designated self restored position was Reverse.

For points not fitted with automatic self restoration which are required to be manually restored to and maintained normal for trapping protection, tests should be made to confirm the necessary indications and alarms (where provided) operate to alert the signaller to set the points to the normal position whenever all the same three conditions have been regained after use as detailed above for automatic self restored points.

4.1.1.9 Anti Pre-selection of Points

If the above detailed Point Interlocking Controls have been tested with the Anti pre-selection feature made ineffective, this control should now be restored and tested.

If the above detailed point controls have been tested with the Anti pre-selection feature effective, using point key operation from the centre position throughout, then the foregoing tests should have verified the anti pre-selection.

The following sequence of tests should be carried out to confirm that the Point Anti pre-selection controls are effective for calling for movements from normal to reverse:

- Operate points under test normal to reverse and back to normal using the key to prove the points are free to move.
- Leave point key in centre with points in normal position.
- Occupy/operate track circuit or train detection device that directly locks the points.
- Operate the point key to the reverse position – check points do not move and leave key reverse.
- Clear track circuit or train detection device – check points still have not moved and are normal.
- Operate the point key from reverse to the centre position and check points remain normal.

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- After pausing with key centre (to allow sufficient time for anti pre-selection to reset) operate key to reverse position.
- Check points have moved to reverse position.

The above sequence of tests should be repeated commencing with the point key in centre and points under test in the reverse position. This tests that the anti pre-selection is similarly effective for the movement of the points from reverse to normal.

4.1.1.10 Route Setting and Locking by Points

Points should apply a lock to a signal route to prevent that route from setting unless the points are lying in the required position or free to move to that position.

Signal routes when setting should apply a call to all points required by that route (including those in the overlap and those set for overrun protection and operating flexibility) to move them to the required position when they are free and lying in the position opposite to that required by the route.

The following sequence of tests should be carried out to verify the points lock against the signal route and the calling of the points by the route setting (the tests should be applied separately to each set of points in the route under test):

- Set points under test to the opposite position to that required by the signal route and lock them in this position using point key.
- Set all other points required by the signal route into the correct position using point keys and place all keys in the centre (unlocked) position.
- Try the signal route and check it does not set. (Repeat this attempt to confirm route call is registered and is prevented from setting by points under test being locked in the opposite position to that required by route).
- Remove lock on points by placing key to centre position, leaving the points lying in opposite position to that required.
- Try the signal route and check that the route calls the points under test to the correct position required by the route. Confirm that the signal route fully sets.
- Cancel the signal route and check points under tests are now free.
- Lock the points on the key in the position required for the route under test.
- Try the route again and confirm it sets fully with the points under test already in the correct position and locked.

The above sequence of tests should be separately repeated for each set of points required by the signal route under test.

It is essential to confirm the above tests check the lock applied by the points to the signal route in the fail-safe interlocking circuitry and that the test is not masked by any non-fail safe switch/button proving circuitry included in the interlocking design.

- In some interlockings this can be achieved by carrying out the following checks on each set of points in the signal route separately:
- Key the points under test to the position opposite to that required by the signal route.

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- Turn the points key to the position required by the route faster than the interlocking can follow.
- Check the points have not moved by observing that the indicated and key positions do not correspond.
- Try the signal route and confirm that it does not set. (This try should be repeated to confirm the route call registered and the points are applying a lock on the signal route).
- Key the points to the position required by the signal route.
- Turn the points key to the opposite position faster than the interlocking can follow.
- Check the points have not moved by observing that the indicated and key position does not correspond.
- Try the signal route and confirm that it does now fully set.
- Return point key to the centre position.

For Relay Interlocking systems where the maintained route locking cannot be removed easily by false energisation or where the design makes such removal inappropriate, the existence of the direct locking should be verified by examination of the circuit design details.

4.1.1.11 Incorrect Route Calling of Points

A check should be carried out to confirm that points are called to operate only by routes that require them set to the position called.

During the testing of each signal route verification should be made to confirm that the route when set only calls points to operate as required by the control tables.

The following sequence of checks should be carried out to confirm that the route under test does not incorrectly call any points to move in addition to those required:

- With no routes set, key all points in the interlocking area to the reverse position – returning all point keys to the centre position. *Note: beware of any self normalising points.*
- Set the route under test.
- Check that the points now set and indicating normal are only those required normal by the set route.
- Cancel the route under test.
- Key all points in the interlocking area to the normal position – returning all point keys to the centre position.
- Set the route under test.
- Check that the points now set and indicating reverse are only those required reverse by the set route.
- Cancel the route under test.

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Often called the “Rogue points call” test and can have limited value where conditional calls are present. It may be necessary to carry out a check of the diagrams to confirm that there are no conditional calls present. In situations where it is not feasible to operate all points in the interlocking, a check of the diagrams shall be necessary.

4.1.2 Signal Route Interlocking Controls

4.1.2.1 Route to Route Class Locking

Where different classes of route to the same destination exist from a signal, tests should be made to confirm that locking is present to permit only one route to be set to a particular destination at any one time.

For example, if the shunt class route is set on a signal, the main class route cannot be set from that signal to the same destination until the shunt class route has been fully returned to normal.

In order to test that this route to route locking is present for a signal it is necessary to prevent the route fully normalising when cancelled. Checks should then be made to confirm that no other route of a different class to the same destination can be set from the signal.

In some interlocking systems employing Normal and Reverse Lock relays (NLR/RLR) preventing the route fully normalising can be achieved by momentarily pulling the entrance button that de-energises the RLR but does not allow the NLR to energise. These conditions have been obtained when the signal aspect has been replaced and the route remains (route lights stay energised). Other class routes to the same destination should not set until the initial route has been fully normalised by properly pulling the entrance button.

An alternative method of achieving the prevention of full route normalisation for other types of interlocking systems is to Approach Lock the initial route set before pulling the entrance button. During the period before the Approach Locking has time released, attempt to set the other route(s) from the signal to the same destination as the route set initially. Confirm the routes do not set until the initial route has time released and fully normalised.

It is essential when trying to set the other route(s) that all the required conditions for these routes are selected such as correct track circuit(s) occupation and appropriate exit button operation.

4.1.2.2 Selection of Class of Signal Route

4.1.2.2.1 Selection of Signal Route Class - General

In order to meet the requirements of Operating Specifications it may be necessary to provide different classes of route from a specific entrance signal to the same destination signal.

Signal Route Class Selection falls into two categories:

- Main or Calling-on Route Class dependent on train occupation of a permitted permissive section of the route.
- Main or Warning Route Class dependent on overlap selected.

4.1.2.2.2 Circuit Selection of Main or Calling-on Route Class

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The class of route (Main or Calling-on) is established at the time of setting dependent on the state of the track circuit(s) in the section of route where permissive working is authorised.

Tests should be carried out to confirm that:

- The signal for a Calling-on route is not replaced by clearing the 'permissive track circuits'.
- The permissive working section track circuit(s) are only those specified in the approved Control Tables.
- The Route Class established obeys the state of all the track circuits in the route **at time of setting** as follows:

Main Class set – All permissive working section track circuits clear.

Calling-on Class set – A track circuit occupied in the permissive working section.

Once a Calling-on Class route has been established the state of the route set cannot be changed by subsequent clearance of all the permissive working section track circuits (i.e. the set calling-on route does not automatically change state to a main class route).

- Similarly, once a Main Class route has been established the status of the route set cannot be changed by subsequent occupation of a permissive working section track circuit (i.e. the set main class route does not automatically change to a calling-on class route).

Where a signal has a main and calling-on route to the same destination tests should be made to verify that a set calling-on class route cannot be changed to a main class (or vice versa) unless the initial route class set is cancelled and fully normalised and the route set again. The class of route should then be established in accordance with the state of the permissive working section track circuits at the time of re-setting.

4.1.2.2.3 Main or Warning Class Route Selection

A Warning class route is similar to a Main Class route but has a restricted overlap. The signal aspect for a Warning class route is delayed clearing to yellow from red until the berth track circuit has been occupied for the required time.

The class of route (Main or Warning) is established by operation of the appropriate route exit function for either a Main Class (Full Overlap) or Warning Class (Restricted Overlap. Tests should be carried out to verify that only the correct route class is established for the exit function operated.

4.1.2.2.4 Stepping Up of Warning Route to Main Route

Where a 'Warning Class' route facility exists, tests should be made to confirm that the 'Warning' route steps up to a Main route whenever a forward route is set on the exit signal providing a full overlap for the initial 'Warning' class route set.

A check on the 'stepped-up' route should be made to confirm that:

- The delayed yellow control has been released.
- The full overlap is locked and maintained when the forward route set ahead of the exit signal is cancelled and fully normalised.

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With the 'Warning' class route under test set and no forward route set on the exit signal a check should be made to confirm the portion of the full overlap ahead of the restricted overlap limit is free of all locking.

With the 'Warning' class route under test **not** set, select and set a forward main route ahead of the Warning class route (i.e. set a main route from the exit signal of the warning route). Now set the warning route under test (using the correct warning exit function) and check that immediately upon setting the warning route set has stepped up to a main class route. This is verified by cancelling the forward route initially set from the exit signal and (when this route has fully returned to normal) observing that the warning route set has a locked full overlap. This proves that the warning route has 'stepped up' to a main route and maintained the 'Main' status even though the set forward route that caused the step up in status has been cancelled/normalised.

If the controlled signal (on which 'Main' and 'Warning' class routes exist) is equipped with an individual automatic working facility which applies to the warning class route and it is set to work in automatic mode for that route then it shall step up to a main route whenever a full overlap is provided by the forward route setting as specified above. Tests should be made to verify this as above with the warning route set in automatic mode.

In addition a further test should be made to confirm that the warning route set in auto-working mode **steps down** to warning class only, after the passage of each train, with it in a 'stepped up' to main class state. This is because the forward route set for the passing train had provided the warning route with a full overlap state. A check should be made to confirm the 'stepped down' warning class state is retained when the forward route is not set again after the passage of the train. Observations should be made to confirm when the forward route is not set again that the route stepped down to warning class status has the delayed yellow control re-applied and only a locked restricted overlap displayed.

A check on the stepped up route should be made to confirm:

- The main route to be available - not barred by technician's control.
- The signal is at red and has not been off as a D/Y - i.e. still free of approach locking.
- It has to be ready to clear - i.e. all aspect controls including foul conditions available except trip (so that a train in the route with the exit off prevents the route stepping up).
- The additional overlap controls required by a main aspect have to be clear.
- A route should be set from the exit & the exit signal stick should be set.

On stepping up:

- The new limits for the overlap should be set (note if this can swing each forward route should be functioned to correspond new overlaps limits).
- Additional aspect controls have to be tested.
- Test full O/L is not held by warning route set in rear.
- Test full O/L is timed off leaving ROL with Warning in rear after Main route.

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Aspect sequence:

- A warning route should have a full aspect sequence relative to the condition of the exit, but on aspects better than yellow will not have additional aspect controls required by the main route overlap.

Automatic working:

- A warning route on auto should work similar to the main in that all the aspect controls are in except the stick.
- On auto the warning should step up to a main, if the conditions are correct and then step down following the passage of a train (i.e. the warning route reselected on “TISP”).
- If auto working is selected after the route has stepped from warning to main, the signal should continue to work on main until cancelled.

4.1.2.3 Directly Opposing Route Locking

4.1.2.3.1 Directly Opposing Route - Definition

A ‘directly opposing route’ to the route under test is a route which:

- *Applies in direct opposition to and along the line of the route under test*

  OR

- *Applies in direct conflict in the same direction along the line of route under test (e.g. a shunt signal in advance of the main signal capable of acting as an Independent or Facing Shunt)*

  AND

- *When set would not require any points to be lying in the position opposite to that required by the route under test.*

4.1.2.3.2 Directly Opposing Route Direct Locking

The following sequence of checks should be made to confirm that any directly opposing routes (as defined above) directly lock the route under test.

In the test procedures below, when attempts are made to set the route under test against the already set Directly Opposing route, it should be verified that the attempt to set the route under test has correctly registered. Where this is not possible, it is recommended that each attempt to set the route under test should be repeated.

Where the interlocking design includes route anti pre-selection circuitry (e.g. ‘DJR hold’ facility) this feature may be used to establish a request that continuously tries to set the route under test. Repeated route setting attempts are thus not required.

Prevent the aspect clearing on the entrance signal of the directly opposing route to be tested. This is to confirm the directly opposing route does not become approach locked that would mask the verification of the presence of the direct locking.

Set the Directly Opposing route.

Attempt to set the route under test and verify that it is locked.

Remove the route locking applied by the Directly Opposing route to the route under test by falsely energising the first route stick relay of the cascade associated with the first track circuit ahead of the entrance signal of the

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directly opposing route. Observation that the route lights for the directly opposing route have extinguished on the signalling display system verifies that the false energisation has been applied correctly.

Attempt to set the route under test and verify that it remains locked.

Cancel the directly opposing route by pulling the entrance button and observe that the route is fully normalised.

Set the route under test and verify that it does now set.

Cancel the route under test.

Set the directly opposing route again and note that no route lights illuminate.

Remove the false energisation applied to the first route stick relay above and observe that the route lights illuminate for the directly opposing route.

Cancel the directly opposing route and then reinstate the aspect clearing.

Repeat the above sequence of tests for each Directly Opposing route.

For Relay Interlocking Systems where the route locking cannot be easily removed by false energisation or where the design makes such removal inappropriate, the existence of the direct locking of the opposing routes should be verified by examination of the circuit design details.

4.1.2.3.3 Directly Opposing Route Maintained Locking

Tests should be made to confirm that the lock applied to the route under test by a Directly Opposing route is maintained by the route locking when the train passes into the Directly Opposing route and the Direct Locking has been removed. The Direct Locking is removed when the Directly Opposing Route has been cancelled and fully normalised after the complete train has entered the Directly Opposing Route and passed clear of the entrance signal.

The following sequence of checks should be made to confirm that the route locking of the Directly Opposing route maintains a lock on the route under test until the train movement passing through has moved clear of the entrance signal of the route under test or where applicable has timed to a stand.

Repeating the attempts to set the route under test (to guard against failure of the entrance circuitry to register) and use of the route anti pre-selection circuitry should be utilised, as detailed at the beginning of 4.1.2.3.2.

- Prevent the aspect clearing on the entrance signal of the Directly Opposing route (to confirm any Approach Locking does not mask verification of these tests as detailed in 4.1.2.3.2).
- Set the Directly Opposing route
- Attempt to set the route under test and verify that it is locked
- Occupy the first track circuit beyond the entrance signal to simulate a train moving through the set route (i.e. the Directly Opposing route)
- Cancel the set route by pulling the entrance button and check positively that the route has normalised (to confirm Direct Locking removed)

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- Attempt to set the route under test and verify that it is maintained locked
- Occupy the next track circuit in the direction of the set route and then clear the previously occupied track circuit. *(Note: to confirm the validity of this test it is essential to continuously maintain a track circuit occupied in the route throughout the test until after the maintained lock has been released on the route under test)*
- Repeat the two tests detailed immediately above for each separately occupied track circuit in the direction of the set route up to and including the last track circuit before reaching the entrance signal of the route under test or before reaching the berth track circuit of the exit signal of the set route (whichever is reached first)
- When the simulated train movement through the set route reaches the entrance signal of the route under test first, the track circuit beyond the route entrance signal should be occupied, and the previously occupied track circuit in the set route cleared
- Try to set the route under test and check that this route now sets fully and the maintained lock applied to it by the set (i.e. Directly Opposing) route has correctly been released. (The route under test should have set immediately the track circuit in the above test was cleared if a stored request was present – Route Anti pre-selection removal facility used)
- Cancel the route under test by pulling its entrance button and verify that both routes are fully normalised
- When the simulated train movement through the set route reaches the berth track circuit at the exit signal first, occupy the berth track circuit and then clear the previously occupied track circuit in the set route
- Where the lock applied to the route under test **is released** after the simulated train movement through the set route has timed to a stand occupying the exit signal berth track circuit, verify the maintained lock applied to the route under test is not released until the berth track circuit has been occupied the specified time

The release of the maintained lock applied to the route under test after elapse of the track circuit occupation time is indicated by the extinction of the overlap route lights (for set routes which have overlaps).

Further tests should be made to confirm that the maintained lock applied to the route under test and the overlap route locking of the set route does not release after the berth track circuit has been occupied the specified time unless the following conditions are all also satisfied:

- All track circuits in the overlap of the set route are clear (required to confirm the train movement timed to a stand at the exit signal of the set route has not passed that signal and entered the overlap)
- The Directly Opposing Route (the set route) has been fully returned to normal
- The sectional route locking of the set route has been released from the entrance signal up to and excluding the berth track circuit of the exit signal (where no long train facility is included)

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- Long train facilities may be provided where required and should be verified as specified in the control tables. The overlap route locking of the set route should release for trains timed to a stand at the exit signal which are longer than the berth track circuit by excluding proving clear the track circuit(s) in rear of the berth track circuit back towards the entrance signal of the set route as far as necessary to accommodate the maximum length train operated. (Reference should also be made to 4.1.1.5 notes on 'Long Train Overlap Release' facilities that similarly apply here)
- Where the lock applied to the route under test is not released after the simulated train movement through the set route has reached the berth track circuit of the exit signal, tests should be made to confirm that:
    - The lock applied to the route under test by the set route is not time released irrespective of the length of time the berth track circuit at the exit signal is occupied.
- Where the lock applied to the route under test is not released until the route locking of the set route is fully normal (i.e. the complete route including overlap has sectionally released with all track circuit sections clear).
- Repeat the above sequence of tests for each Directly Opposing route.

When the 'Maintained Locking' tests have been completed for all opposing routes, the Route Anti pre-selection removal facility (if available and used) should be reinstated and a test made to verify that unavailable routes cannot be pre-selected.

Further tests should be made to verify that the maintained lock applied to the route under test by the track circuits occupied above is genuine route locking (i.e. the track circuits occupied only apply the lock when a route is set). This is verified by the following series of tests:

- With the Directly Opposing route unset and verified normal.
- Occupy each track circuit separately in the direction of route from the entrance signal of the Directly Opposing route up to and including the last track circuit before the route under test entrance signal or the Directly Opposing route exit signal whichever is reached first.
- For each individually occupied track circuit confirm the route under test does set and is not directly locked by the occupied track circuit. (Cancel the route under test and verify the route has returned to normal before changing the occupied track circuit).

The above series of tests should be repeated for each Directly Opposing route which exists relative to the route under test.

4.1.2.4 Indirectly Opposing Route Locking

4.1.2.4.1 Indirectly Opposing Route Locking - Definition

An 'indirectly opposing route' to the route under test is a route which:

- Applies in the opposite direction to the route under test

  AND

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- When set does not 'directly oppose' the route under test because it requires at least one set of points in the opposite position to that required by the route under test

  AND

- When normalised, after a movement has entered the route and passed clear of and released from locking all points not set in the position required by the route under test, leaves the remaining route locked portion of the opposing route effectively 'directly opposing' the route under test as defined in 4.1.2.3.1.

4.1.2.4.2 Indirectly Opposing Route Maintained Locking

Tests should be made to confirm that the indirectly opposing route as defined above when set applies a lock on the route under test. This lock should be maintained by the directional route locking of the opposing route movement after it has passed clear of and released the locking of all points which for the opposing route were not set in the position required for the route under test.

The following sequence of checks should be made to confirm that the route under test is maintained locked by all the indirectly opposing routes which apply to it, until the opposing movement has passed clear of the entrance signal of the route under test or where applicable timed to a stand. (It should be noted that the complete sequence of tests to verify the maintained route locking should be carried out for a specific indirect opposing route, and then repeated separately for the other opposing routes where more than one such routes exist):

- Prevent the aspect clearing on the entrance signal of the selected indirectly opposing route (relative to the route under test) – to confirm any Approach Locking does not mask the verification of these tests as detailed in 4.1.2.3.2.
- Set the selected indirectly opposing route.
- Attempt to set the route under test and verify that it is locked.

Route Anti pre-selection removal facilities as described in 4.1.2.3.2 above should be used for this test where available – such a facility is an advantage for this maintained locking test as the stored request continuously trying to set the route under test removes the need to attempt twice to set this route at each stage of the test (i.e. for each position of the train moving through the route).

The remaining tests detailed below are written assuming no Route Anti pre-selection removal facility is available. When the instructions ask for an attempt to set the route under test to be made, two attempts should be made as detailed and for the reasons given in 4.2.3.2 above unless a stored call has been applied to the route under test.

- Occupy the first track circuit beyond the entrance signal of the selected indirectly opposing route to simulate a train moving through the route.
- Cancel the selected opposing route by pulling the entrance button and check positively that the route has returned to normal.
- Attempt to set the route under test and verify it remains locked.

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- Occupy the next track circuit in the direction of the selected indirectly opposing route and then clear the previously occupied track circuit. (Note: to confirm the validity of this test it is essential to continuously maintain a track circuit occupied in the set opposing route throughout the test until after the maintained lock applied to the route under test has been released.)
- Repeat the two tests detailed immediately above for each separately occupied track circuit in the direction of the selected indirectly opposing route up to and including the last track circuit before clearing the points set and locked by the set opposing route in the opposite position to that required by the route under test.
- When the simulated train movement clears the track circuit through and locking the above detailed points, these points should now be free. Before attempting to set the route under test the points should, immediately upon becoming free, be keyed to the opposite position (i.e. into the position required by the route under test). Return the points key to the centre / unlocked position.
- Now attempt to set the route under test and verify that it remains locked (by the Route Locking of the selected indirectly opposing route).
- Occupy the next track circuit in the direction of the selected opposing route and then clear the previously occupied track circuit.
- Attempt to set the route under test and verify it remains locked.
- Repeat the two tests detailed immediately above for each separately occupied track circuit continuing in the direction of the selected opposing route up to and including the last track circuit before reaching the entrance signal of the route under test or before reaching the berth track circuit of the exit signal of the selected opposing route (whichever is reached first).
- When the simulated train movement through the selected opposing route reaches the entrance signal of the route under test first, the track circuit in the set route beyond that entrance signal should be occupied, and the previously occupied track circuit cleared.
- Try to set the route under test and check that this route now fully sets and the maintained lock applied to it by the selected indirectly opposing route has correctly been released. (The route under test should have set immediately the track circuit in the above test was cleared if a stored request was present – Route Anti pre-selection removal facility used).
- When the simulated train movement through the selected opposing route reaches the berth track circuit of the exit signal first, occupy the berth track circuit and then clear the previously occupied track circuit in the opposing route.
- Attempt to set the route under test and verify it is still locked immediately after the berth track circuit is occupied.
- Where the lock applied to the route under test is released after the simulated train movement (through the set opposing route) has timed to a stand occupying the exit signal berth track circuit, verify the route locking of the set

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route is not released until the berth track circuit has been occupied the specified time. Note that the release of the route locking of the set opposing route after elapse of the track circuit occupation time is indicated by the extinction of the overlap route lights (for set routes which have overlaps).

- Further tests should be made to confirm that the route locking of the set opposing route (including the route locking of the overlap) does not release after the berth track circuit has been occupied the specified time unless the following conditions are all also satisfied:
- All track circuits in the overlap of the set route are clear (required to confirm the train movement timed to a stand at the exit signal of the set route has not passed that signal and entered the overlap).
- The set route (the selected indirectly opposing route initially set) has been fully returned to normal.
- The sectional route locking of the set route has been released from the entrance signal up to and excluding the berth track circuit of the exit signal (where no long train facility is included).
- Long train facilities may be provided where required and should be verified as specified in the control tables. The overlap route locking of the set route should release for a train timed to a stand at the exit signal which is longer than the berth track circuit by excluding proving clear the track circuit(s) in rear of the berth track circuit back towards the entrance signal of the set route as far as necessary to accommodate the maximum length train operated. (Reference should also be made to 4.1.1.5 notes on 'Long Train Overlap Release' facilities that similarly apply here.)
- Where the lock applied to the route under test is not released after the simulated train movement (through the set opposing route) has reached the berth track circuit of the exit signal tests should be made to confirm that:
- The lock applied to the route under test by the set opposing route is not time released – irrespective of the length of time the berth track circuit at the exit signal is occupied.
- The lock applied to the route under test is not released until the route locking of the set opposing route is fully normal (i.e. the complete route including overlap has sectionally released with all track circuit sections clear).

Reference should also be made to 4.1.2.3.3 notes on the 'Release of Route Locking' that similarly apply here.

4.1.2.5 Sectional Release of Route Locking

4.1.2.5.1 Standard Requirements for Sectional Route Locking Release

Tests should be carried out to confirm that each section of route locking of the set route (route under test) does not release until **all** the following conditions are satisfied:

- The set route has been cancelled and has returned fully normal.

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