Massachusetts Bay Transportation Authority

Keolis Commuter Services

Railroad Operations

MBTA C&S 1

INSTRUCTIONS FOR TESTING SIGNAL APPARATUS AND SIGNAL SYSTEMS

COMMUNICATIONS AND SIGNAL DEPARTMENT

Issued By:_____
Pascal Baran
Chief Engineer, KCS

Approved By:_____
Timothy P. Horan, PE
Engineering Officer – C&S , MBTA

Recipient,

Please remove and sign this page. Return it to the issuing officer.

I received a copy and training on the MBTA C&S 1,
Instructions for Testing Signal Apparatus and Signal Systems.

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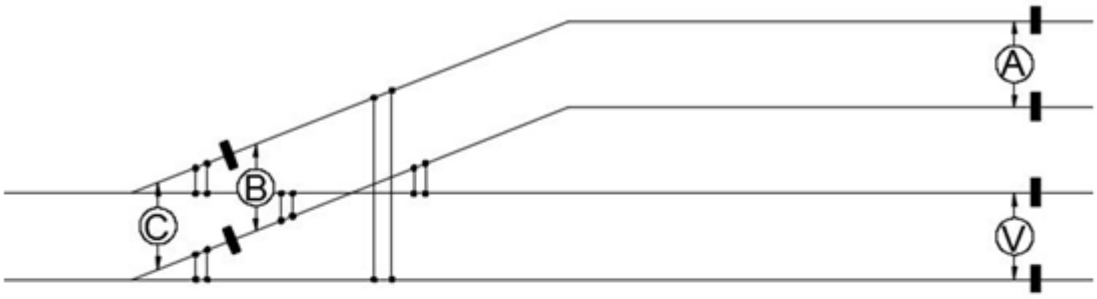


Figure 19-1.
Shunt Fouling Single Track Relay

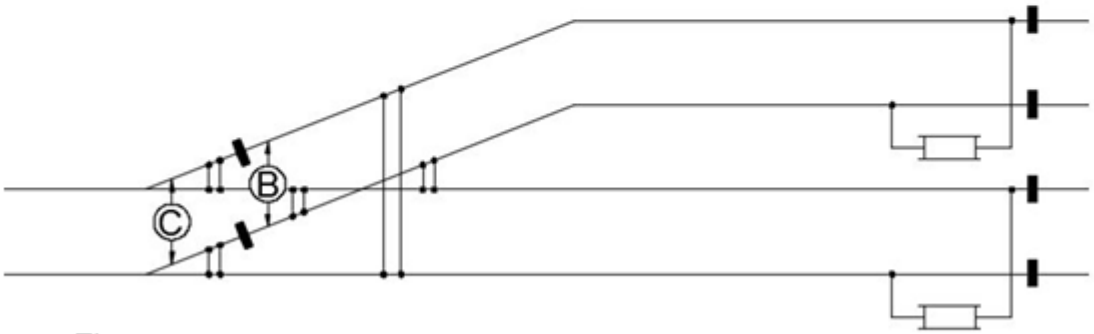
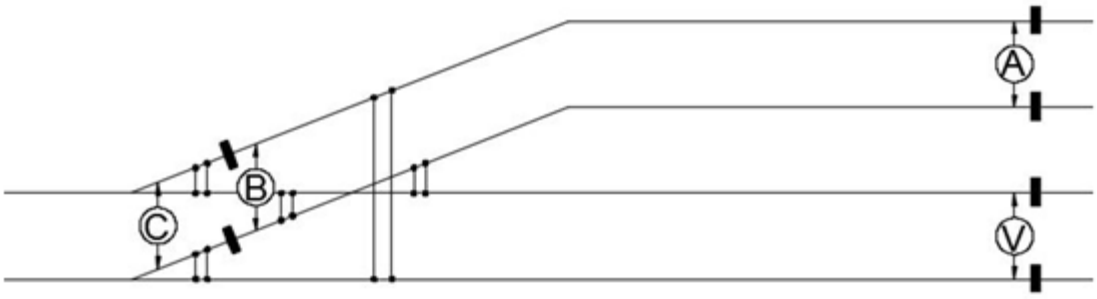


Figure 19-2.
Shunt Fouling Dual Track Relay

TEST FORMS



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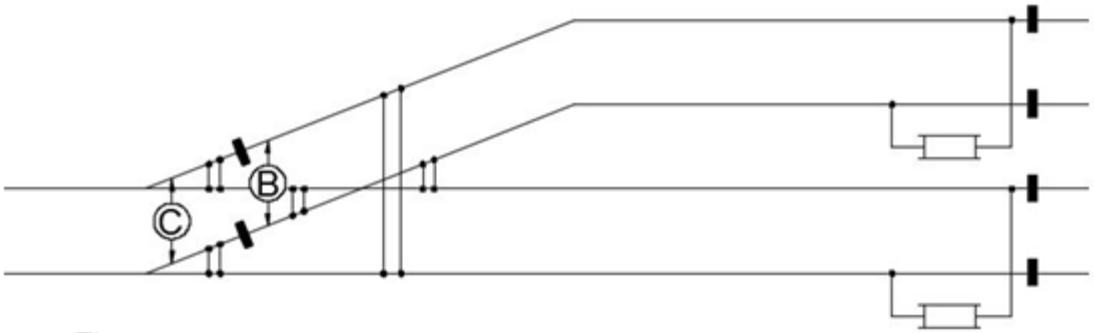

Figure 19-2.
Shunt Fouling Dual Track Relay

TEST 2: INSULATION RESISTANCE

FRA 236.108, 234.267

Purpose:

Test is to ensure that the insulation of wires and connected apparatus meets with resistance values presented below.

Responsibility:

Signal Inspector or Signal Maintainer

Records:

Record of tests must be made on the appropriate form (Form C&S 14). All values must be recorded. The form must indicate the corrective action taken with those wires not meeting minimum requirements. DOT numbers shall be recorded on test forms at Grade Crossing locations.

Results:

Wires with insulation resistance below 1 Meg-ohm must be reported to Roadmaster C&S, who must report this to Senior Engineer C&S. When insulation resistance of wire or cable is found to be less than the values as stated herein, prompt action must be taken to repair or replace the defective wire or cable.

No circuit will be permitted to function on any conductor having an insulation resistance to ground or between conductors of less than 200,000 ohms. Immediate corrective action must be taken and clearly shown on form. Use remarks column if necessary.

Frequency:

1. **At least once every ten years.**
   All wires and cables, including power distribution cables, except as noted (See *Note Below). Wires and cables except house and case wires, which shall be tested on an as required basis.
2. **At least once every twelve months**
   Wires and cables found having one or more conductors with insulation resistance less than 500,000 ohms, but not less than 200,000 ohms, until cable or wiring is replaced.

***NOTE:** Wires connected directly to track rails need not be tested. Communications type wires and cables need not be tested.

Procedure:

1. Tests shall be made when cables and insulation are dry.

2. Test shall be made with a Megger with a self-contained source of direct current test voltage. Megger must read from zero to 20 Megohms minimum and be rated at 250 volts minimum, 650 volts maximum.

3. Test Megger operation prior to cable testing by insuring that the Megger reads infinity when the meter leads are open and zero when the leads are touched together. Ensure that the terminal or buss being used as a ground is connected to ground by placing one lead of the Megger to a structure ground or track lead and placing the other lead to the ground terminal or buss. When operated, the Megger must read zero resistance.

4. Each conductor of a multiple conductor cable shall be opened at both ends and disconnected from circuitry when insulation resistance is being measured.

5. Have the person at the opposite end of the wire ensure continuity by grounding that end of the wire. Megger must read zero.

6. Complete insulation resistance tests of all cables from each conductor to ground. For multiple conductor cables, measure insulation resistance from each conductor to ground, and between each conductor and all other conductors in the cable (cross meggering).

7. All provisions of C&S 2 covering the use of jumpers and safeguarding train movements, and other safety precautions, must be observed.

8. Any wire identified as being open must be tested from both ends to ensure it is not grounded or shorted to another wire. If the wire passes the requirements of Test 2, it can be excluded from annual testing.

TEST 3: FOREIGN CURRENT – DC & 60 HZ. NON-CODED TRACK CIRCUITS

Purpose:
Test is to determine the presence of foreign current and ensure proper corrective action to prevent interference with track circuits.

Where there is known to be A.C. induced energy from any high voltage A.C. power line or other A.C. exposure such as overhead transmission lines. Tests shall be made during a period in which outside current is at or near maximum value.

Responsibility:
Signal Maintainer or Signal Inspector.

Records:
Test results shall be recorded on Form C&S 27.

Results:
If any readings are obtained in excess of 25% of the drop away value of the relay under test in either test, or track relays attempt to pick, report the readings to the Roadmaster C&S immediately.

TEST 3A - DC NON-CODED TRACK CIRCUITS

1. Where there is known to be a D.C. trolley line, high voltage D.C. power line, or other direct current exposure, tests should be made during periods in which the outside current is at or near maximum value.
2. This test shall be made by placing a multimeter in series with the track relay, then disconnecting the wires from the battery and taking a reading. It should be noted at the same time whether the current is equal to or in excess of 75 percent of release value of the relay
3. If the current is not 75 percent of the release value of the relay, a second test should be made in the same manner as the first. In addition to performing a second test, shunt the track circuit adjacent to the relay end of the circuit under test (shunt on the opposite side of the insulated joint from the relay connection), and then shunt one insulated joint at a time between the track circuits.
4. Add the rails of the adjacent track circuit to one side of the track circuit under test to provide an unbalance and make a severe test. If current is 75 percent or more of release value of relay, the circuit should also be watched.

If any appreciable readings are obtained in either test, report the readings to the ACE C&S. In addition, the following precautions shall be observed:

1. Where trolley, transit, subway, mining companies, and other sources of D.C. are present, request to see if their bonding is as good as practicable.

2. Rail joints shall be kept tight, and insulated joints maintained in good condition.

3. Rail bonding carefully maintained.

TEST 3B 60 HZ A.C. NON-CODED TRACK CIRCUITS

Frequency:
At least once a year where foreign current exists.

Procedure:

1. This test is made by removing energy at the feed end of the track circuit to be checked.
2. Shunt the track circuit adjacent to the relay end of the circuit under test.
3. Shunt one insulated joint at a time between the track circuits.
4. Ensure that the track circuit does not attempt to pick.

TEST 4: RELAYS AND OTHER ELECTRO MAGNETIC APPARATUS

FRA 236.102, 236.105, 236.106, 234.263

Purpose:

Test is to ensure that operating characteristics of electro-magnetic apparatus shall be maintained in accordance with the manufacturer operational specifications..

Responsibility:

Signal Maintainer (Test) or Signal Inspector.

Records:

Record operating characteristics on form C&S 13. A copy of the test performed is to be retained at location with the signed original to be submitted to and filed at Office of Senior Engineer C&S.

Results:

Any relay or electro-mechanical device that has failed to meet the requirements of Test 4 shall be removed from service and replaced as soon as possible. If the relay cannot be replaced, measures should be taken to assure safe operation of the signal system. In addition, the Roadmaster C&S must be notified and make arrangements for the safe passage of trains.

ALL RELAYS

Inspection Procedure:

1. Verify that the relay or vital device under test is in accordance with the "as-in-service" plans. If device has an index registration plate, verify that the base plate matches the type of relay installed. Check that the nomenclature tag is legible and in accordance with the "as-in-service" plans.

2. Visually inspect and observe that all parts of the relay are in good condition and in correct position with respect to other parts.

3. Remove and replace relay if any of the following conditions are observed:

    a. The glass or plastic cover is cracked, broken, smoky, or discolored.

    b. The ribbons are not intact and are not in good condition.

    c. The contacts are worn, charred, pitted or have carbon build up.

    d. The contacts are not in alignment and contact openings are not sufficient.

    e. The assembly components within the cover are loose, misaligned, or require cleaning.

    f. Moisture has accumulated inside the relay.

g. The Relay Shop tags have become detached from inside the glass.

h. The seal is broken or missing.

4. Determine by actual operation that the relays have a positive pick (full pick) and drop-away (full down) and that the relay opens without any difficulty due to friction, obstruction or any other reason. Relays failing to meet this visual test should be removed and repaired immediately.

Test Procedure:

1. Prior to performing any on-site field testing of relays, take suitable precautions for maintaining safe operations of train movements.
2. Before beginning field tests on DC and AC relays, obtain a copy of the manufacturer's instructions for field testing that particular relay. In all cases, apparatus must comply with the manufacturers' instructions for field test.
3. At a minimum, open coil wires or remove relay from rack (in the case of a plug-in relay) before connecting test set to the working relay.
4. Test is to ensure that operating characteristics of electro-magnetic apparatus shall be maintained in accordance with the limits within which such apparatus is designed to operate.
5. In order to prevent disarrangement of the signal system, the following procedures must be followed while tests are performed:

    a. Prior to removal of any wires, verify that the nomenclature tag is in compliance with the as-built plans.

    b. On terminal type apparatus, only remove one wire at a time.

    c. On plug-in or plug coupled apparatus, only remove one unit at a time. Each unit must be reconnected or reinstalled in accordance with the as-built plans before another can be removed.

    d. Forms for relay or other electro-magnetic devices must be properly filled out and dated and signed by the person performing the test.

    e. It should be noted that a location may contain multiple devices (relays) that differ in the frequency of testing. All apparatus shall be entered on separate sheets according to their test frequency as shown below.

TEST 4A: DC Neutral Relays

Frequency:

When placed into service and thereafter when modified or disarranged or at least every four years.

All vital relays, except DC Polar Relays

D.C. Neutral Relays Test Procedure:

1. Apply initial voltage in the same direction as normal service energy (See Note 1). Gradually reduce the voltage until the front contacts open. The current obtained is the drop-away value, and should not be less than the manufacturer's recommended characteristics.

2. After opening circuit, apply voltage in same direction starting at zero volts and gradually increase until front contacts just close. This is relay pick-up value. The pick-up value should not be more than 10% above the original marking. Continue to gradually increase energy in the same direction until the armature is against stop pin. This is the working current.

Note 1 An initial test voltage or current equal to service voltage or current must be applied to all D.C. Relays and Electro-Magnetic devices before taking a drop-away reading. This voltage should be applied for a minimum of one minute prior to obtain the drop away current reading.

Note 2 The phrase 'original marking" applies to the manufacturer's specifications unless superseded by a Relay Repair Shop Data Tab.

D.C. Biased Neutral Relays Test Procedure:

1. For biased relays, before returning the relay to service, reverse the energy to the coils of the relay. Relay must remain in the fully de-energized position.

TEST 4B: DC Polar Relays

Frequency:
When placed into service and thereafter when modified or disarranged or at least every two years.

1. Test alternating current vane type relays, direct current polar type relays and relays with soft iron magnetic structures.

2. Test searchlight signal mechanisms.

D.C. Polar Relays Test Procedure:

1. Open one of the wires to the relay operating coils or pull plug-in relay from the rack. Apply test-set leads and reverse polarity.

2. Gradually apply voltage to the coils of the polar relay from zero until the polar armature reverses. Record this value as "Polar Reverse'

3. Increase the voltage to test the neutral pick-up and working current. Then, increase to the full service voltage.

4. Decrease the voltage until the neutral contacts open. This is the neutral drop away current. Continue reducing the voltage to zero. Polar contacts must remain in their last position.

5. Change the polarity of the test set to normal.

6. Gradually apply voltage to the coils of the polar relay from zero until the polar armature returns to normal. Record this value as 'Polar Normal"

7. Increase the voltage to test the neutral pick-up and working current. Then increase to the full service voltage. Next decrease the current to-test the neutral drop away, then reduce to zero. Polar contacts must remain in their last position.

8. Observe that polar contacts pole before exceeding 80% of the neutral contacts pick up value.

9. Ensure that all values are within the manufacturer's allowances for that particular relay.

10. Carefully replace plug relay back into the rack avoiding damage to fingers and contacts. Replace coil wires to shelf type relay, ensuring proper polarity.

Note: Test person should note the position of the polar contacts before beginning this test to ensure they place the polar contacts back into the position they were in before the test began.

A.C. Single Element, Vane Type Relays Test Procedure:

1. Review the manufacturers testing documentation and ensure that the proper testing arrangement or test set is being used. All readings obtained need to occur with the operating voltage and phase angle provided within the manufacturer's testing specification.

2. Disconnect control wires from relay operating windings. Apply relay test equipment.

3. Apply an initial voltage to the winding of the relay with the usual polarity. Ensure the relay is picked fully up to stop.

4. Slowly decrease the applied voltage until the point where the front contacts just open. Record this value as "Release'. Continue reducing the voltage to zero.

5. Disconnect the test equipment for one second to allow the windings to fully de-energize. Re-connect the test equipment.

6. Slowly increase the voltage from zero until the front contacts on the relay just close. Record this value as "Pick-up'.

7. Continue to increase the voltage until the relay armature moves up to the stop position. Record this value as “Working”.

8. Ensure that the vane moves freely without binding or sticking.

9. Observe that there is a uniform clearance between each side of the vane and the pole faces.

10. Observe that the pivoting pin is properly seated by opening and closing the test post several times and observing the action of the relay.

11. Ensure that the values are within the manufacturer’s documented tolerances for that particular relay.

12. Carefully replace relay back into the rack avoiding damage to fingers and contacts. Replace coil wires to shelf type relay, ensuring proper polarity.

A.C. Two Element, Vane Type Relays Test Procedure:

1. Disconnect line control wires from the operating windings, leaving the local control wires intact. Apply relay test equipment.

2. Apply an initial voltage to the winding of the relay with the polarity normal. Ensure that the relay is fully picked up on the normal contacts.

3. Slowly decrease the applied voltage until the point where the normal contacts open. Record this value as “Normal Drop-away’. Continue reducing the voltage to zero.

4. Disconnect the test equipment for one second to allow the winding to fully de-energize. Re-connect the test equipment.

5. Gradually increase the voltage to the relay until the normal contacts just close. Record this value as “Polar Normal”.

6. Continue to increase the voltage until the armature moves up to the stop position. Record this value as “Working Normal”.

7. Repeat steps 1 through 6 for the reverse position of the relay. Record all values.

8. Ensure that the vane moves freely without binding or chafing. Observe that there is a uniform clearance between each side of the vane and the pole faces.

9. Ensure that the values are within tolerances for that particular relay.

10. Replace control wires to return the relay to service.

TEST 7 SIGNAL INDICATION LOCKING

FRA 236.307, 236.380

Purpose:

To ensure that all routes remain locked when signal indicates other than stop.

Responsibility:

Signal Inspector

Records:

Results of Test 7 are to be recorded on Form C&S 27. All forms must be forwarded to the office of the Roadmaster C&S.

Results:

If any discrepancies are found during testing the Inspector shall immediately notify the Roadmaster C&S, and arrangements made for the safe protection of trains.

NOTE: Tests 7, 8 (if applicable), 9, 11A and 15 may be done together for each route.

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least every two years, whichever occurs first.

TEST 7A LIGHT TYPE SIGNALS INCLUDING SEARCHLIGHTS

At All Relay Interlockings verify that:

- the route cannot be released,
- RGPR (RPR) and ALSR (ASR) are down, interlocking route and traffic remains locked,
- the control machine does not indicate signal at stop,
- all switches, movable point frogs, drawbridges and derails remain locked,
- opposing and conflicting signals (if applicable) should not clear.

Procedure:

1. Clear home signal by initiating a request.
    a. Check that all switches, movable point frogs, derails, and any other appliances (such as a drawbridge) in the route are properly lined and locked, that corresponding RGPR (RPR) and ALSR (ASR) relays are down, and that all switch (and other appliances) lock indication lights in the routes are properly displayed.

2. Place signal in stop position by initiating stop or cancel request.

3. Open (break) each signal control relay contact in RGP (RP) circuit on the side from which battery is feeding. Where searchlight signal heads are controlled, open RGPR circuit at each signal head on battery side.

4. Check each signal control relay contact in RGP circuit (for each break in Paragraph 3) that all switches, movable point frogs and derails, traffic and any other appliances (such as a drawbridge) in the route are locked. At all-relay interlockings it will be permissible to observe that corresponding RGPR (RPR) and ALSR (ASR) relays are down and that all switch (or other appliances) lock indication lights in the route are displayed. After ensuring timers are not running, positively establish that each switch and other appliance is effectively locked.

5. Close (restore) RGP circuit, and then observe RGPR picks up. Open or shunt track relays progressively to allow ALSR to pick up. At all relay interlockings, observe that all switch (or other appliance) lock indication lights show switches (and other appliances) released after each break.

6. Check that the RGP circuit is open when any aspect other than Stop is displayed on the home signal.

Microprocessor Interlockings

At Microprocessor controlled Interlockings with Lamp Driver Board control of signal aspects, and without relay contacts to open RGP circuits, it will be sufficient to clear the Home signal, and check that all switches, movable point frogs, derails, and any other appliances (such as a drawbridge) in the route are properly lined, and locked. Test all routes.

TEST 8 APPROACH LOCKING

FRA 236.377

Purpose:

To ensure that while a train is approaching a cleared signal, the route cannot be changed or opposing signal cleared until after the signal is set to its most restrictive aspect and a predetermined amount of time has expired.

Responsibility:

Signal Inspector

Records:

Results of Test 8 are to be recorded on C&S 27 Form. All forms must be forwarded to the office of the Roadmaster C&S.

Results:

It any discrepancies are found during testing the Inspector shall immediately notify the Roadmaster C&S, and arrangements made for the safe protection of trains.

NOTE: Tests 7, 8, 9, 11A and 15 may be done together for each route.

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least every two years, whichever occurs first.

Procedure:

Check Approach Locking As Follows:

1. Check that the approach relay is open when each track circuit in the approach is shunted.
2. Clear home signal.
3. Open approach relay.
4. Place signal to stop position by initiating stop or cancel request.
5. Check that all switches, movable point frogs, drawbridges and derails in the route are locked. After specified time has expired, check that locking is released.
6. Close approach relay.

TEST 9 TIME LOCKING

FRA 236.305, 236.378

Purpose:

To ensure that a route cannot be changed or opposing signal cleared until after the signal is set to its most restrictive aspect and a predetermined amount of time has expired.

Responsibility:

Signal inspector.

Records:

Results of Test 9 are to be recorded on Form C&S 27. All forms must be forwarded to the office of the Roadmaster C&S.

Results:

If any discrepancies are found during testing the Maintainer shall immediately notify the Roadmaster C&S, and arrangements made for the safe protection of trains.

NOTE: Tests 7, 8 (if applicable) 9, 11A and 15 may be done together for each route.

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least every two years, whichever occurs first.

Procedure:

1. Clear the signal over the route to be tested.

2. Restore the signal to stop. Ensure that the timing relay or device acting as a timing relay is operating. At microprocessor Interlockings verify timer is running using a laptop computer.

3. Ensure that all switches, moveable point frogs, derails and bridges in the route remain locked and that no conflicting or opposing signals may be cleared until after the predetermined time has expired.

4. Ensure all track circuits are energized.

5. Ensure route releases after time has expired run down.

6. Repeat for all routes in the interlocking.

TEST 10 TIME RELEASES, TIMING RELAYS, AND TIMING DEVICES

FRA 236.109, 234.265

Purpose:

To ensure that safety is not compromised due to improper timing delay.

Responsibility:

Signal Maintainer, Signal Inspector or Electronic Technician.

Records:

Results of Test 10 shall be recorded for all Time Releases, Timing Relays and Devices on Form C&S 27, showing the time on the plan or device and the actual time found in the field.

Results:

Any relay or device with a time less than 90% of that shown on the plans shall immediately be adjusted or replaced and action must be taken for the safe protection of trains. Any device or relay with a time 10% higher than shown on the plans or device shall be replaced or adjusted as soon as practicable.

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least once every year, whichever occurs first.

Inspection Procedure:

- Ensure that time interval for timing device is shown on the circuit plan and marked on the device itself.
- Inspect that the seals for timing devices are intact and have not been tampered with. Relays with broken or missing seals should be replaced immediately.
- Record the time and ensure that it is not less than 90%, or more than 10% of the time shown on the circuit plans.

Test Procedure

Timing Relays

1. For electric locks equipped with timing relays:
    a. Start timing relay and check time until unlocked

2. At controlled signals with approach locking:
    a. Clear the signal to be tested
    b. De-energize the approach relay
    c. Restore the signal to stop
    d. Measure the time until the Approach Locking Stick Relay (ALSR) energizes.

3. At controlled signals with time locking:

    a. Clear the signal to be tested
    b. Restore the signal to stop
    c. Measure the time until the Approach Locking Stick Relay ALSR (ASR) energizes.

4. For electronic timing relays with LED digital readouts, use an independent timing device to verify the accuracy of the LED readout.

Timing Devices

1. For Loss of Shunt (LOS) timing devices used in loss of shunt protection:

    a. De-energize the controlling relay of the LOS
    b. Re-energize the controlling relay of the LOS
    c. Measure the time until the repeater relay controlled by the LOS picks up

TEST 11 SWITCH INDICATION

FRA 236.380, 236.386, 236.314

Purpose:

Test is to ensure that no signal may be displayed over a switch, moveable point frog, or derail which has failed to operate to the corresponding position of its controlling device.

Note: This test may be done in conjunction with Tests 7, 8 (if applicable), 9 and 15.

Responsibility:

Signal Inspector or Signal Maintainer

TEST 11A SWITCH INDICATION

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least every two years, whichever occurs first.

Procedure:

Switch Indication - Point Detection Correspondence

1. Place a ½" obstruction in the reverse switch point and operate the switch against the obstruction. Ensure that the relay being used for reverse switch correspondence is de-energized.

2. Place a ½" obstruction in the normal switch point and operate the switch against the obstruction. Ensure that the relay being used for normal switch correspondence is de-energized.

3. Place voltmeter on switch indication circuits or switch indication relay and open all switch machine contacts, one at a time, ascertaining that the switch repeater relay opens on each contact opening. Repeat the same operation for the opposite switch position. Perform this test for each switch machine including both ends of a crossover, helper machines, split point derails and movable point frogs.

4. Where type "F" controllers or relays are used

    a. With switch lever normal, open motor circuit. Move lever to reverse indicating point, remove fuse in controller or disconnect control for relay, then operate lever to normal indicating point: Indication should not be received. Check that switch correspondence relays are de-energized. Restore fuse or relay control, indication should be received. Repeat test, starting from reverse position.

5. On crossovers, open crank cut-out on "A" machine and operate switch control to the reverse position. After "B" machine has completed its move to the reverse position, check that the reverse and normal switch repeater relays are in the de-energized position.

6. Close crank cut-out on "A" machine and after machine has completed its move to the reverse position and locked up observe that the switch repeater relay is in the energized position.

7. Open crank cut-out on "A" machine again and operate switch control to the normal position. After "B" machine has completed its move to the normal position, check that the reverse and normal switch repeater relays are in the de-energized position.

8. Close crank cut-out on "A" machine and after machine has completed its move to the normal position and locked up observe that the switch repeater relay is in the energized position.

9. Repeat for "B" switch.

10. When steps 1 thru 6 are completed above, verify that for each route in the Interlocking the dropping of the correspondence relay for each switch results in that governing signal going back to stop.

11. For switches with mid-point helper movements, or circuit controllers, after completing steps 1, 2 and 3 above, place a 5/8" obstruction in the reverse mid-point between the point and the stock rail at the point detector rod and operate the switch under power. Observe that correspondence relay is de-energized. Repeat for each switch machine. Duplicate the test for the normal point.

12. For switches with more than two points, each point must be tested in a like manner. Repeat procedure for movable point frogs.

TEST l1D Electric Lock on Hand Operated Switch

Purpose
Test is to ensure that electric locks operate as intended.

Responsibility:
Signal Maintainer

Records:
Results of Test 11 are to be recorded on Form C&S 27. All forms must be forwarded to the office of the Roadmaster C&S.

Results:
If any discrepancies are found during testing the Maintainer shall immediately notify the Roadmaster C&S, and arrangements made for the safe protection of trains.

Frequency:
When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every year, whichever occurs first.

Procedure:

1. Switches with local time release feature:

    a. Carefully inspect the electric lock for missing or worn parts, which might render the electric lock ineffective. Ensure that all wires are properly tagged and clear of all moving parts.

    b. Verify that the governing signal is clear.

    c. Move the handle of the lock to initiate start of time interval.

    d. While time is running, ensure that governing signal or cab signals display their most restrictive aspects by using a meter to ensure that applicable code rates and line circuits are de-energized.

    e. Ensure that the operating handle for the hand-operated switch cannot be moved past the electric lock restraint.

    f. After specified time interval has expired, check that lock is unlocked by moving handle to fully unlocked position.

    g. Repeat test in opposite traffic direction.

TEST 13 SWITCH OBSTRUCTION
FRA 236.327, 236.382

Purpose:
Test is to ensure that when switch points including moveable point frogs cannot be fully closed to the "locked" position when they are open more than ¼" at the point of switch.

Responsibility:
Signal Maintainer

Records:
Results of Test 13 shall be recorded for all switch points on C&S 27. Form and forwarded to the office of the Roadmaster C&S.

Results:
If any discrepancies are found during testing, the maintainer shall immediately make the proper adjustments to ensure the switch passes the test. Any lock rod that is found to be worn or damaged shall be immediately replaced. If repairs or adjustments cannot be made immediately, the Roadmaster C&S must be informed and arrangements made for the safe protection of trains.

TEST 13A SWITCH OBSTRUCTION

Frequency:
At least once every month or if any part of the switch layout that affects switch locking is modified or disarranged.

Inspection Procedure:

- Inspect the general condition of switch layout, which may affect reliability and safety, such as surfacing, ties, braces, rods, points, stock rails, nuts, bolts and cotter pins.
- Inspect general condition of switch machine which may affect reliability and safety including:
    - Check for play and lost motion in switch operation due to worn pins, worn head timbers, defective or worn cranks, loose rods etc.
    - Check that hand throw switches operate properly.
    - Ensure that the slide plates are adequately lubricated.
- Check the position of the points to ensure they lay flush against the stock rail.

Test Procedure:

1. Place a 1/4-inch obstruction between the open point and the stock rail, 6 inches from the end of the point.

2. Operate the switch machine against the obstruction.

3. Ensure that the switch machine does not lock and fails to indicate. If switch does lock up, lock rods must be immediately adjusted.

4. Remove obstruction and repeat for all points both normal and reverse.

TEST 13B Power Switch Hand-Operating Test

Power switches equipped with dual-control mechanisms.

Frequency:
At least once every six months or if any part of the switch layout is modified or disarranged.

Inspection Procedure:

Alstom Model 5 Switch Machines
The test shall be made by placing a 1/2-inch obstruction in the open point and, after placing the switch machine in the hand-throw mode, moving the switch point against the obstruction and assuring that the switch lever cannot be moved to the full normal position. This test shall be made for both the normal and reverse positions.

TEST 14 MOVEABLE BRIDGES

FRA 236.387, 236.312

Purpose:

Test is to ensure that no signal can be displayed over a moveable bridge unless the bridge is properly aligned and locked in accordance with FRA 236.312.

Responsibility:

TEST 14A Signal Maintainer

TEST 14C - Signal Maintainer jointly with Inspector C&S

Records:

Results of Test 14 shall be recorded on Form C&S 27.

Results:

If any device or apparatus does not meet the criteria of this test, it shall immediately be adjusted or replaced and action must be taken for the safe protection of trains.

TEST 14A RAIL SEATING CONTROLLER

Frequency:

At least once every month or if any part of the rail seating controller is modified or disarranged. Conditions or performance data may warrant more frequent inspections and tests.

Procedure:

Test each lift rail with 3/8-inch obstruction. Rail seating controller or proximity detector should not indicate seating.

Check Rail repeater arms operate to reverse position when bridge is raised.

TEST 14C ADJUSTMENT OF LOCKS, LOCKING AND CIRCUIT CONTROLLERS

Purpose:

Test is to ensure that all moveable bridge components are functioning as intended. Test 8 (377) Approach Locking, or Test 9 (378) Time Locking shall also be performed on a yearly basis for moveable bridges.

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every year, whichever occurs first.

Procedure:
In addition to Test 14A, check operation and adjustment of all circuit controllers connected to the wedges, span locks, etc., to see that contacts make or break when corresponding functions are in their proper position. Check that centering devices operate freely and properly centering devices operate freely and properly.

Check all circuit controllers in accordance with Table 14.1 and as follows:

1. Adjustment of Locks and Circuit Controllers

   Check adjustment of all circuit controllers in accordance with the following schedule:

Device	Position to be indicated	Contact closure conditions
Surface Wedges or Span Locks	Fully driven	Fully driven to within 1" from normal stroke
Rail-Seating Controllers	Closed	Closed when bridge is 3/8 inch from rail seat

2. Indication contact breakdown test will be performed in accordance with Test 20 for all circuit controllers in use at the moveable bridge.

3. Voltmeter will be placed on the indication circuit for each circuit controller to ascertain that the applicable relay (wedges, span locks or rail seating) is de-energized when each contact is energized with the bridge open to ensure the cycle check is effective for all applicable components.

Identify and prove that the first track repeater relay responds to a shunt on its respective track circuit. When this has been done, the first track repeater relay may be opened in lieu of shunting the individual track circuits for the remainder of the test.

NOTE: THE FIRST TRACK REPEATER MAY BE USED ONLY WHEN THE TRACK CIRCUIT RELAY DOES NOT CONTAIN CIRCUITS CRITICAL TO THE TEST.

4. Clear the interlocking signal. Check that the drawbridge cannot operate and that no conflicting signals can be established. De-energize the applicable indication relays (wedges, span locks, rail seating and gate up) and track relays in the route, one by one, to ascertain that each relay, when de-energized, will cause the signal to display the stop aspect. If an automatic grade crossing is within the interlocking limits, ensure that the timers, stick networks and emergency control plugs also put the signal to stop.

5. When all relays in the route have been tested, perform time or approach locking tests on the signal to ensure that the drawbridge cannot be operated until the specified time interval has expired.

6. Repeat procedure for all interlocking signals

7. With signals at stop, de-energize each track relay within the interlocking, one-by-one, to ensure that the drawbridge cannot operate with a track circuit occupied.

TEST 15 ROUTE LOCKING FRA 236.379,

Purpose:
To ensure that the route remains locked in advance of a train that has accepted a signal to proceed into that route, and that switches remain locked under the train. To properly test this function the Test Inspector needs to assure themselves that both "Signal Indication" and "Time" Locking has been released.

Responsibility:
Signal Inspector.

Records:
Results of Test 15 Route Locking are to be recorded on Form C&S 27, showing track circuits shunted and switches locked. All forms must be forwarded to the office of the Roadmaster C&S.

Results:
If any discrepancies are found during testing the Inspector shall immediately notify the Roadmaster C&S and make arrangements for the safe protection of trains.

NOTE: Tests 7, 8 (if applicable) 9, 11A and 15 may be done together for each route.

Frequency:
When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or at least every two years, whichever occurs first.

Preparing for the Test:

1. Check interlocking track diagram for any clearance notes or restrictions.

2. Identify and prove that each track relay (or track repeater) responds to a shunt on its respective track circuit. When this is done, the relays may be opened rather than shunting the individual track circuits for the remainder of the test. (If the track relay is located in the CIL it should be used for the test. If the track relay is not located in the CIL, the first repeater of the track relay should be used for the test.)

3. Verify that all indications on the model board are working.

4. Route Locking tests must be performed using the manual control panel rather than requesting the Dispatcher to line routes and display signals.

Procedure:

1. Line the route to be tested.

2. Clear the home signal for the route to be tested. Verify that the "ASR" is de-energized.

3. Check that all switches in the route, and those required to be locked for other reasons are locked, and that any opposing signals to this route cannot be displayed. Open the first track circuit in route, verify that the signal displays its most restrictive aspect.

4. Cancel signal request, or ensure signal request has cancelled.

5. Check that time or approach locking has released. At interlockings where a two track circuit release is in use, it will be necessary to momentarily shunt the second track circuit in the route to release the time or approach locking. At microprocessor interlockings it will be necessary to verify that ASR function has released by using a laptop computer to check that ASR function is true.

6. After approach or time locking has released, check that all switches, movable point frogs, derails, and other appurtenances in the route are locked.

7. For routes with more than one track circuit, shunt track progressively for entire route, then check, for each shunted track circuit, that all switches, movable point frogs, derails, and other appurtenances in the route are locked.

8. Each route shall be tested.

9. Where sectional route release is utilized, additional verifications are necessary to determine routes involving improper clearances cannot be established to the rear of the route under test.

TEST 16 TRAFFIC LOCKING

FRA 236.381

Purpose:

Test is to ensure that once a signal has been cleared into a section of track, or a train has entered a section of track, the direction of traffic cannot be changed nor can opposing signals be cleared into that section.

Responsibility:

Signal Inspector.

Records:

Results of Test 16 Traffic Locking are to be recorded on Form C&S 27, showing track circuits shunted and switches locked. All forms must be forwarded to the office of the Roadmaster C&S.

Results:

If any discrepancies are found during testing the maintainer shall immediately notify the Roadmaster C&S and make arrangements for the safe protection of trains.

TEST 16B: TRAFFIC LOCKING FOR ALL RELAY OR MICROPROCESSOR INSTALLATIONS

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged.

Procedure:

1. Clear signal on normal route, establishing traffic direction.

2. Check that opposing signal on normal route cannot be displayed, and that traffic direction cannot be changed. Repeat for each track circuit in traffic route.

3. Shunt each track circuit progressively, taking care that the shunt on the next circuit in the route is established before releasing the shunt on the preceding circuit, but insuring that preceding track circuit picks up before testing next circuit. Work progressively from initial signal to next interlocking where opposing signal is located.

4. Where Electronic track circuits (Electrocode, Genrakode or equivalent) are in use between Interlockings, observe the HR relay at the exiting end of the block to ensure that it remains de-energized during successive shunting of track circuits.

5. Test from each interlocking signal leading to track being tested. After all track circuits in route have been tested once to the opposing interlocking signal, other routes may be tested progressively from the entering signal to the first track circuit outside the initiating

interlocking. While the first track circuit outside the interlocking is occupied, check that all opposing interlocking signals are prevented from displaying other than "Stop Signal".

6. Repeat in the opposite direction.

   NOTE: This test must be performed by clearing signals at the Local Control panels in the field. This test should not be done using the office to clear signals.

TEST 17 SIGNAL MECHANISMS AND SIGNAL HEAD INSPECTION

FRA 236.102b

Purpose:

To ensure that the spectacle arm holding the colored discs is free from obstructions and does not bind or catch. In addition this test serves to check that all lenses are intact and that signals are properly maintained.

Responsibility:

Signal Maintainer

Records:

Results of Test 17, Signal Mechanisms, are to be recorded on Form C&S 27. All forms must be forwarded to the office of the Roadmaster C&S.

Results:

If any discrepancies are found during testing the maintainer shall immediately notify the Roadmaster C&S and make arrangements for the safe protection of trains.

TEST 17A SIGNAL MECHANISMS

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every six months, whichever occurs first.

Inspection Procedure:

1. Visually inspect the mechanism for broken, corroded, burned or worn parts. Ensure the glass base is securely fastened and no breakage or cracks are evident. Inspect the inside of the mechanism for foreign objects or evidence of corrosion on moving parts or pole faces.

2. Ensure that the lens system is clean and intact.

3. Ensure that all colored discs are securely fastened within the retaining rims of the spectacle arm and are free of cracks.

   NOTE: The green disc in the searchlight mechanism is pre-cracked by the manufacturer to avoid uncontrolled breakage due to the heat of the lamp. If double cracks occur or white light is visible through the disc, the mechanism should be replaced immediately.

Test Procedure:

1. A "movement" test must be made to determine that the spectacle arm moves from red to green and from red to yellow and vice versa without sluggishness or without being hindered by obstructions.

2. Disconnect one signal control wire from the mechanism.

3. Remove the reflector unit. (The reflector unit houses the lamp.)

4. Apply normal voltage to the signal control terminals, then, abruptly remove the energy. The mechanism should settle to its most restrictive position smoothly, and spectacle arm should "rock" 2 or 3 times before settling. A distinctive click should be heard each time the spectacle passes center. If the spectacle is sluggish or doesn't "rock" to center then friction is indicated and the mechanism must be replaced.

5. Reverse the polarity of the applied voltage to the mechanism, then repeat step 4, above.

6. Replace the control wire. Replace the reflector unit.

Test 17B COLORLIGHT SIGNALS

Purpose

Inspection is to ensure proper placement and condition of the signal lenses, wiring and lighting apparatus.

Frequency

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every six months.

Test Procedure:

1. Ensure signal lenses are proper color, clean and securely attached.

2. Ensure wiring in the unit is not damaged and is properly routed.

3. Ensure light bulb socket is secure, clean and properly aimed.

4. Ensure signal unit is properly focused.

5. Check lamp voltage and adjust if necessary. Voltage should not exceed 9.5 volts.

TEST 17C CLEAR BLOCK SIGNALS

Frequency

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every six months.

Inspection is to ensure that Clear Block Signals function as intended.

Test Procedure:

1. Inspect Clear Block Signal bulb.
2. Ensure signal lenses are proper color, clean and securely attached.
3. Ensure light bulb socket is secure, clean and properly aimed.
4. Ensure signal unit is properly focused.
5. Contact Dispatcher (or take local control) and request Clear Block Signal. Ensure signal is properly lit.
6. Check lamp voltage and adjust as necessary. Voltage should not exceed 9.5 volts.

TEST 17 D L.E.D. Signals

1. Ensure signal lenses are proper color, clean and securely attached.
2. Ensure wiring in the unit is not damaged and is properly routed.
3. Ensure all Light Emitting Diodes are lit.
4. Ensure signal unit is properly focused.
5. Check lamp voltage and adjust as necessary. Voltage should not exceed 9.5 volts.

TEST 18 GROUND TESTS

FRA 236.107, 234.249

Purpose:

To detect any grounded wires or power busses, which could compromise the safety and integrity of the signal system.

Records:

Report results of Test 18 on ground tests on form C&S 27 and summarize monthly. Record voltage of all battery supplies on test report.

Results:

Grounds in excess of that expressed below must be eliminated at once. Any ground that cannot be located must be reported to the Roadmaster C&S immediately.

TEST 18B, & 18C GROUND TESTS

Frequency:

TEST 18B At least once every month at all interlockings and moveable bridges. Using approved tester (S&C 360 or approved equivalent) check each buss and each cable wire entering house or case for grounds. Care shall be taken in observing proper operation of the test device in accordance with the manufacturers' instructions.

TEST 18C At least once every month at highway grade crossings and all other locations.

At locations that have been burned out by fire or have experienced lightning or power surges, ground readings must be taken on all associated wires and apparatus immediately.

NOTE: This test is not required on track circuit wires, AC distribution wires or common return wires of grounded common single break circuits.

Test Procedure

1. Test is made by measuring voltage potential between each energy bus and ground. All external ground connections shall be visually inspected. If a voltage potential between an energy bus and a ground is detected, a current reading shall be taken to determine whether a ground exists in excess of .025 Ampere (25 mA) on high voltage battery (110 volts) or .001 Ampere (1 mA) on low voltage battery is recorded.

2. Connect positive meter lead of voltmeter to a positive energy buss and connect the negative meter lead to a known ground. If voltage is read, there is an apparent negative ground. Make a similar test on the negative energy buss by connecting the negative meter lead to the negative buss and connect the positive lead to a known ground. If voltage is read, there is an apparent positive ground.

3. If voltage is detected, the amount of current flow to ground must be measured by inserting an ammeter between the buss and ground to determine whether a true ground exists. When it is determined that a ground exists, use of an ammeter will facilitate location of same, and will provide a tolerance level. Care should be exercised in use of an ammeter in respect to the movement of trains and the integrity of the signal system; for applying an ammeter between battery and ground can be the second path that completes an undesired operation and/or indication.

CAUTION: IN NO CASE SHALL A CURRENT READING BE TAKEN WHEN A TRAIN IS CLOSELY APPROACHING OR PASSING, NOR SHALL ANY METER CONNECTED BETWEEN ENERGY BUSSES AND GROUNDS BE LEFT UN-ATTENDED

AT NO TIME WILL 2 AMMETERS BE CONNECTED TO THE SAME SOURCE WHILE TESTING GROUNDS AS AN AMMETER INDUCES A GROUND TO THE SYSTEM.

4. **When a current reading in excess of .025 Ampere (25 mA) on high voltage battery (110 volts) or .001 Ampere (1 mA) on low voltage battery is recorded, further tests must be performed to discover the location of the ground and eliminate it.**

5. At locations with approach lighting, signals must be lit before testing with A.C. power turned off

6. At Highway Grade Crossings, D.C. power busses (excluding overlay battery) should be tested with the POR relay down and the crossing operating. This is to ensure that all wiring is ground free. To test A.C. power busses, crossing need not be operating.

   NOTE: Where a "battery bus" is energized only by the use of a rectifier, without including the physical battery, the taking of ground readings on such rectifier "battery bus" is to be included within the scope of this test. Where rectifier is connected directly to A.C. source such as switch bridge rectifier (e.g. FX Interlocking) test should not be made with ammeter.

TEST 19 FOULING CIRCUITS AND SHUNT WIRES

FRA 236.104

Purpose:

To ensure the integrity of the fouling wires in a switch layout and to ensure those wires will detect equipment in the foul of the main track. Also to ensure the integrity of wires used to shunt track circuits in switches and shunt type circuit controllers.

Responsibility:

Signal Maintainer

Records:

Results of Test 19 on fouling circuits and shunt wires shall be recorded on Form C&S 27.

Results:

Any deficiencies noted shall be repaired or corrected immediately.

Inspection Procedure:

Visually inspect fouling circuit to determine that all bonds and fouling wires are intact, visible, in good condition, and in place as per FRA CFR 49 Parts 236.57, and 236.58. Apply pressure with a screwdriver or similar tool to ensure that each end of the bond is secure in the rail.

TEST 19A FOULING WIRES

Frequency:

Shunt fouling circuits shall be inspected and tested at least once every three months.

Test Procedure:

1. Place a voltmeter across the main track rails, and check for track circuit voltage.

2. Place a .06 ohm shunt across the rails at a point within the fouling section farthest from the transposition joints. (See Figure 19-1, Shunt A)

3. Check the voltage on meter of the main track rails. Ensure track relay is in the de-energized position.

4. Move the shunt as close as possible to the transposition joints within the fouling section and repeat. (Shunt B)

5. Move the shunt again on the main track side of the insulated joints and repeat. (Shunt C).

6. For shunt fouling circuits within interlockings that have two track relays, perform test with shunt placement as shown in Figure l9-2 and ensure both track relays drop to their most restrictive position.

7. Visually inspect fouling wires to determine that all fouling wires are intact, visible, in place and in good condition.

   NOTE: See table 24-1 of Test 24 to determine shunt value appropriate for track circuit being tested.

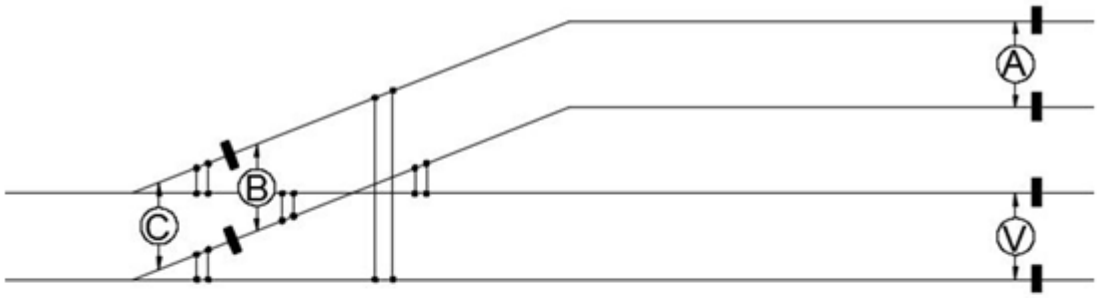

Figure 19-1.
Shunt Fouling Single Track Relay

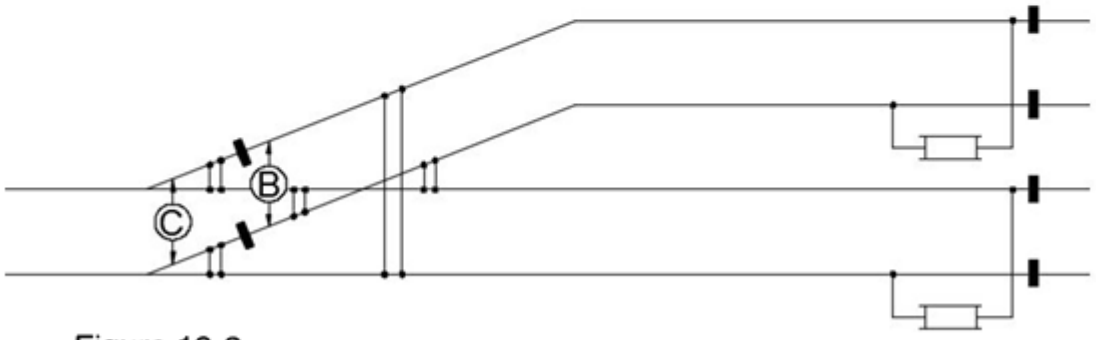

Figure 19-2.
Shunt Fouling Dual Track Relay

TEST 19B SERIES FOULING WIRES

Frequency:
Series fouling wires shall be inspected and tested at least once every three months.

Test Procedure:

1. Visually inspect series fouling circuit to determine that all bonds and fouling wires are intact, visible, in place and in good condition.

2. Ensure that the location of the cable is per the standard plan for that type of switch layout. (Cables not properly aligned may result in a loss of cab signals).

   NOTE: Shunt fouling wires that are included as part of series fouling layout, must be tested per Test 19A.

TEST 20 SWITCH CIRCUIT CONTROLLERS AND POINT DETECTORS

FRA 236.6, 236.103

Purpose:

To ensure switch circuit controllers are in good condition and properly adjusted.

Responsibility:

Signal Maintainer

Records:

Results of Tests 20A, 20B and 20C for point detectors shall be recorded on Form C&S 27. All forms must be sent to the office of the Roadmaster C&S.

Results:

Any circuit controller or point detector not meeting the conditions of this test must be adjusted, repaired or replaced immediately.

TEST 20A ALL POWER SWITCHES INCLUDING HELPER, MOVABLE POINT FROG AND SPLIT POINT DERAIL MACHINES.

Frequency:

All Power switches including helper, movable point frog and split point derail machines shall be inspected and tested at least once every three months.

Inspection Procedure (All Switches):

1. Inspect the general condition of the switch circuit controller, switch point detector, and all connecting rods. Ensure that circuit controller connecting rods, lug and lug connections have not lost motion and are properly lubricated.

2. Inspect all wires to ensure they are properly tagged and clear of all moving parts. Ensure that shunt wires, where used, consist of two conductors and are visible for inspection.

3. Contacts should be clean, bright and uniform. Open contact air gap must not be less than 1/16". Ribbons for contact connections must be in good condition.

4. Rollers and cams must not be worn, cracked or flat spotted. Adjusting screws should be in good condition and must not be stripped or worn. Linkage and roller pins must not be worn excessively and must be in proper position and fastened securely.

5. Inspect general condition of switch machine which may affect reliability and safety including:

    a. Proper lubrication of switch plates

    b. Inspect all switch housings for cracks, make sure gaskets are intact, hinges and latches are in good condition and all padlocks are intact and perform their intended function.

6. Ensure proper amount of point pressure

7. Check the condition of the lock rod to ensure that the edges are square and the openings conform to safety standards.

8. Check locking dog or plunger to ensure that the locking edges are square.

Switch Points

Procedure:

1. Connect a voltmeter across the relay end of switch repeater circuits to determine if the switch controller is working as intended.

2. Test point detector with gauges in accordance with manufacturers instruction pamphlet so that the switch will latch out with a 3/8" obstruction where mechanical latch out is provided. If switch fails to latch out, point detector needs to be adjusted.

   Where mechanical latch out is not provided, switch indication contacts must be opened by a 1/4–inch obstruction gauge inserted 6 inches back from the front of the switch point. Float the normal lock-rod to allow the switch machine to lock when operated against the obstruction. Ensure that locking dog is fully through the lock-rod.

3. Confirm that switch indication contacts are open and voltmeter reads zero.

4. Remove the gauge, close the switch, and ensure that the switch repeater circuit closes.

5. Repeat steps 1 through 4 for all the points in the switch layout.

Moveable point frogs for standard turnouts, #15 and larger switch points.

Procedure:

1. Connect a voltmeter across each normally closed switch repeater contact in turn and:
   a. Ensure the voltage reading is zero
   b. Ensure the voltage reading changes to circuit voltage when opened
   c. Repeat for opposite direction

2. Place a voltmeter across the relay end of the normal switch repeater circuit.

3. Open the switch point far enough to place a 1/4–inch obstruction, 6" back from the frog point. Float the normal lock-rod to allow the switch machine to lock when operated against the obstruction. Ensure that locking dog is fully through the lock-rod.

4. Confirm that switch indication contacts are open and voltmeter reads zero. If voltmeter shows voltage to the switch repeater, point detector needs to be adjusted.

5. Remove the obstruction. Re-adjust lock rod so switch will not lock with 1/4" obstruction. Operate the switch normal and ensure voltage is to the switch repeater.

6. Repeat the procedure for the reverse point

7. Repeat steps 1 through 7 for all the points in the switch layout

TEST 20B MID-POINT CONNECTED CIRCUIT CONTROLLERS
(Applies to Power Switch Machines or Midpoint Circuit Controllers)

Frequency:
All mid-point connected circuit controllers shall be inspected and tested at least once every three months.

For 39 or 45 foot points.

Procedure:
1. Perform Test 20A Inspection Procedure part 1 through 8.

2. Inspect the mid-point of each switch point to ensure that it is adjusted to fit solidly against the stock rail while maintaining gauge.

3. Connect a voltmeter across the relay end of switch repeater circuits to determine that the switch controller is working as intended.

4. If the mid-point is equipped with a circuit controller, ensure that the switch indication circuit is opened when the mid-point has a 5/8" obstruction between the point and the stock rail at the point where the point detector rod connects to the circuit controller or at operating rod location. This step is not necessary where there is no mid-point circuit controller.

5. Switch indication circuit should indicate when the mid-point has a 1/2' obstruction between the point and the stock rail at the point where the point detector rod connects to the circuit controller, or at the operating rod location.

TEST 20C HAND OPERATED SWITCH WITH CIRCUIT CONTROLLER
(Includes spring switch equipped with circuit controller)

Frequency:
All hand operated switch with circuit controllers shall be inspected and tested at least once every three months.

Circuit Controllers

Procedure:

1. Perform Test 20A inspection procedure Parts 1 through 6.

2. Connect a voltmeter across the rails where a shunt is used or across the relay end of switch repeater circuits to determine if the switch circuit controller is working as intended.

   For shunt type circuit controllers visually inspect series fouling circuit to determine that all bonds and fouling wires are intact, visible, in place and in good condition

3. Place a "1/4" obstruction gauge 6 inches back from the point between the point and the stock rail.
4. Close the switch point against the gauge.

5. Ensure that:
   a. Track is shunted, or
   b. Signal control circuits are open, or
   c. Switch repeater circuit is open

6. Remove the obstruction gauge, close the switch, and ensure track shunt is removed, signal control circuit closes or switch repeater circuit closes.

7. Repeat for reverse point if applicable.

8. If switch has another end, repeat test for other end.

Circuit controllers connected to derails shall be so adjusted that the control circuits will be opened, shunted, or both, or the track will be shunted when derail is obstructed by a 1/2 inch obstruction. Test shall be made by opening derail and placing a 1/2 inch obstruction on top of rail. Derail should then be closed and contacts checked with a meter to ensure control circuits are open, shunted or track is shunted. In the case of derails where track circuit is shunted a visual check of the track wires should be made to ensure they are in good condition.

Circuit controllers connected to hand operated non-interlocked split point derails shall be so adjusted that the control circuits will be opened or shunted, or both, or the track will be shunted when the derail point is within 2 1/2 inches of the stock rail.

TEST 20D: SPRING SWITCHES

Frequency:
All spring switches shall be inspected and tested at least once every month.

Test Procedure:
1. Oil buffer or mechanical switchman shall be adjusted so that switch points will return from fully open position to the proper position according to the manufacturer's specifications and instructions. Check shall be made for both normal and reverse positions of the switch.

2. Switch circuit controllers installed on a spring switch shall be tested and inspected in accordance with Test 20C.

3. Ensure buffer cylinder is full of specified lubricant.

TEST 23 A&B, NEW INSTALLATIONS OR MODIFICATIONS TO INTERLOCKINGS, AUTOMATIC SIGNALS AND HIGHWAY CROSSING SYSTEMS, TEST 23 C, REPORTED OR SUSPECTED FALSE PROCEED INDICATION OF ANY VITAL SIGNAL SYSTEM, TEST 23 D, REPORTED GRADE CROSSING ACTIVATION FAILURE.

FRA 236.4, 234.209

Purpose:

1. This test ensures that new installations or modifications to existing installations are operating as intended.

2. To ensure a complete and accurate investigation is conducted into alleged false proceed signals, wrong side failures or "Failure to Activate" reports at Grade Crossings.

Responsibility:

Signal Foreman, Signal Inspector, Electronic Technician and Signal Maintainer.

Records:

Test 23 A&B Results for Test 1 shall be recorded on Form C&S 27 showing the number of each test performed, the date tested and by whom. The Employee in charge shall sign the C&S 27 form only after all required tests have been completed. A separate form shall be filled out for each separate test as required by the C&S 1.

Test 23C False Proceeds. The Senior Engineer C&S shall complete and submit a false proceed incident report within 7 days of report or incident to the Office of the Assistant Chief Engineer- C&S.

Test 23D Grade Crossing activation failure. The Senior Engineer C&S shall complete and submit an FRA form F 6180 detailing the cause and corrective action and submit to the A.C.E. C&S for reporting to the FRA within 10 days.

Results:

All discrepancies must be corrected and adjustments must be made before the facility is placed into service unless authorized by the Roadmaster C&S who must make arrangements for the safe protection of trains. If conditions are observed in which the approved plans do not seem to provide proper protection or flexibility of operation, such conditions shall be immediately protected and brought to the attention of the Roadmaster C&S and Assistant Chief Engineer C&S.

TEST 23A OPERATIONAL CHECK

Frequency:

All new installations or any modifications to interlockings, automatic signals, and highway crossing systems that are to be placed into service shall have an operational check performed.

Procedure:

1. A complete operational check to ensure proper switch locking and proper sequence of operations must be made, including:

a. Signal aspects;
b. Cab signal codes;
c. Opposing and conflicting signal protection;
d. Facilities check.

2. In addition, all applicable C&S 1 tests shall be made on any new or modified installations.

3. With the route lined through the interlocking (or portion of the interlocking) being tested, place the next signal beyond the interlocking (or portion being tested) to its most restrictive aspect, and observe that the signal being tested displays "Approach", "Medium Approach", "Slow Approach", or "Diverging Approach" as required in the route being tested.

4. Without changing the route, it will then be necessary to look at each of the other routes leaving the interlocking (or portion being tested) in the same direction as the route being tested, as follows:
   a. For each route other than the route lined, arrange to display the most favorable aspect on the next signal. Observe the incoming control ("D", "AD", and "BD") for each track on these other routes. Ensure that the signal under test does not display a better aspect then intended.
   b. The incoming "D", "AD", "BD" or controls may occur simultaneously, one by one, or in any combination to expedite the checking, but all must be seen to ensure that none causes the "Approach", "Medium Approach", "Slow Approach", or "Diverging Approach" aspect to upgrade on the signal being tested.

5. With the original route lined, arrange the signal under test to display "Stop and Proceed" or "Restricting" (as required by the route being tested) by occupying any portion of the first block beyond the interlocking in the route lined (re-establishing the directional stick if necessary to accomplish this).

6. Look at the incoming "H" controls for each other route in the same direction as lined from the signal being tested, to ensure that the receipt of an energized "H" control for any track on these other routes will not cause the signal under test to display a better aspect than intended. The incoming "H" controls may be arranged simultaneously, one by one, or in any combination, but all must be checked against the signal and the route being tested.

7. New installations must be given a detailed check promptly upon installation as indicated below in Test 1B. Plans-so-marked must be given a detailed check. All subsequent changes must be checked and plans-so marked must be checked promptly upon completion.

TEST 23B DETAIL CHECK OF LAYOUT, LOCKING AND CIRCUITS

Frequency:
Before new installations or modifications to existing installations are placed into service, there shall be a complete detail check of layout, locking and circuits performed.

Procedure:

1. Check layout conditions in the field for agreement with layout plans concerning
    a. Track arrangement;
    b. Number, location, frog angle and fouling point of crossovers and turnouts;
    c. Location, type, aspects and routing of signals;
    d. Location of signal housings, buildings, bridges, poles and other structures which affect preview of signals and operation of signal system.

2. Inspect physical conditions of:
    a. tracks and switches,
    b. signal bridges,
    c. foundations,
    d. pipe lines,
    e. machine,
    f. tower,
    g. Signal housings and any other buildings involved.

3. Check signal housings and other buildings for fire hazards.

4. Check circuit conditions in the field for agreement with layout plans concerning the condition and location of:
    a. insulated joints;
    b. fouling points,
    c. fouling wires,
    d. batteries and chargers,
    e. relay connections and locations,
    f. wires and cables,
    g. switch circuit controllers and rods,
    h. transformers,
    i. switch movements,
    j. electric switch locks
    k. And all other apparatus on or about the tracks.

5. Each relay (or other signal apparatus) location must be inspected to ensure the following:
    a. that the location contains all the apparatus called for on the plans and that there are no excess apparatus or foreign material,
    b. that the apparatus is of proper type and has proper inspection dates,
    and that power and battery supplies are provided, fused and designated according to plan.

6. Check must be made of the number in use, kind, condition and adjustment of contacts in relays, electric locks, circuit controllers, releases, and similar devices, and tagging wire nomenclature of wires to controls and contacts.

7. (Not used)

8. Tests must be made of all circuits to ensure that the opening of each contact in control circuit cuts off the control current as shown on the plans, following through all multiple circuits and cut-around (wrap around circuits). When a circuit is broken over a relay twice, or when it is broken over some other contact that will be opened by opening the relay, the wires in the circuit must be disconnected to test, as well as, the opening of the relay.

9. Conditions found that are not in accordance with approved plans shall be corrected at once, or steps shall be taken to revise the plans to agree with the work.

10. All index plates on bases and plug-in relays must be checked to ensure that the prescribed pins and holes for each relay are properly installed and secured.

11. All EPROM's containing vital signal logic must be verified with approved plan for each specific item of equipment at each location. This verification must include all information on Signal plans and EPROM label. This is described in the Software Management Control Plan (SMCP). In case of doubt of any information pertaining to vital signal logic equipment please refer to the Keolis "T" drive for the SMCP, Signal Software Library Database (SSLD), Signal Maintenance Documentation Database (SMDD) and the Signal Design Procedures (SDP).

12. All vital software changes shall be shown in the VHLC Validation Report, VHLC Revision History Log, Colored Red and Green Equation Printout and the Keolis SMCP and shall be reported on C&S 27 report form. For non-vital software, changes will be tested the same way but without the validation report and shall be reported on C&S 27 report form.

13. Any changed vital or non-vital software shall be tested as described by the Senior Engineer C&S Design or his designee. A colored software printout will show all the changes made to the equations from within the program to be changed as following:
14. RED=To Be Removed and GREEN= To Be Installed.

15. Tests should be completed to prove these changes only, or tests that are associated with these changes. Electro-Code changes shall have colored Red and Green Equation Print-outs with a comparison of the existing programs. Electro-Code is compiled using a DOS base program and doesn't have a Validation report function.

16. Additionally, it may be necessary to perform a functional test of the system to ensure signals, switches and other appliances operate as designed.

17. A copy of all tests on software changes performed shall be sent to the Senior Engineer C&S Design for compliance with 49CFR 236 Subpart H and the Keolis SMCP. All old EPROM software shall be returned to the Signal Design Office after all tests are performed and in compliance with the plans and software documentation.

18. Disarrangement of Signal Software upon catastrophic failure of operating or executive software due to Electrical surges, Lightning strikes, fire, vandalism or other reasons.

a. An exact duplicate of the existing software shall be replaced and a complete operational test be performed to restore the system as before.

19. Once a contractor has designed a Vital Signal Logic system and it's installed and placed in service with a revision level of "N/C" as per Keolis SMCP, all future contractor changes will be submitted to the Keolis Signal Design office, for approval prior to any software being put in service.

20. Revision updates of Executive Software will be determined by Keolis C&S, Letters on the manufacturers Product Improvement Announcements (PIA), and their Engineering Service Bulletins (ESB). Testing of this software, when installed in equipment that is already in service will consist of an operational test and watch a train movement in both directions.

21. When any vital software is changed all changes to the program as detailed in the Validation Report shall be tested as described by the Senior Engineer C&S Design or his designee. In addition it may be necessary to perform a functional test of the system to ensure signals, switches and other appliances operate as designed.

22. A copy of all tests performed shall be sent to the Senior Engineer C&S Design for compliance with 49CFR 236 Subpart H.

23. The Test Inspector shall submit the sign off sheet (SDP-1021-3) detailing what software revision was removed, what revision was installed and other relevant information the office of the Senior Engineer C&S Design for compliance with 49CFR 236 Subpart H.

24. Inspect signal cases and housing to ensure all excess material has been disposed of and the installation renders a neat and orderly appearance and inspect the plans and software documentation that it agrees with the field conditions.

25. When making these checks and tests, if conditions are observed in which the approved plans do not seem to provide proper protection or flexibility of operation, such conditions shall be immediately protected and reported to Roadmaster C&S and Assistant Chief Engineer C&S.

TEST 23C FALSE PROCEED

Frequency:

If signals are found or are suspected of giving false indication, the signal control wires shall be disconnected at the signal heads. The housing enclosing the signal apparatus must be sealed without change or repair until inspected or as otherwise directed by the Assistant Chief Engineer C&S or his representative. (C&S 2 Rule number 57)

Procedure:

1. When the signal system is reported or suspected to have given False Proceed information, the Roadmaster C&S shall be notified immediately and the system shall be given a complete operational check when directed by Roadmaster C&S to ensure proper switch locking and proper sequence of operations including:

    a. Signal aspects,
    b. Cab signal codes,
    c. Opposing and conflicting signal protection and overrun protection.

2. It must be ensured that facilities are functioning as intended. (**Verify sequence of events through recording devices and control system playback where available).**

3. If the False Proceed, or reported False Proceed cannot be duplicated and verified as to cause, then a 24-hour signal watch is to be established. The Senior Engineer C&S Design shall designate a C&S employee to verify, for 24 hours, all signal aspects, cab signal aspects, and switch positions in the route involved. All aspects shall be recorded for each train movement and each change in aspect by the C&S employee in charge.

4. In addition, all applicable C&S 1 tests shall be made on such installations as follows:

    a. Test 2, Insulation Resistance to ensure insulation resistance is within design parameters and in accordance with the specifications.
    b. Test 4, Relays and other Electro-Magnetic Apparatus to ensure that relays are within specification and are according to approved plan.
    c. Test 18 Ground Readings to ensure ground grid is within specification and is performing within the design parameters.
    d. Test 24 Track Circuits to verify the track circuits are within specification and are performing within the design parameters.
    e. Test 1B, Detail Check of Layout, Locking and Circuits to verify the as-builts drawings are accurate, as well as, confirm that the locking, control and indication circuits are within specification and are performing within design parameters.

5. Depending on conditions and circumstances, the following tests may be required:

a. Test 9 Time Locking
b. Test 10 Timing Devices
c. Test 11 Switches
d. Test 13 Switch obstruction
e. Test 15 Route Locking
f. Test 16 Traffic Locking
g. Test 19 Fouling Circuit
h. Test 20 Switch Circuit Controllers
i. Test 26 Highway Crossings
j. Test 27 Insulated Rail Joints
k. Test 29 Restricting Code Change Point
l. Test 30 Approach Medium Code Change
m. Test 36 Audio Frequency Overlay Devices

6. The Assistant Chief Engineer C&S shall record and provide the following:

a. False Proceed Report Form
b. Electronically recorded engine data shall be transferred and maintained in electronic and written format.
c. Reporting Engineer Interview Report Form

TEST 23 D REPORTED GRADE CROSSING ACTIVATION FAILURE

Frequency:
Upon receipt of a reported activation failure, as defined in 49 CFR 234.5.

The definition of "Activation Failure" shall be as follows:

- The failure of an active highway-rail grade crossing warning system to indicate the approach of a train at least **20-seconds** prior to the train arrival at the crossing and the gate arm, if so equipped, shall start its downward motion not less than **3-seconds** after flashing lights begin to operate and shall assume the horizontal position at least **5-seconds** before the arrival of any normal train movement, unless the crossing is provided with an alternative means of active warning to highway users of approaching trains;

- A location with more than 50% of the flashers (not gate lights or back lights) on any approach lane not properly functioning;

Procedure:

1. Ensure that the Dispatcher has issued "stop and protect" order (NORAC Form "D")
2. Ensure Police Department having jurisdiction has been notified by Trouble Desk.
3. Notify Roadmaster C&S or C&S Manager in charge of section immediately.
4. If possible obtain names and phone numbers of witnesses or persons who reported the incident. *(This is critical in order to eliminate nuisance reports from the general public and law enforcement who may not be familiar with railroad operations)*

5. Ascertain what track is involved, and direction of train movement from reporting person or Train Dispatcher.

6. Roadmaster will immediately arrange to have the Locomotive Engineer of the train interviewed, and Locomotive event recorder downloaded.

7. Communicate with the Train Dispatcher, Agency reporting failure, or other pertinent witnesses to ascertain whether gates came down, flashers operated, and with the train crew to determine what signal aspects were observed / operated under.

8. If an accident is at a highway crossing equipped with automatic devices, an operational test of the installation must be made to check that the apparatus is functioning properly. Where the apparatus has been damaged, the crossing must be protected until repairs have been made.

9. <u>If the accident involves personal injury or a fatality, or if signals are found or are suspected of giving false indication, or if switches or other apparatus have not functioned properly, the housing enclosing the apparatus, which may be involved in the accident, must be sealed without change or repair until inspected or as otherwise directed by the Assistant Chief Engineer C&S or his representative. (C&S 2 Rule number 57)</u>

10. Arrange for the downloading of the Highway Grade Crossing event recorder after receiving proper authority.

11. If recorder, witness interviews, or operational test indicates the failure of a particular piece of equipment or circuit, that item must be repaired, replaced or removed from service immediately. Crossing will remain out of service until repairs, or modifications are made.

12. Test 26 A, B & C will be performed as soon as possible and all readings and results documented on proper test form.

13. In addition, all applicable C&S 1 tests may be required including:

    a. Test 2, Insulation resistance test to include gate mechanism cables, flashers circuits, track wires, express cable, and all local wiring.
    b. Test 3, Foreign Current DC & 60 Hz. Non-Coded track if applicable.
    c. Test 4, Relays, and other electro mechanical apparatus to ensure that relays are within specification, and are according to approved plan.
    d. Test 10, Time Releases, Timing Relays, and Timing Devices
    e. Test 18, Ground Tests
    f. Test 24, Track Circuits
    g. Test 36, Audio Frequency Overlay Devices Including Block Joint / Overrun Detectors, and Presence Detectors.

14. Depending on track configuration, conditions, and circumstances the following tests may be required:

    a. Test 11 Switches
    b. Test 13 Switches
    c. Test 19 Fouling Circuits
    d. Test 20 Switch Circuit Controllers
    e. Test 1b Detail Check of Layout, Locking, and Circuits.
    f. Test 27 Insulated Rail Joints

19 **If the reported activation failure cannot be duplicated, or no defects / exceptions are found, and the crossing is not equipped with an event recorder for verification purposes, the crossing shall be monitored for 24 hours. The Senior Engineer C&S Design shall designate a C&S employee to observe, for 24 hours, the operation of the crossing and document all train movement times.**

20 The results of all tests must be properly documented and submitted to the Assistant Chief Engineer C & S promptly. Assistant Chief Engineer C & S will send completed report FRA form F6180.83 to the FRA.

TEST 24: TRACK CIRCUITS

FRA 236.51, 236.56, 236.59

Purpose:

TEST 24A- To ensure track relays and track receiver units are safe and reliable, adjusted in conformance with manufacturer's instructions and are not over energized.

TEST 24B- To ensure that track relays, and devices that function as track relays are in their most restrictive state when occupied by other than a track car.

TEST 24C- To ensure that coded cab signals are properly adjusted to provide accurate block information to the cab of the engine.

TEST 24D- To ensure that the track circuit polarity is in accordance with the plans and to maximize protection against defective insulated joints isolating adjacent track circuits.

TEST 24F- To ensure that all track circuit wire connections are properly secured and tight, insulated joints are in good condition and arresters and protectors in good condition.

TEST 24G- To ensure the proper operation of the cab signal test and cut-in circuits.

Responsibility:

Signal Inspector, or Signal Maintainer

Records:

Results of Test 24 for track input voltage shall be recorded on Forms C&S 24 and C&S 27 in duplicate, with the track circuit nomenclature and all appropriate readings. C&S 24 form shall be left in the house or case and a copy forwarded to the office of the Senior Engineer C&S.

Results:

Any track circuit failing to meet the requirements of the above tests shall be repaired or corrected immediately. If discrepancies cannot be immediately rectified, then the Roadmaster C&S must be informed and arrangements must be made for the safe protection of trains.

TEST 24A TRACK CIRCUIT INPUT MEASUREMENT

Frequency:

At least once every two years or if the electrical operating characteristics of the track circuit are significantly altered. For example: change in ballast conditions due to track being undercut and ballast renewed, welded rail, replacing jointed rail, track section extensively bonded, change in any track circuit component, or adjustments due to failures.

Procedure:

Conventional Track Relays and Electronic Track Circuits

1. Take voltage reading on relay track input terminals.
2. Place ammeter in series with track relay and observe current reading.
3. For Electronic Track Circuits, take voltage and current readings according to manufacturers' instructions.

TRU-II Track Circuit (Use Simpson 260 or Digital Meter)

1. Take AC voltage reading on track input to TRU-Il unit.
2. Take DC voltage reading on output of TRU-II unit.
3. With meter still connected to TRU-Il output, remove the 3 amp track fuse. Output to relay must not exceed 2.5 volts DC.
4. Connect ammeter in series across open fuse to read current to TRU-II unit.
5. TRU-II units in cab signal territory must be checked to ensure that they pick up (reset) on receipt of the highest possible code (180 or 270 where used).
6. Record AC Reference Voltage.

Phase Selective Track Circuit

1. Read AC track voltage on the phase selective unit by connecting the meter to the input wires on the PSU.
2. Read DC output to the normal coil of the track relay, then to the reverse coil of the track relay.
3. Take current reading by placing ammeter in series with the track relay and read the peak current.
4. Record AC reference voltage.

TEST 24B SHUNTING SENSITIVITY

Frequency:

At least once every two years or if the electrical operating characteristics of the track circuit are significantly altered. For example: change in ballast conditions due to track being undercut and ballast renewed, welded rail, replacing jointed rail, track section extensively bonded, change in any track circuit component, or adjustments due to failures

Test Procedure:

1. Test should be made when weather is dry, when the maximum current is flowing through the rails and the ballast resistance is highest. If during new installations or extensive renewals, testing is performed when wet or raining, test should be repeated as soon as practicable thereafter when weather is dry.

2. Test must be made with an approved shunt device.

3. Connect the shunting device to track circuit at the relay end. Select the maximum resistance that will drop the relay.

4. Repeat for the feed end of the track circuit.

5. Any track circuit that fails to shunt with a resistance less than the minimum shown in the following table (Table 24-1) must be reported to the Roadmaster C&S.

Table 24-1: Track Circuit Shunt Range

Track Circuit Type	Minimum	Maximum
A.C. Vane	0.10 ohm	0.20 ohm
TRU-II	0.15 ohm	0.25 ohm
Phase Selective	0.15 ohm	0.25 ohm
AC Electronic Coded	0.15 ohm	0.25 ohm
D.C. 4 ohm	0.10 ohm	0.20 ohm
D.C. 1 ohm	0.10 ohm	0.20 ohm
D.C. 0.5 ohm	0.15 ohm	0.25 ohm
D.C. Coded	0.15 ohm	0.25 ohm
D.C. Electronic coded	0.15 ohm	0.20 ohm
Audio Frequency	0.15 ohm	0.20 ohm

6. All track circuits ***must*** shunt with a minimum resistance of .06 ohms.

TEST 24C CAB SIGNAL AXLE CURRENT

Frequency:
At least once every two years or if the electrical operating characteristics of the track circuit are significantly altered. For example: change in ballast conditions due to track being undercut and ballast renewed, welded rail, replacing jointed rail, track section extensively bonded, change in any track circuit component, or adjustments due to failures.

Procedure:
ABS Territory

1. Ensure that the advance signal has at least an approach aspect to avoid the cab signal from dropping out due to a code change point.

2. Place an ammeter at the entering end of the track circuit from rail to rail and read peak current.

3. Adjust to ensure at least 2 amperes axle current at the entering end with sufficient margin to cover all track circuit conditions without sacrificing broken rail protection. Leaving end axle current should not exceed 12 amperes. If leaving end axle current exceeds 12 amps, Roadmaster C&S and Assistant Chief Engineer C&S must be promptly notified. Under no circumstances must leaving end current exceed 20 amperes.

Interlockings

1. Have a signal displayed for a route. Ensure that the aspect on the wayside signal will conform to a cab signal aspect other than restricting.

2. Place an ammeter at the entering end of the track circuit from rail to rail and read peak current.

3. Adjust to ensure at least 2 amperes axle current at the entering end with sufficient margin to cover all track circuit conditions without sacrificing broken rail protection. Leaving end axle current should not exceed 12 amperes. If leaving end axle current exceeds 12 amps, Roadmaster C&S and Assistant Chief Engineer C&S must be promptly notified. Under no circumstances must leaving end current at either frequency to exceed 20 amperes.

NOTE: Be aware for code change points which may remove cab signals before a reading is taken.

TEST 24D POLARITY AND INSULATED JOINT PROTECTION

Frequency:
At least once every two years or if the electrical operating characteristics of the track circuit are significantly altered. For example: change in ballast conditions due to track being undercut and ballast renewed, welded rail, replacing jointed rail, track section extensively bonded change in any track circuit component, or adjustments due to failures.

Procedure:
DC Track Circuits

Test by applying voltmeter to track circuit, which will show actual polarity of the circuit. Verify proper polarity according to circuit plans. Ensure polarity is staggered at insulated joints. If any discrepancies are found during testing Roadmaster C&S should be notified.

TRU-II Track Circuit

1. Disconnect the feed from the track circuit being tested. Do not place a shunt on the track, as the TRU-II track circuit will not properly respond to the test.

2. Bridge each insulated joint simultaneously; (Figure 24-1) observing that the track relay does not attempt to pick and DC output from TRU-II unit does not exceed 6 volts.

3. Simultaneously cross shunt the insulated joints diagonally (see fig. 24-2). Observe that the relay should attempt to pick momentarily and DC OUT increases to approximately 9 volts or more. If these results are obtained, test is performed satisfactorily.

4. Replace feed to track circuit.

AC Electronic Coded Track Circuits (WRML-Foley St to Fells)

1. Bridge each insulated simultaneously (Figure 24-1).

2. Observe that the signal assumes it's most restrictive aspect and vital codes are not being transmitted in either direction.

DC Electronic Track Circuits (Electrocode / Genrakode)

1. Test by applying voltmeter to track circuit, which will show actual polarity of the circuit. Ensure that the polarity is staggered. Ensure polarity is staggered at insulated joints. If any discrepancies are found during testing Roadmaster C&S should be notified.

AC Vane Track circuits

1. Bridge the Insulated Joints simultaneously.

3. If the Track Circuit drops the Polarity is correct. If the Track circuit stays up the polarity is the same and has to be changed.

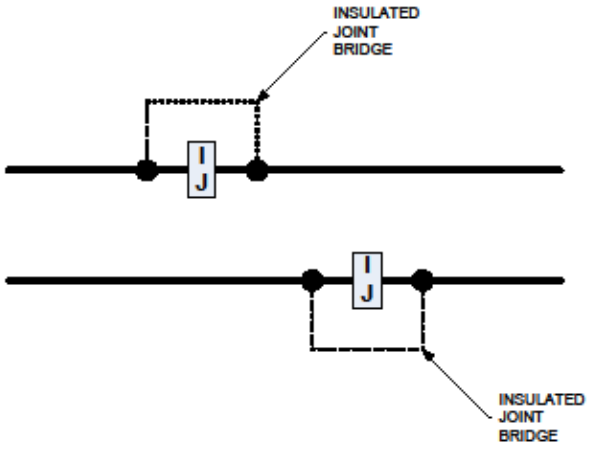

FIGURE 24-1

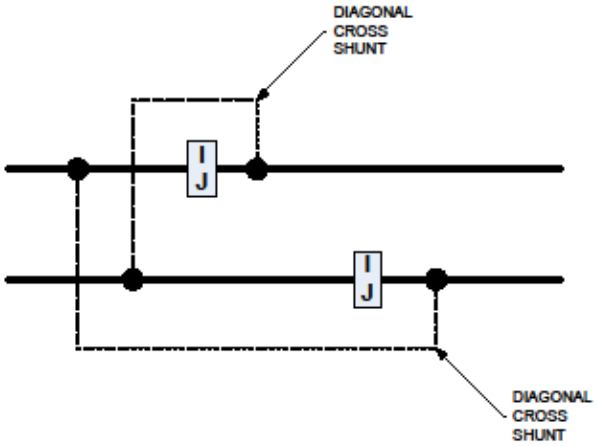

FIGURE 24-2

Figure 24-1: Insulated Joint Bridge
Figure 24-2: Diagonal Cross Shunt

TEST 24F VISUAL INSPECTION OF TRACK CIRCUIT COMPONENTS

Frequency:
At least once every six months preferably in April and November before and after snow cover.

Procedure:
1. Inspect all track circuit bond wires by walking track circuits. Replace all broken, frayed and loose bonds.

2. Inspect all bonding on shunt fouling sections and series fouling sections to ensure fouling wires are all double bonded and intact. Replace all broken, frayed and loose bonds.

3. Inspect all track connections for damage to bond strand due to dragging equipment or track machinery. Repair or replace any bond strand that has been damaged.

4. Inspect track circuit lightning arresters and surge protectors to ensure that they are intact and have not been damaged by lightning, power surge or traction. Replace any arresters or surge protectors, which appear to have been damaged.

5. Visual insulation test.
    a. All Track Insulation must be visually inspected. If inspection indicates poor conditions of insulation, test shall be made in accordance with Test 27. Insulated joints **MUST** also be inspected for spikes, rail anchors, tie plates, rail flow, end post missing and any condition that would bridge the insulation of the joint. In addition, switches **MUST be** inspected for rod clearances that would bridge the insulation and affect the integrity of the track circuit.

Conditions accountable to the C&S Department that would affect the integrity of the track circuit **MUST** be corrected immediately. All other conditions **MUST** be reported to the immediate Roadmaster for correction.

TEST 26: HIGHWAY GRADE CROSSINGS

FRA 234.247 thru 234.273

Purpose:

This test is to determine that all equipment in connection with each Highway Grade Crossing installation is in good working order and functioning as intended.

Responsibility:

TEST 26 A Signal Maintainer
TEST 26 B Signal Maintainer
TEST 26 C Signal Maintainer with Signal Inspector (or another Maintainer)

Records:

All results for Test 26 shall be recorded in duplicate on Forms C&S 26 and C&S 27. It is to be sent to the Roadmaster C&S with a copy to be kept at the crossing.

Results:

Any defects or discrepancies shall be noted on the test form and corrected immediately. If defects cannot be immediately corrected, the Roadmaster C&S must be notified and arrangements must be made for the safe passage of rail and highway traffic as per FRA 234.105 or 234.107.

TEST 26A HIGHWAY GRADE CROSSINGS

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once each month.

Procedure:

1. Observe line control and/or track relays and directional stick relays to ascertain proper condition. Crossings with mechanical interlocking relays should be tested on all tracks in all directions to ensure proper operation.

2. Measure voltage of all batteries while on charge, and record values on the battery card.

3. Check that POKE light is operational.
    a. Open AC power feed to place installation on standby battery.

4. Operate the crossing warning devices and determine there are no burned out lamps and that the auxiliary devices such as crossing bell & No Turn signs are operating properly. (Where test switch is provided such as knife switch use this means to operate warning devices.)

5. Observe if lamps appear to have normal brilliance after operating a minimum of two minutes. At crossings equipped with gates, the operation of the gates down and up three times may be used in lieu of two minutes of flashing light operation.

6. Measure voltage of all batteries at the crossing while charge is off and batteries are supplying the lighting load and record values on battery card. Values must be in accordance with values shown in C&S 2 or manufacturers' instructions for the type of cell. If not, batteries should be inspected and/or rectifiers should be adjusted.

   Perform the ground test in accordance with Test 18. Ground readings taken at crossings will be made with AC power on and with AC power off while crossing is activated. Record ground readings and battery voltages on Test 18 C&S 27 form.

7. Wipe dust and dirt off flasher roundels using a soft cloth and water if necessary, and determine as far as practicable that the alignment has not been disturbed.

8. Observe that no obstruction interferes with gate operation or obscures view of lamps. **Report such obstructions on test report in defects section.**

9. Restore AC power and warning system to normal operation and determine that AC energizes all rectifiers. Check actual charging current to ensure batteries are being charged.

10. **Inspect main and track batteries at the highway location for height of electrolyte, fill to top line if necessary and check for tightness of connections and cleanliness.**

11. At crossings equipped with predictors, record all display information such as RX value, phase angle, error codes, etc. Review and record the warning times of the past six trains, notifying Roadmaster C&S of any irregularities immediately. Reset error codes.

12. **Inspect gate arms, mechanisms and hold clear devices for signs of obstructions, damage, stress, maladjustment, or improper operation. Where shear pins and spring loaded gate arms are used, they must be inspected. Also, check that raise and lower buttons are functioning as intended, where provided.**

13. **Operate crossing to ensure that the crossing gates begin to descend not less than 3 seconds after the flashers activate. Record time on test report.**

14. Ensure that the gates descend together and reach full horizontal position simultaneously 10 to 15 seconds after starting down. Ensure that the gates are fully down a minimum of 5 seconds before the train arrives. Observe train movement to assure normal warning system operation and record in the crossing inspection book time, date and employee signature.

    NOTE: Total warning time must be a minimum of 20 seconds.

15. Ensure that crossing bell or other audible warning device (where provided) operates when flashers activate and remains in operation.

16. With gates in the horizontal position, ensure that they are straight and parallel with the roadway surface without "drooping". Gates should cover at least 90% of the lanes.

17. Inspect highway traffic signal preemption interconnections. Observe that the preemption interconnection operates for the time designated as shown on the as-built crossing plans**.** ***Notify Roadmaster immediately if any irregularities exist with clear out sequence time or traffic light functions. See C&S 2 #510.***

TEST 26B HIGHWAY GRADE CROSSINGS

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every three months.

Procedure:

1. Inspect all batteries at the highway approach location for height of electrolyte, and fill to top line if necessary. Check tightness of connections and cleanliness.

2. Check actual charging current (not rectifier output) of all batteries at highway and approach locations and record on battery record card. Charging currents and voltage of cells under charge should be adjusted in accordance with C&S 2 or manufacturer's instructions for the particular battery and temperature. If necessary to add water, record on battery card.

3. Inspect all bonds, fouling, track connecting wires, and insulated joints within the approaches to the crossing.

4. Each cut-out circuit shall be tested to determine that the circuit functions as intended. A cut-out circuit is any circuit, which overrides the operation of automatic warning systems. This includes both switch cutout circuits and devices, which enable personnel to manually override the operation of automatic warning systems.

5. Dispatcher override circuits at Four Quadrant Gate crossings must be tested unless these circuits have been disconnected at the crossing location, tagged out of service and notation made in circuit plans.

6. Where circuit controllers are used on switches to cut out operation of crossing warning devices, test each circuit controller with a 3/8 inch obstruction between reverse switch point and stock rail. Contacts should not assume the position that cuts out crossing warning devices.

7. Emergency Control Cut-out (where approach has to be down to cut out crossing)

Procedure 1:

GET JUMPER PERMISSION IN ADVANCE IN ACCORDANCE C&S 2 #301 BEFORE STARTING TEST

a) Get time from Dispatcher to take crossing out of service on track to be tested.
b) Pull plug from "normal" at the crossing and insert into "Gates up" position. .

c) Apply jumper from appropriate B12 to timer + terminal to start timer.
d) When timer is approximately 30 seconds from complete drop approach circuit then remove jumper so that crossing activates.
e) When timer is complete gates should raise and crossing should be de-activated.
f) Pick approach circuit.
g) Ensure jumper is removed and, check that timer has re-set to normal position.
i) Call clear of jumper permission
j) Put plug back to normal position
k) Test crossing ensure normal operation.
k) Give Track back to Dispatcher

Repeat procedure for remaining tracks.

OR

Procedure 2:

a) Get time from Dispatcher to take crossing out of service on track to be tested.
b) Shunt approach circuit.
c) Remove Emergency control plug from normal and place in "Gates up"
d) Record time it takes for gates to pick up.
e) Pick up Approach circuit.
f) Ensure timer re-sets to normal position.
g) Put plug back to normal position

Repeat procedure for remaining tracks.

8. Emergency Control Cut-out (where approach does not have to be down to cut-out crossing) Get time from Dispatcher to take crossing out of service on track to be tested.
   a) Remove Emergency control plug from normal and place in "Gates up"
   b) When timer is approximately 30 seconds from complete, drop approach circuit so that crossing activates.
   c) Record time it takes for timer to stop and gates go up.
   d) Ensure timer re-sets to normal position.
   e) Put plug back to normal position

5. Inspect and test stick release timers (if installed) for proper operation. Simulate a train operation through the crossing, holding the applicable leaving track circuit down to ascertain the proper stick relay releases after the specified time interval and the crossing protection reactivates. Repeat procedure for all stick release timers.

TEST 26C HIGHWAY GRADE CROSSINGS

Frequency:
When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every year.

Procedure:

1. Check visibility and focus of signals, visibility and condition of signs including RR advance warning signs on the highway, and XC signs or equivalent. Record obstructions on defects section.

2. Electric gates must be checked to see that the gates rise to full upright position no more than 12 seconds after the gates are permitted to clear.

3. Check the number of flashes per minute. If found to be less than 35 or more than 55 arrange for correction.

4. Check flashing contacts by observing that at least one lamp on each flasher unit and two lights on each gate arm are burning when flasher is at rest.

5. Check voltage at lamps after AC power has been off for two minutes. Flasher relay should be de-energized when voltage readings are taken. Voltage at lamp must be maintained at not less than 85% of the prescribed lamp rating by varying resistors in the lamp circuit. Lamps should be of the proper wattage per C&S 2.

6. AC power should then be restored and transformer taps adjusted to provide correct voltage. Gate arm lamp voltages should be checked at junction box or gate mechanism case.

7. Take hydrometer readings on:

    a. All nickel-iron and nickel cadmium cells. Specific gravity should be in accordance with C&S 2. Gravity reading, electrolyte temperature and height of electrolyte below upper limit fine readings are to be recorded on battery record card.

    b. All maintainable lead-acid type batteries at main and approach locations in accordance with C&S 2 before addition of water. Gravity reading, electrolyte temperature and height of electrolyte below upper limit line readings are to be recorded on battery record card.

8. Where circuit controllers are in service on switches to cut out operation of crossing protection, test each circuit controller with a 3/8 inch obstruction between reverse switch point and stock rail. Contacts should not assume the position that cuts out crossing warning devices.

9. Check gate arm torque adjustment in accordance with manufacturer's instruction to ensure that gate arms are free from friction or other interference that might prevent them from functioning as intended. Ensure gate down contacts where provided, function as designed.

10. Test the hold clear device for proper operation in accordance with manufacturer's instructions. Hold clear devices are not required to be tested for operating values. Observe the hold clear device while operating to ensure that it is functioning properly.

11. Check time delay of starting circuits (example preemption circuits). Time shall not exceed that shown on plans.

12. Check time delay of cut-out circuits. Time shall not be less than that shown on plans.

13. Where grade crossing warning is automatic using directional stick relays, check operation for each track in each direction and after tests are completed, observe that directional stick relays are de-energized.

14. Grade crossing predictors, motion sensors and overlay track circuits shall be tested in accordance with manufacturer's instructions.

15. Verify that the warning times on each track in both directions are as shown on the as-built crossing plans. Test each approach to ensure proper warning times at maximum authorized speed. Electronic devices that accurately determine actual warning times may be used to perform this test.

16. a. On Four Quadrant Gate Crossings activate crossing by dropping the approach circuit. Activate first and subsequent detector loops and ensure cabs go to restricting.

    b. On Four Quadrant Gate Crossings activate crossing by dropping approach circuit. Ensure all gates are down. Then, activate the first detector loop. Ensure cab signals drop out. Pick up the entrance gate high enough (approx. 5 degrees). Exit gate should go up. Activate the second loop. The exit gate should stay up and cab signals should remain at restricting. Continue with next loop (if applicable) through the crossing observing exit gate stays up. When vehicle clears last loop the crossing should return to normal with all gates in the down position and cab signals returned to normal.

    Repeat a & b for all directions of vehicular traffic.

TEST 27: INSULATING RAIL JOINTS AND SWITCH INSULATION

FRA 236.59

Purpose:

Test is to determine if the protective apparatus installed is operative and in good condition.

Responsibility:

Signal Maintainer or Signal Inspector.

Records:

Results of Test 27 shall be recorded on Form C&S 27.

Results:
Any defective insulation must be reported to the Roadmaster C&S promptly and noted on the test report.

Frequency:
When placed into service or once every two years.

All insulating rail joints and switch insulations must be tested utilizing the approved standard track insulation test unit. Manufacturers' recommended instructions shall be followed in determining if an insulated joint should be replaced or not.

TEST 29: "RESTRICTING" CODE CHANGE POINTS

FRA 236.511

Purpose:

Test is to ensure that the track code rate changes to zero within stopping distance on the approach to a signal displaying its most restrictive aspect.

Responsibility:

Signal Maintainer with Signal Inspector

Records:

Results of Test 29 shall be recorded on Form C&S 27.

Results:

If any part of Test 29 fails to pass the test or if the time is over that prescribed by the plans, immediate corrective action must be taken and the Roadmaster C&S must be notified.
**NOTE: Test 29 may be performed in conjunction with Test 24

All Tests:

All tests must be made with an approved meter or with a locomotive or MU car equipped with cab signals properly adjusted in accordance with Mechanical Department instructions.

TEST 29A CODE CHANGE POINTS

Frequency:

Every two years or upon initial installation.

Procedure:

1. Code change at a cut section:

    a. Ensure that the advance signal displays a Stop & Proceed, Stop or a Restricting aspect.
    b. Place an ammeter outside of the code change track circuit. There should be a 75 code.
    c. Place an ammeter within the code change track circuit. There should not be any code.

TEST 29B AT LOCATIONS WHERE USE OF A TIME DELAY APPARATUS EFFECTS CODE CHANGE

Frequency:

When placed into service and thereafter when modified or if circuits or devices are changed or disarranged or once every two years.

Test Procedure:

1. Ensure that the advance signal is displaying either Stop Signal, Stop & Proceed or a Restricting aspect.

2. Place an ammeter in the approach track circuit to the advance signal.
3. The cab signal must not assume zero code for a minimum of 10 seconds.
4. The cab signal must assume zero code within the time shown on the circuit plan or aspect chart. Should the time not be as designed, Roadmaster C&S should be notified.

TEST 29C AT LOCATIONS WHERE BRIDGING TRANSFORMER OR RELAY SHUNT IS EMPLOYED TO EFFECT CODE CHANGE

Frequency:

At least once every two years

Procedure:

1. Ensure that the advance signal is displaying a Stop & Proceed, Stop or a Restricting aspect.
2. Ensure that the track cab code changes to zero a minimum of approximately 1600 feet in the approach to the advance signal. The distance depends on the location of the code change equipment.

TEST 32: TRAIN INSPECTION DEVICES

Purpose:
Test is to ensure that all train inspection devices and associated equipment are in good order and functioning as intended.

Responsibility:
Electronic Technician

Records:
Results of Test 32 shall be recorded on Form C&S 27. All work and test data must be logged on the test form in duplicate **with** one copy being forwarded to the Manager of Control Systems and the other copy staying at the location.

Results:
If any part of Test 32 fails to pass the test, immediate corrective action must be taken and the Roadmaster C&S must be notified.

All Tests:
All tests must be made with an approved meters or testing devices appropriate for testing the apparatus described.

TEST 32A HOT BOX DETECTORS

Frequency:

32A.2 Calibration and Inspection — at least once each month.

Procedure:

1. Make a visual inspection of the instrument house, aerial cables, ground rods, and ground connections.

2. Check the batteries, record the per cell readings on the battery card.

3. Check the time and date and correct if necessary.

4. Where a carrier is in use, validate the values in accordance with manufacturer's instructions.

5. Calibrate the system following manufacturer's instructions.

Frequency*:*
32A.3 Test and Inspection — at least once every six months.

Procedure:
1. Perform all monthly inspections and calibrations.

2. Check the height and alignment of all scanners using the alignment procedure outlined in the C&S Engineering Maintenance Manual.

3. Follow the manufacturers' instructions for performing a heat test. If the detector is a "talker" have a radio to listen to the message as it is broadcasting during the test. The message must be clear and understandable.

4. Test the scanners using the procedures outlined in the manufacturers' recommendations.

TEST 32B DRAGGING EQUIPMENT DETECTORS

Frequency:

32B.1 Inspection — at least once each month or promptly following an actuation.

Procedure

1. Visually inspect all Dragging Equipment Detectors to ensure proper operation. Ensure that they are clean, and any loose parts are made secure.

2. Verify that the ties are solid and there is no play in the detector due to the mounting on the ties.

Frequency:

32B.2 Test — at least once each year.

Procedure:

1. Where dragger is in service in conjunction with track occupancy, shunt the appropriate track circuit.

2. Operate the dragger and confirm that the alarm is sounded, and proper actuation is received.

   a. For self-restoring draggers, deflect plates until contacts open.

   b. For non self-restoring DED's, disconnect the wire at the arm of detector unit.

3. [Blank]
4. On self-restoring draggers, check that the torque required to actuate the dragger is not less than 90 foot pounds nor greater than 100 foot pounds. This measurement is to be made with an approved torque wrench or scale, and should be taken at the point when the contact opens. Using a scale of 100 foot pounds, measurement taken one foot off of center of shaft would reflect the actual foot pounds.

5. Ensure that the contacts of the self-restoring dragger are open when plates are deflected **15 DEGREES** and closed when the plates are deflected **10 DEGREES** in both directions.

TEST 32 C HIGH LOAD DETECTOR TEST

Frequency:

32C.2 Test — at least once every three months.

Procedure:

1. Pass a pole of non-conducting material with a surface not more than 1.5 inches between the light source and receiver of the photo-electric system.

2. Clean optical sensors once a month.

3. The height of the pole above the top of the rail for testing high load detectors must be equal to the specified height of the detector at that location.

4. Check that each passing pole between the light source and the receiver actuates the alarm.

5. When interconnected with signal circuits, check that the proper wayside signal is displayed.

TEST 36: AUDIO FREQUENCY OVERLAY, BLOCK JOINT / OVERRUN DETECTORS AND PRESENCE DETECTORS

Purpose:
Test is to ensure that all solid state and microprocessor track circuits are properly adjusted and in accordance with circuit plans.

Responsibility:
Electronic Technician or Signal Maintainer

Records:
Results of Test 36 shall be recorded on Form C&S 27 in duplicate with one form to be left in the house or case and one form forwarded to the office of the Roadmaster C&S.

Results:
If any part of Test 36 fails to pass the test, immediate corrective action must be taken.

Frequency:
At least once a year or if circuits or devices are modified or disarranged.

Procedure:

1. Ensure that transmitter output levels are within specifications established by the manufacturers' instructions.

2. Ensure that receiver sensitivity and selectivity are within specifications established by the manufacturers' instructions.

3. Ensure that the frequency is in accordance with the circuit plans. (See C&S 2 # 162)

4. Shunt each track circuit as per test 24B.

5. Test that series electric lock release circuits pick-up at 0.06 ohms shunt. Verify that series overlay will not pick up with a shunt at switch points.

6. Verify that closure rail circuits are in accordance with steps 1 through 5 above.

TEST 39: RECORDING AND RECORDER DEVICES

Purpose*:* Test is to ensure that all recording devices are functioning as intended for time date, accuracy and information. Tests should be done for all recorders, including predictor recorder boards.

Responsibility:
Electronic Technician, Signal Inspector or Signal Maintainer.

Records:
Results of Test 39 shall be recorded on Form C&S 27 and forwarded to the Manager of Control Systems.

Results:
If any part of Test 39 fails to pass the test, corrective action must be promptly taken.

Procedure:

1. All recording and recorder devices are to be tested.
2. Access each recording or recorder device at the location or via modem or network. (If so equipped)
3. Ensure that the time and date is correct.
4. If multiple recorders are used, ensure that they are sycnronized by utilizing the manufacturer's recommended procedures.
5. Record several events and ensure that the information is recorded without error.
6. If device is sending an alarm, verify that proper sending and receiving information is working as intended.

TEST 40: Software Management Control Plan (SMCP) audit test

Purpose *:*
Audit of software management procedures per 49CFR 236

Responsibility:
Electronic Technician, Signal Inspector or Maintainer.

Records:
Results of Test 40 shall be recorded on approved forms. Templates and examples of the forms required can be found on the KCS network. All work and test data must be logged on the test form in duplicate with one copy being forwarded to the Manager of Control Systems and the other copy staying at the location.

Results:
If any part of Test 40 fails to pass the test, immediate corrective action must be taken and Manager of Control Systems must be notified.

Frequency:
Each location in the database must be audited at least once every five year in accordance with the SMCP policy.

Procedure:

Signal Personnel that are required to perform an audit will need to access and print copies of the software and hardware databases and the SMCP Audit Documentation Forms. A copy of the circuit plans, details and Software Application Notes Documentation should kept be at each location.

a. Once this is done proceed to the audit location and verify the field parameter settings against the databases by checking off the items on the Audit Documentation form. Verify Software by comparing the circuit plans to the name of the EPROM with the field and then match that with the database and check sums. If this Audit passes, then send the documentation to the Manager of Control Systems.

b. If the check sums do not match it should be reported to the Roadmaster immediately and subsequent train movements safeguarded per C&S 2, section 53.

c. If corrective actions are needed, fill out the bottom of C&S 27 form and send it to the proper personnel for processing. Software changes will go to the Signal Design office, hardware changes will go to the manager of Control Systems for revision.

d. After any corrective actions are completed, the C&S 27 form will be dated and copies will be sent to the Manager of Control Systems for record keeping.

If the field needs corrected documents or printed circuit boards updated that material will be sent by the proper personnel.

TEST FORMS

ROUTE:_____

SECTION No.:_____

LOCATION :_____

CROSSING DOT#:_____

INTERLOCKING:_____

TOWN:_____

SIGNAL LOCATION:_____

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RELAY TEST REPORT
FORM CS-13

CHECK ONE	102 (2 YR.)	104	106 (4 YR.)

PAGE _____ OF _____

DATE TESTED:_____

TESTED BY: _____ | _____
(PRINT NAME) (SIGNATURE)

ASSIST BY : _____ | _____
(PRINT NAME) (SIGNATURE)

SUPV. SIGNATURE:_____

ENTERED TO SUMMARY:_____

RELAY LOCATION	NOMENCLATURE	MODEL	RES	SERIAL NUMBER	SERVICE		DIRECT WORKING			DIRECT PU			DROP AWAY			POLAR CHANGE				REMARKS
					VOLT	AMP	TEST		DATA	TEST		DATA	TEST		DATA	NORMAL		REVERSE		
							NORMAL	REVERSE		NORMAL	REVERSE		NORMAL	REVERSE		TEST	DATA	TEST	DATA	

NOTE: NEUTRAL COILS OF POPULAR RELAYS TO BE TESTED FOR NORMAL AND REVERSE OPERATION

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

REPORT OF INSULATION RESISTANCE TEST

FORM CS-14

FRA RULE 108

10YR._____1YR._____

DATE:_____

TESTED BY: _____
(PRINT)

ROUTE: _____ TITLE:_____

SECTION No.: _____ SIGNATURE: _____

LOCATION:_____ ASSISTED BY:_____

CROSSING DOT#:_____ SUPV. SIGNATURE_____

LOCATION STATION FROM TO	CABLE		RESISTANCE			REMARKS
	TYPE	No. COND.	TO COND.	TO GROUND	BETWEEN COND'RS	

Massachusetts Bay Transportation Authority

Keolis

C&S 24

REPORT OF TRACK CIRCUIT TEST

SECTION:	TEST ID: 24 A, B, D, F	REGULATION NUMBER: 236.51,56,59	INSPECTOR:	DATE:
SUPERVISOR:	MILE POST:	INTERLOCKING:	TERRITORY:	PAGE ___ OF ___

TO BE PERFORMED AT LEAST EVERY TWO YEARS AND ANY TIME THE ELECTRICAL OPERATING CHARACTERISTICS OR THE TRACK CIRCUIT ARE ALTERED.

TEST 24(A) - TRACK CIRCUIT INPUT VOLTAGE (2 YEARS)

CIRCUIT NO.	TYPE CIRCUIT	INPUT VOLTAGE	OUTPUT VOLTAGE	CURRENT	TRU-OUT WITH 3 AMP FUSE REMOVED

TEST 24 B, C, D (2 YEARS)

CIRCUIT NO.	TEST 24 (B)	TEST 24 (C)	TEST 24 (D)	TEST 24 (E)	TEST 24 (G)

TEST 24 (F) - INSPECTION (6 MONTHS)

CIRCUIT NO.	BOND WIRES	FOULING WIRES	TRACK LEADS	Arresters/Protectors	VISUAL INSULATED JOINT INSPECTION

1. For Test 24(a), write the circuit number. Next record the type of track circuit; i.e. TRU-II, USS, PSTC, GRS, ETC. For input, record the input voltage reading on the TRU-II or phase selective or electronic unit. For output, record the output voltage from the track unit to the track relay if applicable. Current readings should be taken across an open fuse. The last block in the table is reserved for TRU-II circuit only and is an output reading from the TRU-II unit to the track relay with the track fuse removed. This reading should not be higher than 2.5 VDC.
2. Test 24 (B) is to be marked OK, if the track shunts properly or ADJ., if adjustments are made.
3. Test 24 (C) should be the recorded value of the cab signal axle current at the entering end of the circuit in both directions.
4. Test 24 (D) should be marked OK, if polarity is proper, or FAIL. If FAIL, The supervisor must be notified.
5. Test 24 (E) is made when required. Box should be marked OK if broken rail protection is intact, or FAIL. If FAIL, The supervisor must be notified. Additional defects and remedial actions should be listed on addition forms and attached hereto.

Defects Found	Date	Remedial Action	Date

Inspector's Signature	Date	Supervisor's Signature	Date

KCS CS-24 (1412)

Massachusetts Bay Transportation Authority

TEST OF GRADE CROSSING WARNING SYSTEM

Keolis

Section:	Road Name:	Date:	Inspector:
DOT#:	City / Town:	Test: 26A, 26B & 26C	FRA CFR 49 Part 234

Test 26A – Monthly	Test Procedure	Results
1	Observe Track, Line & Directional stick relays	
2	Measure battery voltages (on charge) & record on battery card	
3	Open A.C. power feed to place crossing on standby	
4	Operate warning system & check lamps	
5	Observe lamp brilliance	
6	Measure battery voltages (off charge) & Check Grounds	
7	Clean all roundels & check alignment	
8	Check there are no obstructions blocking flashers. Record in defects column.	
9	Restore A.C. power	
10	Inspect battery electrolyte	
11	Predictors/Motion: Record EZ/EX or RX/Phase Record warning times & record & reset error codes	
12	Inspect all gate arms, shear pins, gate keepers & gate mechanisms	
13	Operate crossing & record delay of gate descend time	
14	Operate crossing & record gate descend time. Check gates descend together	
15	Check bell	
16	Check gates are parallel to roadway	
17	Inspect Traffic Preemption	

Test 26B – Quarterly		
1	Inspect batteries at approach locations	
2	Check charging current at approach & highway locations	
3	Inspect bonds, track connections, foul wires & insulated joints within approaches	
4	Test all emergency control cut-outs and switch reverse cut-outs	
5	Test each stick release timer for proper operation	

Test 26C – Yearly		
1	Check visibility and condition of signals and signs	
2	Check gates raise to full upright position in no more than 12 seconds	Sec
3	Check number of flashes per minute	FPM
4	Check at least one lamp is lit when flasher is at rest	
5	Check voltage at lamps with power off after 2 minutes	
6	Restore A.C. power	
7	Take hydrometer readings	
8	Check switch cut-out circuits function correctly	
9	Check gate arm torque & check gate arms free from friction	
10	Check hold-clear device	
11	Check time delay of starting circuits	
12	Check time delay of cut-out circuits	
13	Check directional stick circuits function as designed	
14	Check predictors, motion sensors & overlay in accordance with instructions	
15	Calculate & test warning times for each approach using Max. Auth. Speed	Trk 1 N/E( ) S/W( )
		Trk 2 N/E( ) S/W( )

Defect Found:	Date:	Remedial Action:	Date:

Additional Defects and Remedial actions should be listed on additional forms and attached hereto.

Inspector's Signature:	Date:	Supervisor's Signature:	Date:

KCS C&S-26 (1412)

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

C&S 27

TESTS OF SIGNAL APPARATUS

Route	Section	Date	Page ____ of ____

1	2	3	4	5	6	7	8
Test No.	Date	Location	Unit No. *	Results of Test	Test Information and Remarks	Repairs Replacements Adjustments	Condition Apparatus was left

Report all AMT 27 Required Tests on This Form
Columns 1, 2, 3, 4, 5, 7, 8 MUST BE FILLED IN.

Inspector's Signature:	Date
Supervisor's Signature:	Date

* Note: When listing highway crossing tests, the AAR/DOT inventory number must be shown in column #4

Distribution: White - File, Canary - Originator, Pink - Inspector

MBTA Form CS - 27