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INSTITUTION OF RAILWAY SIGNAL ENGINEERS
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GUIDELINE ON

TESTING OF MECHANICAL LOCKING FRAMES

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Anyone who wishes to contribute additional items or correct / amend any of the entries or wants further information may contact the IRSE Minor Railways Section Guideline co-ordinator at mrsdc@irse.org or via the IRSE Headquarters.

Any railway seeking to follow the guidelines in this document should ensure that it is suitable for their particular railway concern. Duty holders are reminded that they must be satisfied that they are doing all that is needed under health and safety duties to control risks. Compliance with this guideline issued by the IRSE is not mandatory as it provides advice on how an issue may be addressed.

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1 INTRODUCTION

This document provides information on the best practice for the testing of mechanical locking frames

It is not intended to be a definitive document on how to test mechanical locking but to disseminate information on best practice. Where possible regional differences where ever possible have been omitted but this is not always possible.

The IRSE Minor Railways Section has used its best endeavours to ensure that the contents of this document are factually and technically correct and is suitable for its stated purpose but the IRSE Minor Railways Section cannot be liable for any subsequent use to which the document may be put.

2 DEFINITIONS

The following is a list of the more common definitions, a fuller description may be found in subsequent sections.
In this document terms relating to gender equally apply to the opposite.

Reference should also be made to the Minor Railways Section Glossary of Signalling and Telecommunications Terminology

B position	A lever that is placed between the Normal position and the mid position in the frame. Generally only provided when electrical point operation is in place or the signal is fitted with approach locking.
Back Lock	For the purposes of this guideline it is a mechanical lock that holds a lever in the reverse position. Also another description for a signal B position lock.
Back to Back Locking	A dead lock between two signals at either end of a section of railway that read away in opposite direction. Not always provided where regular splitting of trains occurs
Both ways lock	A lock that mechanically locks another lever in either the normal or reverse position, generally found between signals and points.
Bridle Irons	See Locking Bars
C position	A lever that is placed to the middle of the frame. Generally only provided on switching out levers or signal levers that operate signals in the normal and reverse positions.
Catch handle	A mechanical device attached to a lever which holds the lever in the correct position in the lever frame
Conditional Locking	Locking between two levers that is dependent on one or more other levers being in certain positions
D position	A lever that is placed to a position between the mid position and the reverse position. Generally only provided when electrical point operation is in place.
Dead lock	A mechanical lock where one lever locks another lever when operated.
Dog	A shaped mechanical device fitted into locking trays when connected together with bars interlock with the tappet to create the mechanical locking. Can also be known as Nibs. Can be made of cast Iron, Mild steel or Brass dependant on the manufacture of the lever frame
Dog Chart	A diagram depicting the mechanical locking giving details of all the dogs (or Nibs) and connecting bars. Can also be known as a locking chart

Lever Leads	Can also be known as Pull Plates. A plate fitted on or near the lever giving a description of the function controlled from the lever and what other levers need to be operated to allow the lever to be operated.
Locking Bars	Bars provided in the locking trays to connect dogs (or interlocking nibs) together. There can be up to five bars per locking channel
Locking Channels	A position in the locking tray where the locking bars are fitted. There can be a number of channels per locking tray dependant on the type of frame.
Locking Table	A document that specifies the locking to be applied between levers
Locking Tray	A tray containing all the mechanical locking including the locking bars, dogs (or nibs) and tappets. There can be more than one locking tray dependant on the size and type of frame
Maintenance Testing	Where a locking frame is routinely tested to ensure that the existing locking is still valid and NO alterations, including the removal of redundant locking, is undertaken.
New Works Testing	Where either a new locking frame is provided OR where alterations have been undertaken to part of an existing locking frame.
Nibs	Another name for Dog (see above). Nibs can be fixed (i.e. connected directly to the locking bar) or have a shell where the stud on the locking bar engages.
Normal	The normal position for the lever, generally away from the signalman at the back of a locking frame irrespective of function.
Notch	A cut-out in the tappet to accept a locking dog or nib. Can also be known as a Port.
Object Lever	The lever under test.
Port	A cut-out in the tappet to accept a locking dog or nib. Can also be known as a Notch
Race	A slot cut in the locking tray that holds the Tappet in place. Has ribs either side to retain the tappet blade securely
Reverse	A lever that is operated fully to the front of the frame, i.e. towards the signalman
Signal Box	Location of the locking frame under test. Can also mean a mechanically operated ground frame.
Signalman	Person responsible operating levers for the passage of trains. Can also mean the person responsible for the movement of trains when the levers are operated from a ground frame.
Studs	Fixings on locking bars which engage in nibs which are not otherwise secured to the bars.
Tappet	Normally a steel blade connected directly to the lever or catch handle dependant on the type of locking provided
Ticker	A person recording the results of the testing.

3 SAFETY CONSIDERATIONS

Rooms or areas where mechanical locking is provided are often restricted in space and out of site of the tester and assistants. It is important to ensure that staff in locking rooms are clear of the working parts of the frame before the levers are operated.

If signals or points are still connected to the frame mechanically it is important that the work is carried out between trains, or a clear understanding has been made with the train crew when movements should take place. Care should also be taken to ensure that the mechanical interlocking between points and facing point locks, or mechanical detectors on points and facing point locks for signals do not mask the mechanical locking on the frame. It may be necessary to disconnect rodding and signal wires to ensure that there is no undue stress put on either the rodding or wires.

If electric locking is provided is important to ensure that the mechanical locking is not masked by the electrical locking.

4 REQUIREMENTS FOR TESTING

Lever frames need to be tested after any alterations to the locking have been made (New Works) and also on a regular basis (Maintenance) to ensure that the frame is in good condition and will continue to operate safely.

4.1 Maintenance Testing

The locking table and dog chart can be assumed to be correct. The tester should be aware of any change to the train service pattern or other external influence which might mean that assumptions made when the frame was originally commissioned are no longer valid.

The Tester should have experience on the type of locking frames that the maintenance testing is to be undertaken, including a working understanding of the mechanical linkages so that slack locking can be identified before the interlocking fails completely.

4.2 New Works Testing

The tester needs to validate the locking achieved by the frame. This requires the tester to have knowledge of:

- Rules and Regulations of the Railway.
- Mechanical signalling interlocking principles
- Regional or Railways practices
- Traffic patterns for trains passing through, or being marshalled at the signal box or ground frame.
- An Understanding of the drawings, locking tables and dog charts.

4.3 Test Assistants

The Test Assistant must have an appreciation of the mechanical locking frame under test, and must have the ability to understand the difference between a mechanical lock, slack mechanical locking due to losses in linkages; and a lever that is being held as a result of an electric lock or rodding / signal wires. Anyone who regards that a lever puller only to have sufficient muscle to operate the lever has totally failed to appreciate what the tasks entail.

4.4 Tickers

The ticker must understand the particular design of locking table and the significance of their task in ensuring that a 100% complete test is undertaken. Anyone who regards that the tickers job only requires the ability to use a pencil has totally failed to appreciate what the tasks entail.

5 INTRODUCTION TO MECHANICAL LOCKING

There are two basic ways of applying mechanical locking to a lever:

- by locking the lever itself,
- by locking the catch handle (or trigger).

Whilst there was a variety of interlocking methods invented, the vast majority of locking are forms of tappet locking though in each case there is a variety of methods of actually transferring this locking to the lever.

A typical arrangement has a steel blade called a tappet connected directly to the lever.

Each tappet fits in a race which is a vertical slot milled across a locking tray. This is a cast iron plate which has horizontal dividing strips (called ribs) separating it into many channels which hold the locking dogs or nibs. These are the actual locking pieces which engage in the tappets to perform the interlocking. Often multiple locking trays are needed to contain all the locking required, particularly for direct lever locked frames.

Certain designs of lever locked frames and all designs of catch handle locked frames require the tappet to be connected by means of steel linkages and escapement mechanisms

Pros and Cons of indirect connection are:

- short tappet travel which makes the avoidance of foul ports
- easier and allow far more locking to be included in a given size of locking tray,
- reduction in the amount of mechanical stress that can be applied to the locking,
- however there is the susceptibility to wear in the several pins and links associated with the driving mechanism - certain designs are particularly prone to such problems which can be serious after many years of service.

Generally all levers in a frame will usually stand normal (i.e. to the back of the frame). Lever leads tell the signalman which levers have to be pulled to the reverse position before the relevant lever can be pulled. They generally do not say that the lever is locked whilst certain other levers are reversed, the signalman is expected to keep a tidy frame and replace (i.e. normalise) levers when they are not specifically required. There are of course exceptions to this rule; in particular FPLs (facing point locks) are sometimes designed to “stand locked” and sometimes designed to “stand unlocked”. Hence it is quite usual to see the blue levers reversed and all else normal in a frame when no train is signalled.

- A lock therefore keeps a lever normal when another one is reversed,
- a release allows a lever to be reversed when another is reversed
- a back-lock holds a lever in the reverse position

5.1 Outline of Operation- Dead (or Absolute) Locking.

When a lever is pulled its associated tappet moves along the race in the locking tray. There are notches or ports in the side of the tappet and locking is achieved by dogs that are constrained to slide at right angles to them in the channels.

Dogs are made so to be a good sliding fit in the channel. There must be no sloppiness allowing them to twist within the channel between the ribs of the locking tray; however they must not be so tight as to hinder their free movement along the channel.

Locking dogs were usually cast iron though, due to the difficulty in obtaining it, mild steel is normally substituted nowadays. They come in many different shapes and sizes; each type of frame has a range of different types of dog (the simplest Stevens frame has 7 patterns, Brighton locking has 17 and a Westinghouse frame has nearly 100).

Dogs act as wedges which fit into the ports of the tappets and can then prevent the tappet from moving if the dog is held firmly in position by the locking to be imposed on the lever. Dogs are shaped with a nose on one side which has a carefully shaped ramp or bevel on it. It is this bevel that allows motion of the tappet to impart a sideways motion to the locking thus allowing the dog to move fully of the way of the tappet if the lever is free to be moved. Bevels must be cut to the right dimensions or else the locking won’t travel to its proper extent.

Whether a dog locks a tappet or allows it to move depends on the locking imparted to it by bars that connects it to other dogs. These bars are also housed in the locking channel; most types of tray accommodate four bars- two above the tappets and two below them. On Stevens frames only three bars (one bottom, two top) are used and whilst the earlier Great Western frame also only had three bars the later variety had five (two bottom, three top).

Note that dead locking results in automatic converses. If lever 5 locks 12 then it is also true that 12 locks 5. The two dogs are physically linked together and cannot move relative to each other- at any one time one of them must be in the port of its tappet (preventing the associated lever from moving) so that the other can be clear of its tappet. Whilst this reciprocal locking is inherent in mechanical lever frames it has to be explicitly provided if locking is performed electrically (whether this be via electric locks on lever frames, relay interlocking driven from a panel or within computer software within in a computer based interlocking.

5.2 Details requiring careful checking.

The ports cut into the tappet have to be cut accurately so that they are opposite the relevant channel in which the locking is affected. The shape of the port must exactly follow the nose of the dog and if these surfaces are unable to fit closely then the result will be slack locking or in extreme cases a complete locking failure.

Ports cut in a tappet will obviously move along the tray as the controlling lever is pulled. A problem arises if the motion which moves it away from the channel for whose locking it has been cut, takes it into another channel where there is other locking for that lever. This could mean that locking that ought to be held in position by the edge of the tappet is invalidly allowed to move and thus an unsafe wrong-side failure of the locking would occur. These are known as foul notches or conflicting ports.

The tester must always be on guard to discover whether such conflicting ports exist. It is necessary to continuously apply pressure on the lever that is supposed to be locked throughout the entire travel of the lever under test as it is slowly moved. If at any point of the stroke of this lever there is a conflicts with a port cut for some other purpose, it will be revealed by the sudden loss of locking on the other lever.

5.3 Diagrams depicting Locking.

All the locking contained within a lever frame is drawn on a dog chart. This is a pictorial representation of the locking trays showing the ports in the tappets and all the lock dogs and the bars to which these are attached.

The interlocking that is achieved by a locking frame is summarised on a form called a locking table. There are many varieties of these diagrams, although most railways standardised on their own particular format. These generally consist of the following columns (although the wording and presentation do vary, and some types have additional columns):

- the first lists in numerical order all the levers within the locking frame,
- another “Released by” column specifies which levers have to be pulled first before the lever being considered is free to be pulled (this information is generally as shown to the signalman on the lever lead plate attached to / adjacent to the lever itself).
- another “Locks” column specifies which levers are locked in their normal position when the lever being considered is pulled.

Lever positions are regarded as being normal unless otherwise specified (most presentations suffix a lever number with an R for Reverse, although the Southern Railway convention was to show the lever number within a ring to denote this). The need to show this generally occurs in relation to one of two needs for locking:

- conditional locking where locking between two levers is conditional on another being in a certain position (either Normal or Reverse),
- a both-ways lock (also called back and front) which denotes that a signal lever sometimes has to lock a point lever in whichever position it happens to be. This is needed, for example, when the same signal lever is pulled for different routes and the actual arm or route indication given to the driver is selected by the lie of the relevant points.

5.4 Outline of Operation- Conditional Locking.

Whereas the dead locking is that which is always needed, conditional locking is only applied under specified conditions (e.g. locking between two levers only IF a third lever is in a certain position). There are several means of achieving conditional locking but the two main ones are:

- Catch handle / indirectly locked frames employ swingers which are special sliding pieces fitted on top of a tappet. Two dogs are arranged to butt up against each side of the swinger so that motion can be imparted from one side to the other and there is no relative movement between the two dogs. However if the lever on which the swinger is mounted is moved to the other position, a bevel at one end of the swinger comes opposite a locking channel allowing the dogs to move relative to each other.
- Direct lever locked frames utilise a Stowell’s Diamond (invented on the SR in the 1920s). One of the dividing ribs between two channels of a tray is removed and a bridge is fitted. This holds in position under it the diamond-shaped lock dog which comprises two parts which can slide horizontally relative to each other but no vertical movement is possible. This is used, in conjunction with carefully shaped dogs, to transfer motion from one channel to the next only if certain other conditions are fulfilled.

6 TESTING OF LEVER FRAMES

6.1 Organising Before Testing.

- Plan the activity and involve the Operating Department
- Consider what possession, if any, is necessary.
- Best done when the line is closed to traffic.

For New Works or Remedial work it may be necessary to disconnect some or all of the points and signals from the frame and arrange for full hand-signalling and possibly a restricted train service as a result.

In minor alterations where the integrity of the locking has been disturbed, the best solution is often to leave all external functions on the frame but arrange for the operating department to provide a "check signalman" to act as a second person to ensure that the signalman does not make an error without the guarantee of an effective interlocking. In these cases the distant signals (where provided) must be disconnected to prevent trains approaching at speed.

Routine maintenance testing (when the locking is being checked for wear but has not been disturbed) may not require any formal possession. It is usually best achieved "between trains" having reached a clear understanding with the signalman about which levers may be operated at any time and which must be left alone.

- Arrange correct staffing, remembering to keep the number of staff in the signal box to the minimum possible and do not allow any idle onlookers who only serve to distract both you, your assistants and the signalman!
- For small frames one assistant to pull levers and record the testing with another under the box to lift electric locks etc. is generally ideal. More complex frames would require more lever pullers (say 1 for every 30 levers in the frame), one recorder and two under the box thus allowing the tester purely to concentrate on specifying the locking required and test sequence.
- Ensure that the assisting staff are fully competent. Anyone who regards that the tickers job only requires the ability to use a pencil and a lever puller only to have sufficient muscle has totally failed to appreciate what the tasks entail.
- The ticker must understand the particular design of locking table and the significance of their task in ensuring that a 100% complete test is undertaken.

A lever puller needs to know how much pressure to exert on the locking and what degree of slackness is acceptable.

The person under the box must be able to endure long periods with nothing to do or anything interesting to observe and yet be ready to act immediately and accurately when called upon to do so.

6.2 Initial actions

Remember that whilst the frame may be the responsibility of the S&T, the Signalbox is the signalman's territory and you are the stranger. To do your job you need to be treated as a welcome guest and not an unwelcome visitor.

Walking mud into the room, leaving the door open, touching a lever without a duster and sitting in the signalman's chair are just a few of the ways for the job to go badly wrong before it even starts. Conversely arriving with cream cakes for the signalman (and his mates on the other shifts) can pay dividends later when you need an extra minute to get a test finished before the signalman is able to pull off for a train; it also virtually guarantees an offer of a cup of tea at frequent intervals throughout the work.

6.3 Locking Room Checks

- Ensure all holding down straps are fitted and secure; also any covers if these are needed to retain the locking in place.
- Check all cotter pins are correctly fitted in tappet and catch handle linkages.
- Inspect all of the locking in the trays to the Dog Chart (NOT vice versa). This should include marking all extra ports, straps, damage etc. as well as confirming those items drawn. Then check the Dog Chart for anything unticked and resolve any discrepancy this shows up.

- MAKE SURE THAT EVERYONE ON SITE KNOWS THAT UNDER NO CIRCUMSTANCES WILL THE LOCKING BE INTERFERED WITH AT ALL EXCEPT UNDER YOUR PERSONAL OBSERVATION. If anyone does anything for whatever well motivated reason once you start testing, you will have to do it all over again.
- Depending on the possession arrangements, tie up all electric locks so that it is known that any locking found to be present is mechanical. [On alterations affecting both, ALWAYS CHECK THE MECHANICAL LOCKING BEFORE FUNCTIONALLY TESTING THE ELECTRICAL CONTROLS.] If it is not possible to tie up all or some of the locks – locks with a force down features (so therefore cannot be tied up) or that it may be necessary to keep the block release on the section signal as an example, this will involve lifting locks on demand. This could necessitate at least two people to do this- as someone can only lift one lock at a time and any temporary arrangement to tie up an individual lock is to be discouraged as it is almost inevitable that it will be forgotten to untie it immediately afterwards. Either lift each as and when required or deliberately tie it up for the duration with the appropriate safeguards in place.
- If locking has been disturbed at all make sure that every lever can be pulled and replaced before even thinking about starting a test.
- Generally all levers should be normal in the frame before starting and at the completion of every test performed.

6.4 Starting Testing.

Brief the assistants before starting the task taking especial care if any are unknown to you or they have not had much relevant experience. In particular ensure that if someone is ticking for you (essential on New Works jobs where there have been locking alterations designed) that they know the ticking procedure.

Explain the overall sequence and requirement to test to the signalman. It is surprising how many signalman do not appreciate what you are setting out to prove and will otherwise wonder why you are always trying to pull levers that they know are locked. They may then offer "helpful advice" about putting levers in the correct position first and could rapidly come to the conclusion that you are incompetent! A little explanation first and some really enter into the spirit of it and become your best assistant- after all they know the box better than you. If they become involved in the process and the testing can be integrated with running of trains, the margins available for testing can be increased significantly.

Gain familiarity with the layout diagram so that you associate numbers of levers with the functions that they control. Ensure that you are familiar with the mechanical signalling interlocking principles and practices relevant at the time the frame was originally designed and which subsequent changes ought to have been applied subsequently. Listen to anything that the signalman can tell you about the locality.

Try to start at lever 1 as the object lever and complete one lever before moving on the next. Its often not possible to keep to this exactly but its well worth trying to do so as much as possible. Note if you test the converses as you go, your progress along the frame will start very slowly but speeds up rapidly towards the end as most has already been tested- this is good for morale when the job has been dragging on for a long time.

Generally operate the object lever yourself and get the lever puller assistant to run up and down the frame to pull all the others to prove the locks. This is not because you are lazy- they only have to pull but you have to think and it's easier if you don't disorientate yourself by moving about. Also you can keep quite close to your ticker and keep half an eye on what he is marking on the locking tables.

6.5 Completion and Handback

Once testing has been completed or train is required to run, unless otherwise agreed, any preparatory works for the testing must be re-instated to ensure the safe running of the trains. This is not always necessary in the case of between trains testing if for instance a check signalman is provided – a Signalman that is competent on the signal box to check at the signalman has correctly operated the levers for the movement.

These checks should include but are not limited to:

- Ensure all electrical locks that have been tied up have been released and the covers put back on.
- Check that the frame is sufficiently lubricated, and that the lever locks are suitably protected from contamination by the lubricant where relevant (normally when the lever lock is directly connected to the tappet blade).
- Reconnect any signal wires or rodding to the external functions – check that the functions operate correctly!
- Handback the possession
- Ensure that any restrictions that were in place or are required as a result of the testing are effective communicated to the signaller and maintainer.
- Make sure that the signalman's cups are returned clean to the signaller and not left in the locking room.
- Return the testing documentation to the designer to ensure the records are up dated.

7 TESTING "RULES"

7.1 Rule 1- ensure lever is free both initially and then again after lock is removed.

Each individual lock MUST be tested separately; if a lever is supposed to be locked by two functions you cannot tell whether only one is effective or both. Hence you must always prove that a lever is free just prior to doing the one thing which you are going to test locks it. ALWAYS PROVE FREEDOM BEFORE PROVING THE LOCK, PROVE THE LOCK AND THEN PROVE FREEDOM AGAIN. You need to do this to be sure that you know what you have tested.

7.2 Rule 2- test the converse lock as part of the same test.

As explained earlier, reciprocal locking is provided automatically by mechanical frames, it must be tested in each direction since the drive and locking directions are reversed wear on the various surfaces can have different effects on the security of the locking. If a lock is good but it's reciprocal is slack suspect first wear on the linkage between the tappet and the lever rather than the interlocking of the dogs and tappets themselves.

Suppose that you need to test the dead lock between levers 5 and 12 and, having started at the low end of the frame lever 5 is the first one we are considering which is referred to as the object lever and it has just been proved free at the end of the previous test (rule 1).

Since you will need to pull 12 to check that it is free (rule 1), if you actually pull it right over whilst trying 5 to prove it is locked the lock can be tested in this direction initially. Replacing 12 will then allow 5 to become free and as soon as it is moved from normal attempts to pull 12 again should be prevented by the interlocking. It can then be replaced to prove 5 free again. This saves a lot of lever operations which can be very tiring after a full day and also lead to a considerable economy of time, which is especially important if you have to work in margins between trains as you might have to wait ten minutes to do another minutes work.

Note that there is also a converse of a both-ways lock in which a signal lever locks a point in whichever of the two positions it lies at the time. The converse is that the signal lever must be locked unless the point lever is fully normal or fully reverse.

7.3 Rule 3- permutate releases.

A lever may require several others to be reverse before it can be pulled. It is important not only to test that the object lever becomes free when the last of the lead levers is pulled but that each and every one of them is required reverse. In order to discover any conflicting ports careful methodical testing is needed to exercise each permutation.

A common example is a distant lever (say 1) released by all (say 2,3,4) stop signals.

The sequence:

- try 1,
- pull 2, try 1,
- pull3, try 1,
- pull 4, pull 1,
- try back-locks on 2, 3 and 4.

is an INCOMPLETE TEST and therefore UNSATISFACTORY as the only thing that has really been proved is the locking between 1 and 4.

You need to understand the design of the variety of the frame to determine what you must do. Generally you can complete the test by:

- replace 1,
- replace 2, try 1,
- replace 3, pull 2, try 1,
- replace 4, pull 3, try 1,
- replace 2, replace 3.

This sequence is possible when there is sequential locking between the levers. Even this has not tested all possible permutations between the levers and for some frames all must be tested. This can result in a large number of individual tests and this number increases alarmingly with the number of levers involved within the release. It takes a significant time and since it is likely that you might have to stop or be otherwise distracted whilst performing the sequence it is highly desirable that the combinations are written down and marked off as the test is underway.

7.4 Rule 4- test the "free" move of conditional locking.

The important thing to grasp about conditional locking is that locking should not always present. It must be tested:

- to be effective when it should be there,
- to be ineffective when it isn't required.

Failure to test for the "free condition" would not detect the right-side failure resulting in the locking actually being a dead lock; whilst this may not be dangerous it will tie up the layout, cause delays and severely frustrate the Operating department and the passengers.

7.5 Rule 5- test for the counter condition holding.

For every condition there must be a counter condition. The condition gives a degree of freedom and disables some locking that would otherwise be there, so the condition itself must not be allowed to change subsequently. For example, having allowed two levers to be reverse simultaneously only because a third happens to be in a certain position, it is now essential to stop that third lever itself being moved whilst the other two are both reverse.

Often this can be inherent in the locking, since the majority of conditional locking is reinforced by both-ways locking. However sometimes it has to be provided explicitly and can be overlooked. IF THERE IS AN "or", "when", OR "if", ASK YOURSELF HOW DO YOU KNOW THAT THE THING THAT ALLOWED THE FREEDOM CAN'T BE SUBSEQUENTLY ALTERED.

If you see something like 21 locks (57 w 52) and 52 isn't dead locked by the relevant positions of 21 or 57 there has to be an explicit counter condition provided. The locking between 21 and 57 is only to be effective when 52 is normal and hence you must test that if 52 starts off being reverse, something prevents it being placed normal until either 21 or 57 are normalised. If this locking is missing this would be a wrong-side failure.

Testing Locking Example.

Consider a situation where disc signal 7 reads in two directions over facing points 8 and, if the points are normal, also needs to be released by the next disc signal 10. Its lever lead will say "8 or 10" which might be written on the locking table as: 7 by (10 w 8). This means 7 is released by 10 when 8 is normal and hence there is a 8 condition on the locking between 7 and 10 since there is no requirement to pull 10 if the points are set the other way. The need for the signal to dead-lock the point's both-ways prevents this condition being destroyed whilst lever 7 is not normal. Hence there is no possibility of destroying the condition once the move has been set up.

To test the release:

- try 7- locked,
- pull 10, pull 7, try back lock on 10 [PROVES 7 BY 10],
- replace 7, replace 10,
- pull 8, pull 7, try back lock on 8 [PROVES 7 BY 8],
- replace 7, replace 8.

Similarly if there is an opposite direction disc signal 9 that reads over the crossover points 8 in the other direction, the two disc signals need to lock each other but only when the points are reverse. Hence 7 locks (9 w 8R).

- To test this lock and reciprocal and break-down the condition:
- pull 10, pull 7,
- pull 9 (to check freedom also replace and re-pull 7, then both 7 and 9 in mid stroke),
- replace 10, 9 and 7,

- pull 8,
- pull 7, try 9 [PROVES 7 LOCKS 9],
- replace 7,
- pull 9, try 7 [PROVES 9 LOCKS 7],
- replace 9, check 7 free and replace.

Again 7 and 9 will both lock 8 so there is obviously no possibility of having cleared both disc signals and then moving the points.

However in some situations a counter condition has to be provided specially and this is just one example. Trailing points in rear of a signal would normally be locked both-ways by it, however if there is an intervening facing point the lock should not be applied if this facer is set the other way. Suppose signal 12 at the end of an island platform loop with points 27 selecting which face is used by the incoming train and a trailing crossover 19 on the approach to the facing point.

The locking to be tested would be: 12 locks (19BW w 27). There cannot be point to point locking between 19 and 27 and 12 would not normally lock 27 at all. The both-ways lock on 19 is therefore conditional on 27 but this cannot be allowed to be free with 12 not normal.

Testing needs to ensure:

- with 27 normal, 12 locks 19 both-ways [the conditional lock]
- with 27 reverse, 12 does not lock 19 [freedom with the condition broken down]
- with 19 in mid-stroke and both 27 and 12 reverse, 27 is back locked and cannot be normalised. [the counter condition]

8 RECORDING THE TESTING.

Use a colour pencil (not red or green where these colours have been used to depict locking alterations) that is easily seen against the base diagram and is distinguishable from colours used by other testers if several are involved in directing the testing. Sign drawings in the same colour to identify your markings.

There is no national standard regarding recording testing; you must come to a clear understanding with your fellow testers prior to commencing work.

One scheme often used is:

Tick in the “locks” column when you have tested the lock AND ITS CONVERSE. Continue testing one lever until it is complete and then tick the lever number column itself.

When waiting for a margin to test between trains (or whilst travelling to / from site) update by ticking the entries for the converses that have been tested as a consequence of testing already performed. When all this ticking of the converses has been performed for a lever, put a cross tick on the tick in the lever number column.

Never allow anyone who you don’t fully trust to tick off on the locking table. Once there is the slightest possibility that incorrect ticks might have been applied, you are thoroughly lost and have wasted the testing previously performed. If a competent ticker is not available it is better to record in a note book the testing performed, and transfer this information subsequently.

9 NEED FOR ALTERATIONS DURING TESTING.

Determine whether the problem is one of design or implementation.

IF THE LOCKING NEEDS TO BE DISARRANGED (EITHER BECAUSE IT HAS BEEN INSTALLED INCORRECTLY, IS WORN ETC. OR BECAUSE THERE HAS BEEN A DESIGN CHANGE) YOU MUST PERSONALLY SUPERVISE THE REMEDIAL WORK. It is easy for a locking fitter to volunteer to do a couple of minutes work whilst you are doing something else but without personal observation you can’t know exactly

what he did and therefore what might need to be re-tested and more important what doesn't. Unless you have absolutely no doubt that any piece of locking was not disturbed you must re-test it and this can often be limited to the locking in a particular channel which passes a particular tappet. If however you are unable to be certain exactly what was disturbed, you will have to test the whole frame again.

10 MAINTENANCE REQUIREMENTS

From October 1st 2010 maintenance is subject to the ROGS requirements on minor railways.

10.1 Maintenance Standards

The frequency of maintenance will be different for each railway, based on the following factors, this list is not exhaustive:

- Usage
- Weather and/or exposure to salt spray or other corrosives
- Operational periods of the railway.

10.2 Maintenance Intervals

Some frame types are more subject to wear than others. Generally the more convoluted the linkage between the lever and the locking the more opportunity for loss of travel and slackness although where tappets are directly attached to the lever the locking itself can be subject to greater pressure. As an indication GWR 5 bar frames in good condition should be tested every 5 years unless locking is known to be getting slack, but frames such as the double twist often need to be checked annually, although the amount of usage is also a significant factor to consider.

10.3 Maintenance Records

It is recommended that every test or replacement is recorded in a logbook, record card or database. Generally the following items are recorded:

- Date of the test
- Who undertook the test
- Condition of the equipment.
- What was replaced or altered.

10.3.1 Development of Maintenance Plan

The use of the detailed maintenance records will enable the development of a maintenance plan, which will make the best use of the available staff or volunteers.

11 REFERENCES

Some of the documents listed below are not current but provide useful base information.

RSPGs and RSPs Issued by the Office of Rail Regulation see www.rail-reg.gov.uk

- Railway safety principles and guidance Part 1 (1996) (HSE 1996)
- RSPG Part 2D - Guidance on signalling (1996)
- Railway Safety Publication 3; Safe movement of trains
- Railway Safety Publication 4; Safety critical tasks - Clarification of ROGS regulations requirements
- Railway Safety Publication 5; Guidance on minor railways

Department for Transport

Railways and Other Guided Transport Systems (Safety) Regulations 2006; Statutory Instrument No 2006/599.

IRSE Green Books

12 APPENDICES

None.