

Category 2 document

S2551 Hand and air operated miniature lever frames; Annual maintenance method schedule

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1 Purpose

- 1.1 The purpose of this standard is to define the minimum annual maintenance requirements for hand and air operated miniature lever frames. It is not intended to define the methods of test, but where it does so the Maintainer should adhere to those tests.

2 Scope

- 2.1 The scope of this standard covers the interlocking machines used by London Underground that ensure signals cannot be cleared unless points are in correct lie and also prevents the clearing of other signals such as might lead to the collision of two trains.

3 Maintenance requirements

3.1 Safety considerations

3.1.1 Safety of the railway

- 3.1.1.1 Interlocking machines are critical components in the safety system which directly guard against collision and derailment of trains.

3.1.2 Safety of maintainer

Systems of work should guard against the following hazards:

3.1.2.1 *Compressed air*

The Maintainer should be aware that the system has a nominal working pressure of 60 psi, with a maximum potential pressure on failure of the sub-station supply regulator of 125 psi.

3.1.2.2 *Electrical hazards*

Interlocking Machine contacts carry voltages of nominally 100 or 110 volts at 33⅓ or 125Hz, or 60 volts DC. Locks and valves operate at nominally 24 volts DC.

3.1.2.3 *Hazardous substances*

Adequate ventilation should be used when applying paint to levers. Precautions may be necessary when handling lubricants, thread locking compounds, or other substances used. COSHH Health and Safety literature shall be consulted prior to use.

3.1.2.4 *Remote operations*

Interlocking Machines are remotely controlled and are likely to operate at any time without warning. Therefore, prior to undertaking any adjustments, the Machine must be isolated from the control circuitry by removal of the compressed air supply from the Machine.

3.1.3 Safety of the environment

- 3.1.3.1 There are not thought to be any special environmental hazards directly associated with the Interlocking Machine maintenance.



3.2 Authorisation

3.2.1 Staff licensing

- 3.2.1.1 Maintenance staff shall be assessed to be competent to work on that asset type in accordance with the standard S1203, Competence of Personnel Working on Signal and Signal Control Systems.

3.2.2 Task authorisation

- 3.2.2.1 Individual tasks involving disturbance to the Interlocking Machine must be sanctioned in advance and certified on completion through the issue of an Authority to Work Certificate in accordance with standards S1201, Signalling and Signalling Control – Approvals, E7500, Signalling and Control Systems safety critical processes, and SCS-ST0021, Installation handbook standards.

3.3 Planning requirements

- 3.3.1 The Asset Steward shall devise a maintenance regime to ensure that the equipment is maintained in a safe and effective state. The regime shall define the frequency or other criteria for maintenance and the tasks to be carried out.
- 3.3.2 The Asset Steward shall employ an appropriate method of verification to monitor the effectiveness of the maintenance regime.
- 3.3.3 Any changes required to the maintenance regime, whether identified by the verification process, or for any other reason, shall be managed in accordance with the requirements of S1538, Assurance.
- 3.3.4 Any request for concessions against this standard shall be submitted in writing in accordance with 1-641, Concessions to Standards.

3.4 Reporting of failures

- 3.4.1 Failure of an Interlocking Machines to meet any of the criteria laid down in this standard that are unable to be rectified during the maintenance procedure, shall be documented for remedial work.
- 3.4.2 Failures which result in imminent danger arising either to the Maintainer or to the integrity of the signalling system shall be reported to the Line Service Centre.
- 3.4.3 The Asset Steward shall document all failures, thereby creating an asset history.

3.5 Quality assurance

- 3.5.1 The Asset Steward shall maintain a register of all Interlocking Machines. Records of annual maintenance shall be kept and made available to the Professional Head of Signalling or his approved deputy for audit purposes when required.

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3.7 General instructions

- 3.7.1 Information should be sought each night from the Track Access Control Centre regarding details of engineering works, Possessions, Engineering Train movements, etc.



- 3.7.2 Permission must be sought from the Duty Signal Operations Manager before turning off the air supply or carrying out any work on an Interlocking Machine.

The air supply should normally be turned off before commencing any work and restored when work is complete.

- 3.7.3 The Duty Signal Operations Manager for the line concerned and the local Technical Officer must be informed of work to be carried out and in order to avoid accidents, every consideration must be given to staff working on the track or on apparatus controlled from the lever frame.

- 3.7.4 On completion of the work it is essential to ensure that all signalling controlled from the lever frame is working correctly and, in the case of a Remotely Controlled frame, that the **air is on**, or, in the case of a normally un-manned manual Frame, that the **King Lever is over**.

- 3.7.5 All apparatus changed on a lever frame must be returned to the signalling depot. Also, any scrap metal parts changed through wear etc, be returned and placed in the scrap bin provided.

3.8 Lever frame colour codes and identity

3.8.1 Lever colour codes

LEVER	COLOUR
Signal	RED
Point	BLACK
Release	YELLOW
King	BLUE
Control	YELLOW/RED STRIPE
Route	RED/BLACK/RED
Slot	RED/BLACK/RED/BLACK
Switch Lock	YELLOW/RED STRIPE
Spare	WHITE

3.8.2 Identifying B and K style frames

- 3.8.2.1 **B Style** - Longer quadrant shaft and shorter contact shaft than K Style, with 5/8" D section joining together shafts in a 1" bush rotating in a twin-arched shaped bearing casting.

K Style - Shorter quadrant shaft and longer contact shaft than B Style, with 1/2" D section joining together shafts in a 7/8" bush. Rotating in a single angle shaped bearing casting.

Quadrant shafts or contact shafts cannot be inter-changed. All other equipment is standard to both frames.

3.8.3 Identifying N and N2 style frames

- 3.8.3.1 **N Style** - Provided with ODD and EVEN lock slides for Signal and Point lever lock positions. Cut in forward and backward positions to suit staggered fixings of electric locks on bed plate.

N2 Style - Provided with a standard lock slide for Signal levers, and a standard lock slide for Point levers. These are held by an alternate odd and even link to suit staggered fixings of electric locks. Bed plate casting re-designed to enable a slide to



be changed, without upsetting adjustment of lock, by means of a detachable block forming one side of the lock slide guide.

All other equipment is standard to both frames.

3.8.4 Lever arrangements

- 3.8.4.1 The differences in the layout arrangement of the lever mechanisms between B, K Style frames and N, N2 Style frames are diagrammatically shown in Figs 1 and 2.

3.9 B and K style frames

3.9.1 Maintenance method instruction

1. Before starting any work ensure that the necessary permission has been obtained (see Section 3.3).
2. In the case of air-worked frames, air is normally turned off before work is carried out on frame and restored when work is completed.

3.9.2 Instrument panel

1. Open top panels of frame and lay a sheet of paper across bed plate to catch dirt.
2. Open top and rear lids of instrument panel case and clean inside case and all apparatus contained, e.g. release unit, train describer transmitter, volt meter, air gauge, etc.
3. Check all Yale locks on lids and lightly oil with recommended lubricant. Close lids.
4. Clean outside panels and lids. Carefully remove paper from bed plate. Close top panels.

3.9.3 Visual panels

1. Thoroughly clean legend plate and engraving by means of a damp swab and soap. Re- wax or paint in engraving as required.
2. Open visual panel, clean visual glasses and inside of panel flap. Renew broken or damaged visuals. Check two 4BA nuts per plate.
3. Remove all lamps. Clean and place aside.
4. Clean all lamp shields and back-plate. Check six 2BA screws per hinge for security.
5. Refit lamps and close visual panel. Renew any unserviceable lamps.
6. Remove rear top panel from lever frame and clean back of visual panel lamp holders and tree of wires under lever frame shelf. Visually check wiring on lamp holders and check that lamp holders are intact.
7. Check that visuals are functioning correctly to lever movements.
8. Close rear top panels of lever frames.

3.9.4 Levers and segment plates

1. Remove finger board and flat panels behind levers.



2. Remove segment plates, two 1BA cheese head screws per plate, and place aside in order.
3. Clean lever segment plates with fine emery cloth. Re-dress catch rod slots and steps as necessary with a fine-cut file.
4. Clean lever and bearings. Check two 5/16" pins and cotters per lever, checking for pin wear, shaft wear and side play of lever. Lubricate pins and bearing shaft.
5. Check security of 3/8" holding bolt and nut (one per twin lever casting).
6. Replace lever segment plates, renewing worn or damaged screws. Check lever movements are free in plate.
7. Check and lubricate lever catch handle, rod, spring and pins. Renew all worn parts.
8. Check for any flaking chrome-plating on lever handle or catch handle. Rub down with fine emery cloth. If dangerous, renew lever or catch handle.
9. Re-paint, as required, lever segment plates and levers in appropriate colours. Refer to Colour Chart, Section 3.8.
10. Replace panels.

3.9.5 Mechanical locking

1. Remove front and rear panels. Remove wooden struts or metal tee irons as required.
2. Remove locking wire from special head screws and remove screws, four or six per bracket. Remove cover, clean and lay aside in order.
3. Remove cross lock and swing dogs. Clean and lay aside in order.
4. Wipe clean all locking bars, locking brackets, drivers and clips.
5. Visually check that peening of dogs is in alignment with screw head slot. Remedial action shall be carried out as required. See Fig 3. Check screws for tightness on trunnions and driver clips. Two 4BA cheese head screws for each item.
6. Re-grease all locking bars, cross locks, swing dogs and covers with Vaseline thinned with clock-oil.
7. Replace swing dogs and cross locks, locking bracket covers and screws.
8. Underframe: - Check security of two 2BA hex head screws per lock bar driver. Clean down back of locking, brackets, drivers and bearing castings. Lubricate bearings using recommended lubricant.
9. Slacken off two 5/16" nuts per locking bracket and tighten two 5/16" cheese head screws per bracket. Hold screw with screwdriver whilst re-tightening 5/16" nuts.
10. Make complete test of mechanical locking from latest locking schedule, including secured levers.
11. Locking to be verified against the dog chart including locking associated with secured levers.



12. Take up any slackness in locking.
13. Lock special head screws with locking wire. Replace wooden struts or tee irons and refit panels.

Size of Locking Bar	5/8" x 1/4" M/S.
Cross lock	3/8" x 3/8" M/S.
Length of Cross lock:	24 way bkt 12 inches. 36 way bkt 18 inches.
Levers, shafts, bearings, etc	2 1/2" centres.
Each 11 lever section is	2 feet 6 inches long.

3.9.6 Bedplate and lock quadrants

1. Remove front horizontal and rear top panels from frame.
2. Clean bed plate, shafts, cranks and links, quadrants and carriers and bearing castings.
3. Check that quadrant shaft cranks are tight on shafts and 3/16" taper pin is secure. Check for bearing pin wear.
4. Lubricate, using recommended lubricant, middle bearing and front bearing behind quadrant shaft crank.
5. Check two 2BA hex head screws and one 2BA pin screw per quadrant carrier and two 2BA hex head screws in quadrant.
6. Check that quadrant is running through tulip with equal clearance on either side. See Fig 4.
7. Replace panels.

3.9.7 Electric locks

3.9.7.1 All electric locks on B and K Style Frames are DC and are of two types:

15 Volt 160 Ohm Lock

Original pattern, enclosed in cylindrical metal case with soft iron core and armature plate. This lock is now fed at 25V to 30 V to give satisfactory pick-up to lift latch over the larger 3/16" lock face of the modified lock quadrant.

60 Volt 1000 Ohm Lock

Open pattern with laminated soft iron yoke and hinged armature. The travel of the stem and latch is approximately 3/16".

Note: Both types of locks are fed through a rectifier (one for each lock).

Procedure

1. Remove top, rear and end panels.
2. Clean all electric locks taking care to clean out all adherent metal dust between armature and pole faces. Check wire to lock terminals.

15V DC Locks

Check that stem is free in its movement with lock de-energised and that no residual magnetism exists. Check residual pins for air gap of 0.020" (± 0.005 ") between armature plate and pole face when lock is energised. Check that latch head is secure on stem. Check that one 1/4" x 40 TPI locknut is tight on armature plate.

60V DC Locks

With lock de-energised, check that stem and armature are free in movement and latch is secure on stem. Check residual pins, that a gap of 0.020" (± 0.005 ") exists between the armature and pole face with lock energised. Check hinge pin and cotters (slightly lubricate). Check pin and roller and Diablo Nut for wear, see Fig 5. Check locknut and tab washer.

Check security of lock in tulip. (Locking screw should be fitted for securing tulip's fixing screw.)

Check adjustments of locks and quadrants. Refer to Electric lock adjustments, below.

3.9.8 Electric lock adjustments

1. Conditions

With lever catch-rod hard against step on segment plate, (Signal lever B position, Point lever B or D position, Release lever D position), latch should be free in its movement and not impaired by lock face of quadrant (see Fig 6).

Adjustment

Obtained by slackening or tightening 2BA hex head screws at top of quadrant carrier in order to move carrier to the left or right on its fixed centre. Ensure that 2BA screws and pin- screw are tight after adjustment.

2. Conditions

With lock de-energised, latch should have 1/8" (+1/64" -0) engagement of the lock quadrant. See Fig 6.

Adjustment

Obtained by 2BA adjustment screw at base of lock. Re-lock with 2BA locknut and tab washer. (Open type locks only.) Enclosed type lock, this adjustment is natural.

3. Conditions

Hand Worked Frames:

With lock energised, Signal, Point and Release levers should have a clearance of 0.025" between the underside of the latch and the top of the quadrant spur. See Fig 8.

Air Worked Frames:

Conditions and adjustments are as described in step 5.

Adjustment

Enclosed Type Lock:

Obtained by 1/4" x 40 TPI nut and armature plate. Open Type Lock



Adjustment nut on end of stem.

Re-lock armature plate, or adjustment nut, with locknut and tab washer.

4. Conditions

Open Type Locks:

With lock energised and with quadrant in ramp position, (Signal lever reverse, Point lever normal or reverse or Release lever normal), there should be a clearance of 1/16" (0.0625") between underside of armature and top of 2BA adjustment screw, see Fig 7.

Adjustment

Adjust if required.

5. Conditions

Air Worked Frames

Where Lock Checking Contact is fitted, and with lock energised, Signal, Point and Release levers should have a clearance of 0.060" between underside of latch and top spur of quadrant. See Fig 8.

Adjustment

Obtained by adjustment nut 1/4" x 40 TPI at end of stem, or by armature plate on end of stem. Ensure adjustment nut, or armature, is locked by locknut and tab washer after adjustment.

3.9.9 Lock checking contacts

1. **Units**

Units are fitted directly to bed plate by two 2BA hex head screws, tapped in casting, 2 1/4" from stem centre and in line with latch of electric lock, see Fig 9.

Adjustment

With lever normal and lock de-energised, adjust 2BA thrust screw so that the contact rod has a clearance of 0.015" from springs. Lock the thrust screw by a star washer and 2BA locknut.

With lock energised and lever normal, (lock adjusted as in step 5 of Section 3.7.8), the latch should push contact springs well off keepers.

3.9.10 Lever contacts

1. Remove top and back panels.
2. Remove all separators and place aside.
3. Using a small, clean fitch, brush off all dust from contacts and contact blocks, contact shafts and bearings.
4. Check two 1/4" cheese head screws, per middle bearing and rear bearing. Check one 2BA cheese head clamping screw plus one 2BA pin screw per middle bearing bush. Lubricate items.
5. Clean wiring and trees under contact section.



6. Visually inspect wiring and report any potential hazards. In particular, report:
 - Insulation shrinkage.
 - Liquefying or embrittled insulation.
 - Conductive deposits (such as copper chloride 'green spots').
 - Unterminated wires not protected in accordance with E7500, Signalling and Control Systems safety critical processes.
7. Using a chamois leather, thoroughly clean all contact springs and pieces. Very lightly oil the contacts.
8. Check for wear on contact pieces and change where required.

Note: Investigation is required prior to contact replacement as some contacts are modified to suite site conditions. Wear shall be considered to be a change in contact shape or surface finish attributed to abrasion between two faces.

9. Check all contact springs for wear or weakness. Take note of springs required to be changed.
10. Check adjustments of lever contacts. See Section 3.9.13.
11. Replace all panels.

3.9.11 Air break contacts

3.9.11.1 Non-Reversible Type

The type shown in Fig 19. This contact is of the non-reversible type in which the circuit is closed by the bridging of two adjacent springs by the contact.

3.9.11.2 Reversible Type

The type shown in Fig 20. This contact is of the reversible type which is used in Lever Circuit Breaker Boxes. In this case the contact completes the circuit between two contact springs in diametrically opposite positions.

When the contact is closed the pressure is maintained by the tension of the coppered steel spring. The bronze keeper is provided to limit the spring movement when the contacts are opened.

3.9.12 Lever frame contact adjustments

1. Check contact pressure is 250 grammes (± 10).
2. Visually inspect for worn contact springs.
3. Ensure that the contact spring is making right across its width and is not twisted, also that both springs make and break at the same time.
4. Check that peaking of spring to contact is correct. In the case of under-peaking, rectify by placing square washers of suitable thickness between contact spring and contact block. See insert on Figs 19 and 20.
5. In the case of over-peaking, check the circuit in which contact is employed to ensure that situation is not intentionally set up. Also refer to Section 3.9.13, Contact Adjustments before attempting re-adjustment.