THE PENNSYLVANIA RAILROAD

TESTS OF SIGNAL APPARATUS
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TEST

TO BE MADE AT LEAST BY

1—Mechanical locking in interlocking machines:
   (a) Terminal Plants
   Once in 2 yrs. Foreman, Inspector or Testman *
   (b) Other
   Once in 4 yrs. Foreman, Inspector or Testman

2—Insulation resistance test:
   (a) Low voltage wires and cables, except track wires.
      1. Braided rubber insulated wires and cables, including those with metal tape but no lead sheath, and trench-lay (any part of which is underground or in trunking).
      Annually Testman
      2. Braided rubber insulation aerial wires and cables, (no part of which is underground or in trunking).
      Once in 4 yrs. Testman
      3. Lead sheath and parkway cables with lead sheath.
      Once in 4 yrs. Testman
      4. Local signal wiring:
         (a) Position light signals.
         Once in 4 yrs. Testman
         (b) Semaphore signals.
         Once in 2 yrs. Testman
      (b) Lead covered signal power cables:
         1. Aerial (No part of which is underground).
         Once in 4 yrs. Testman
         2. Underground.
         Once in 2 yrs. Testman
      (c) Underground signal power lines. (Not lead sheath)
      Semi-annually Testman

3—Electrolysis test on lead covered cables, except where protected by T. & T. tests.
   Annually Testman

*"TESTMAN"—Includes maintainer or signalman not regularly assigned to testing but who has qualified and has been assigned to make the test specified.
<table>
<thead>
<tr>
<th>Test</th>
<th>To Be Made At Least</th>
<th>By</th>
</tr>
</thead>
<tbody>
<tr>
<td>4—Foreign current tests, D. C. track circuits: (Except where foreign current protection is provided, where there is no source of stray direct current such as a trolley line, and where tests over a 3 yr. period show no evidence of foreign current).</td>
<td>Annually</td>
<td>Foreman or Inspector</td>
</tr>
<tr>
<td>5—Relays, indicators, magnets, slots, etc.—field test:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) A. C. apparatus.</td>
<td>Annually</td>
<td>Testman</td>
</tr>
<tr>
<td>(b) D. C. apparatus.</td>
<td>Once in 2 yrs.</td>
<td>Testman</td>
</tr>
<tr>
<td>(Exclusive of E. P. switch magnets, switch indication magnets with safety tooth, signal indication magnets with force-down feature and relays included under 6-(b).) Note:—In congested territory, where the electrical field tests are not practicable, they may be omitted and more frequent shop tests as seem necessary substituted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6—D. C. Relays and indicators—Shop Tests—unless field test indicates relay needs overhauling:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) D. C. Relays and indicators—except those included under 6-(b).</td>
<td>Once in 6 yrs.</td>
<td>Testman</td>
</tr>
<tr>
<td>(b) Code following relays, code modulators, interlocking and flasher relays.</td>
<td>Once in 2 yrs.</td>
<td>Testman</td>
</tr>
<tr>
<td>7—A. C. relays and indicators—Shop Tests—unless field test indicates relay needs overhauling:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Vane type, except Plate H-101¾, US&amp;Sco. Catalogue.</td>
<td>Once in 4 yrs.</td>
<td>Testman</td>
</tr>
<tr>
<td>(b) Centrifugal relays.</td>
<td>Once in 3 yrs.</td>
<td>Testman</td>
</tr>
</tbody>
</table>
(c) H-101½ Vane type, code transmitting relays and other types. 

8—Ground resistance tests:
(a) When grounded to steel catenary structures. Once in 4 yrs. 
(b) Other ground connections—unless experience indicates more frequent tests in certain locations are necessary. Once in 2 yrs.

9—Lightning arresters (gas or vacuum type).

10—Signal indication lock circuit:
(a) Light signals. 
Once in 2 yrs. 
(b) Semaphore signals. Semi-annually

11—Approach and time locking.

12—Switches:
(a) Switch indication, power switches. Monthly 
(b) Restoring feature:
1. E. P. switches with friction lock and electric switches. Quarterly 
2. E. P. switches without friction lock. Semi-monthly
(c) Lock magnet, PL.0953 Fig. A on electro-pneumatic switch valves. Quarterly
(d) Valve test—E. P. switches. Quarterly
(e) Indication circuits—electro-mechanical and mechanical switches. Semi-annually 
(f) Indication circuits—Style CP Valves—Type F controller. Semi-annually

13—Cross protection—Electric interlocking machines (GRSCo. and Federal Types). Main protection breaker and devices on all switches and signals so equipped. Monthly
TEST

14—Observe "SS" relays, opening when switches are operated. Monthly Maintainer

15—C. E. 40—Switch Obstruction Tests:
(a) Bar test interlocked switches. Semi-monthly Maintainer, Track Foreman
(b) Obstruction test:
   1. Interlocked switches. Quarterly Maintainer, Track Foreman
   2. Hand-operated switches:
      (a) Facing point Semi-monthly Maintainer, Track Foreman
      (b) Trailing point Monthly Maintainer, Track Foreman

16—Drawbridge locking:
(a) Mechanical locking. Weekly Maintainer Foreman
(b) Adjustment and operation of circuit controllers and electric locks. Quarterly Maintainer Foreman, Inspector

17—Switch and traffic lever locking:
(a) Open lock circuit and move lever or latch against stop. Quarterly Maintainer
(b) With track occupied. Quarterly Maintainer

18—Friction torque tests on power operated semaphore signals. Once in 2 yrs. Testman if necessary in terminals, or Maintainer

19—Ground detector readings. Daily Maintainer or Operator

20—Fouling circuits on switches: Test where fouling wires are not visible and inspect where visible. Monthly Maintainer

21—Switch circuit controllers:
(a) Where connected direct to switch point. Semi-monthly Maintainer
(b) All others. Monthly Maintainer

22—Voltmeter tests for grounds where apparatus has been burned out by lightning. When replacing apparatus Maintainer

23—(a) Adjustment of contact springs with relation to safety tooth on segments of power machines. Annually Testman if necessary in terminals, Foreman or Inspector
(b) Quick switch for stopping on center. Annually Testman if necessary in terminals, Foreman or Inspector
24—Interlocking, automatic signals, and highway crossing signals: Detail check of layout, locking and circuits.

25—Track Circuits:
(a) Voltage at relay except A. C. track relays or other A. C. track apparatus of very low impedance for which current readings shall be taken.
(b) Polarity.

26—Siding protection for inflammable liquids.

27—Highway grade crossing signals.

28—Insulated rail joints and switch insulations.

29—Shunt test—hand operated switches in cab signal territory.

30—Shunting efficiency — gas electric and similar single unit equipment, except where experience has indicated more frequent tests are required.

31—Dragging equipment detector circuits. (Where actuations have occurred within designated period, test not required).
INSTRUCTIONS FOR MAKING THE AFOREMENTIONED TESTS OF SIGNAL APPARATUS

TEST 1—MECHANICAL LOCKING IN INTERLOCKING MACHINES:

The purpose of this test is to determine that mechanical locking is in accordance with plans and specifications, and in such condition as to insure proper functioning.

Make test in accordance with Form C. E. 238 (Formerly C. S. E. 38.)

TEST 2—INSULATION RESISTANCE:

The purpose of this test is to insure that the insulation of wires and connected apparatus meet the prescribed resistance values.

Tests shall be made in accordance with recognized Megger practice. Provisions of C. S. E. 23 covering the use of jumpers, the safeguarding of train movement, and other safety precautions, must be observed.

2(a)—Low Voltage Wires and Cables:

Minimum allowable resistance value—1 Megohm.

Test must not be made on control circuits except when completely disconnected from battery and common.

Where circuit to be tested embraces types of wires or cables of more than one class under 2(a)1, 2(a)2 and 2(a)3, and it is more convenient, the entire circuit may be tested in accordance with the class due for test most frequently.

2(b)—Lead Covered Signal Power Cables:

1. Aerial:

(No part of which is underground).

Reading should not be less than 100 megohms between sectionalizing switches. (The insulation resistance of cables exposed to extreme summer heat will be somewhat below the values shown for the same cable at lower temperatures).

2. Underground:

Reading should not be less than 1000 megohms between sectionalizing switches.

2(c)—Underground Signal Power Lines:

(Not lead sheath).

Reading for section test:ed should be not less than 40 megohms for voltages to and including 500 volts. For voltages exceeding 500 readings between sectionalizing switches should be not less than 1000 megohms.
TEST 3—ELECTROLYSIS, LEAD COVERED CABLES—EXCEPT WHERE PROTECTED BY T. & T. TESTS:

The purpose of this test is to determine whether deterioration of lead covered cables is occurring through effect of electrolysis corrosion by the presence of currents passing from any point on the cable system to ground.

The most effective means of determining whether stray current is passing from a particular cable sheath to ground is to determine the direction of any potential difference that may exist between the sheath and small isolated piece of the same material in contact with damp earth in bottom of manhole. Where the sheath is found to be positive to this testing electrode, it is generally to be assumed that current is flowing from the sheath to ground, since the only condition under which current flow would not occur would be one where the cable sheath was effectively insulated from the earth, and such cases are rare. Observations of potential difference to nearby rails, pipes and other sub-surface metallic structures and observance of fall of potential along the sections of the cable sheath, should also be made in connection with the measurement of potential difference to earth and will serve to throw light upon what the stray current is doing. When measurements of this character have been made at all parts of the cable system and show that no current is flowing from the cable sheath to ground, except through drainage wires and that no excessive amount of stray current is flowing from ground to the sheath, it may safely be concluded that the cable system is not undergoing an electrolytic corrosion. If contrary indications are found, it is necessary to conclude that electrolytic corrosion is taking place and to adopt measures which will serve to mitigate its effects.

Readings should be taken as follows:

1. Difference of potential between points on the cable system and the adjacent earth.
2. Difference of potential between the cable system and electric railway rails, other cable systems, piping systems, metal bridges, steam railway rails, etc., at points where these cross the cable system or come in close proximity to it.
3. Measurements of current flowing in the cable sheath. Test to be made in accordance with Report of Committee on Protection Against Electrolysis, as adopted June, 1932, by the T. & T. Section, A. A. R. Report results of test on Form C. T. 1517.
TEST 4—FOREIGN CURRENT—D. C. TRACK CIRCUITS:

The purpose of this test is to determine the presence of foreign current and insure proper corrective action, to prevent interference with track circuits.

Where there is known to be a trolley line or other direct current exposure, test should be made and readings taken during periods in which the outside current is at or near maximum value.

This test shall be made by placing a milammeter in series with the relay then disconnecting the wires from the battery and taking a reading, it being noticed at the same time whether the current is sufficient to pick up the relay. Where it is found that the relay picks up, this circuit should be considered one which should be carefully watched, and the results reported. If the relay does not pick up, a second test should be made, in the same manner as the first, but by placing a connection around first one and then the other of the insulated joints at the battery end of the circuit, so that one of the rails of the circuit being tested will be connected to one side of the relay and the other rail in the circuit, plus one of the rails in the next circuit, will be connected to the other side of the relay, thus unbalancing the circuit and making a severe test. If the relay picks up, this circuit should also be watched and reported. If any appreciable readings are obtained in either test, the following precautions shall be constantly observed:

1. Trolley and power companies requested to see that their bonding is as good as practicable.
2. Ballast kept clear from the rails.
3. Rail joints kept tight and insulated joints maintained in good condition.
4. Rail bonding carefully maintained.

Foreign current test need not be made where foreign current protection is provided; coded current is used for wayside signal control; where there is no apparent source of foreign current such as trolley lines, etc., or where tests for a 3 year period indicate no evidence of foreign current.

Note:—Under certain conditions there is a storage battery effect, between rails and ballast, that may have a current value sufficient to hold the relay closed several minutes after the battery feed wires have been disconnected. If such condition is observed, either short circuit the rails temporarily or wait a sufficient time for the amperage to drop before deciding that foreign current exists.
TEST 5—RELAYS, INDICATORS, MAGNETS, SLOT, ETC.:

The purpose of this test is to insure that relays, indicators, magnets, slots, etc., are in proper condition to insure functioning as intended.

Field Tests on A. C. and D. C. relays shall be made in accordance with C. E. 222 (formerly C. S. E. 22) and C. E. 221 (formerly C. S. E. 21), respectively.

Field tests on magnets, slots, etc., shall be made by observing, insofar as possible, the instructions in C. E. 221 (formerly C. S. E. 21) and C. E. 222 (formerly C. S. E. 22).

For apparatus not covered by P. R. R. instructions, instructions furnished by the manufacturer should be followed.

TEST 6—D. C. RELAYS AND INDICATORS—SHOP TESTS:

This test shall be performed in accordance with C. E. 221 (formerly C. S. E. 21).

For apparatus not covered by P. R. R. Instructions, instructions furnished by the manufacturer should be followed.

TEST 7—A. C. RELAYS AND INDICATORS—SHOP TESTS:

This test shall be performed in accordance with C. E. 222 (formerly C. S. E. 22).

For apparatus not covered by P. R. R. Instructions, instructions furnished by the manufacturer should be followed.

TEST 8—GROUND RESISTANCE:

The purpose of this test is to insure that grounds are maintained at sufficiently low resistance, so that protection may function as intended.

Resistance of grounds shall not exceed 15 ohms. Where a resistance of 15 ohms or less seems impracticable, it should be reported promptly to the Supervisor of Telegraph & Signals.

Tests shall be made in accordance with A. A. R. Drawing 1377 or Plan S-817.

A record of each ground in use should be kept, readings to be recorded as tests are made. When ground resistance is found to be above limits specified, corrective action must be taken. In testing protector grounds on power lines, test apparatus shall be connected at the ground rod, and careful visual inspection shall be made of the ground wire. In test of other protector grounds, connections shall be made at the arrester, instead of at the ground rod, for the purpose of checking the wire and connection, in addition to the actual ground.
TEST 9—LIGHTNING ARRESTERS—GAS OR VACUUM TYPE:

The purpose of this test is to insure that arresters are in condition to provide the desired protection.

Test shall be conducted on all arresters of the type involved, in accordance with instructions with the test set furnished for this purpose.

TEST 10—SIGNAL INDICATION LOCK CIRCUITS:

The purpose of this test is to insure that levers of power and electro-mechanical machines and the latches of mechanical levers cannot be placed in normal position until the corresponding control relays for position and color light signals are open (or properly poled) and the corresponding arms of semaphore signals are within 5° of their normal positions; also, that the repeating indicator or light where used to indicate the position of a non-interlocked signal corresponds to the position of the signal.

Light Signals: Place signal lever at indicating position. Disconnect lock circuit wire at each relay contact in the circuit, on the side of the contact from which battery is feeding, and signal lever should not indicate to normal position.

Semaphore Signals: Place signal lever at indicating position. Move each signal arm approximately 15 degrees from its normal position and slowly return it to within approximately 5° of normal position. Signal lever should not indicate to normal position.

Make careful visual inspection of each contact involved to see that it opens and closes as called for on plan, and is clean and free of any possible fouling.

Repeating indicators or lights for non-interlocked signals should be checked and observed in accordance with the above.

In CTC type or relay type interlockings, proceed as above, except that lever is restored to normal position, checking the “FM” relays in lieu of the indication locks.

TEST 11—APPROACH AND TIME LOCKING:

Approach Locking

The purpose of this test when lock is on signal lever is to insure that the signal lever or latch cannot be restored to the normal position with proper route set and the approach circuit open; when combined with switch lever locking, to
insure that the switch or lock lever cannot be moved from normal or reverse position after signal lever has been reversed and restored to normal with the approach circuit open. Test to be made as follows:

When on Signal Lever:

1. Check approach relay by observing the shunting of each track circuit involved and, also, open or close any multiple circuits or other contacts involved, separately to insure that relays function as intended.

2. With lever or latch at indicating point and approach circuit closed (multiple circuits must be open) restore lever or latch to normal position. Lever or latch should be released.

3. With lever or latch at indicating point and approach circuit open (multiple circuits must be kept open) attempt to restore lever or latch to normal position. Lever or latch should be locked.

4. With lever or latch at indicating point and approach circuit open, close each multiple circuit separately and attempt to restore lever or latch to normal position. Lever or latch should release.

5. Check time of slow release for setting in accordance with C. E. 209 (formerly C. S. E. 9) and that starting of slow release opens the signal control circuit.

6. In CTC type or relay type interlockings, proceed as above, except that in 3 and 4 the lever should be restored to normal position, checking the "KM" relay in lieu of the indication lock. Check the time of the "TE" relay in lieu of a time release.

When Combined with Switch Lever Locking:

1. Proceed as in 1, 2, 3 and 4 under Signal Lever, except lever and latch must be tested in both normal and reverse positions as required.

2. Check time of slow release for setting in accordance with C. E. 209 (formerly C. S. E. 9); also, operation of stick relay, to insure that locks do not release unless signal lever is in normal position when release is started or if this lever is moved from the normal position at any subsequent time.

Time Locking

The purpose of this test when lock is on signal lever is to insure that signal lever or latch cannot be restored to normal position until the specified time interval has elapsed; when combined with switch lever locking, to insure that the switch
or lock lever cannot be moved from the normal or reversed positions after signal lever has been reversed and restored to normal until specified time interval has elapsed. Test to be made as follows:

**When on Signal Levers:**

1. With lever or latch at indicating point, operate time release (multiple circuits must be open) and attempt to restore lever or latch to normal position while time release is operating. Lever or latch should release after specified time interval has elapsed.

2. With lever or latch at indicating point and time release in normal position close each multiple circuit separately and attempt to restore lever or latch to normal position. Lever or latch should release.

3. Check time of slow release for setting in accordance with C. E. 209 (formerly C. S. E. 9) and that starting of latch type slow release opens the signal control circuit.

**When Combined with Switch Lever Locking:**

1. Proceed as in 1 and 2 under Signal Lever, except that lever or latch of switches or locks affected must be tested in both normal and reverse positions as required.

2. Check time of slow release for setting in accordance with C. E. 209 (formerly C. S. E. 9); also, operation of stick relay, to insure that locks do not release unless signal lever is in normal position when release is started or if this lever is moved from the normal position at any subsequent time.

**NOTE:**—Setting of time release must be kept within 5 seconds of the time designated. The time for each release as set must be marked on or near each release. Similarly, the time for time element relays used in C. T. C. or similar operation should be shown.

**TEST 12—SWITCHES:**

(a)—Switch Indication Power Switches:

The purpose of this test is to insure that controlling lever cannot be latched in either normal or reverse position, unless switch or switches operated by the lever have properly operated to the corresponding position.

Test each switch lever for each switch involved, for both normal and reverse indication, first with 1/2" obstruction, to allow switch movement to operate but not lock the switch, and second, with valve stem removed from lock magnet of EP switches and with fuse removed from electric switches, to prevent any operation of the switch movement.
(b)—Restoring Feature—Power Switches:

The purpose of this test is to insure that power will be applied and restore switch movements to full normal or full reverse positions before creepage of the movement would open SS circuits.

1. E. P. Switches with Friction Locks; Use bar to move slide bar toward the opposite position, and note that air comes on and restores slide bar before SS contacts have opened. Operation of contacts may be checked by visual observation, by voltmeter, or by observance of SS relay.

(Where C or CP valves are in service with Model 14 S&L movements, kick-back should be effective when the SS contacts in the indication box open).

Electric Switches: Remove fuse in motor circuit and crank switch movement toward opposite position until motor circuit contacts are closed in circuit controller, noting that SS contacts have not opened. Restore fuse and switch movement should restore to original position. Check in both normal and reverse positions.

2. E. P. Switches without Friction Lock:

Test same as EP switches with friction lock.

(c)—Lock Magnet Switch Valve:

The purpose of this test is to insure that the "D" valve of old style valves (PL. 0953) is properly locked.

Remove armature stem in lock valve magnet and have lever operated. If switch responds the "D" valve lock is defective and should be replaced. Check in both positions.

(d)—Valve Test:

The purpose of this test is to detect leakage in EP switch valves which might result in improper switch operation.

Test each set of valves with switches in both normal and reverse positions by holding in for approximately one (1) minute lock and reverse armatures while normal is energized and lock and normal while reverse is energized. If switch changes position, valves are defective and should be replaced.

(e)—Indication Circuits, Electro-Mechanical and Mechanical Switches:

The purpose of this test is to insure that lock levers cannot be operated to the locked position unless all the switches locked by the lever involved and the levers which operate these switches are in proper corresponding positions.
On Mechanical Switches: Obstruct each point successively with 3/8" obstruction and with switch operating levers latched F. P. L. lever should be electrically locked in the normal position.

On Electro-Mechanical Switches: With locking lever at indicating point, open normal indication circuit at each indication box in the circuit and locking lever should not indicate. Repeat with switch or switches reversed for reverse indication circuit.

(f)—Indicator Circuits—Style CP Valves—Type F Controller:

Where CP valves or Type F controllers are used with indication circuits selected through them, tests must be made by placing the S&L movement in the position opposite to the valve or controller and check that the switch does not indicate under these conditions. This can be done where CP valves are used by blocking slide bar of switch movement and shifting valves by operation of the lever.

Where Type F controllers are used open the switch motor circuit and shift controller by operation of the lever.

TEST 13—CROSS PROTECTION ELECTRIC INTER-LOCKING MACHINES:—(GRS AND FEDERAL TYPES:)

The purpose of this test is to insure that protection devices work properly to prevent movement of switches, signals, etc., when current is improperly applied to the circuits.

Test should be made when plant voltage is at the maximum.

Make temporary connection between normal and reverse operating wires for each switch at the pole-changer. This should open polar relay or circuit breaker.

Make temporary positive battery connection from the nearest switch to the signal control wire as close as practicable to the signal motor. This should open the polar relay or circuit breaker. If the signal control circuit is connected to the common return wire through one or more switch circuit controllers, the energy should be applied to this wire, first opening the connection to the main common to prevent blowing fuse in the switch circuit.

If plant is sectionalized one or more functions in each section should be crossed with wires taking energy from each of the other sections. In case functions in various sections are too widely separated, the temporary crosses can be made between the binding posts on the terminal board of the interlocking machine. This should open the section breakers.
**TEST 14—OBSERVE "SS" RELAYS OPENING WHEN SWITCHES ARE OPERATED:**

The purpose of this test is to insure proper functioning of the "SS" Relays.

Have switch operated, check "SS" Relay while switch is operating; see that "SS" Relay assumes full open position and note operation of neutral and polar contacts when relay is in both normal and reverse positions.

**TEST 15—C. E. 40 SWITCH OBSTRUCTION:**

The purpose of this test is to insure proper maintenance and adjustment of switches.

Test shall be made in accordance with instructions on back of Form C. E. 40.

To insert obstruction between switch point and stock rail of mechanical interlocked switches with electric locking, pry switch point open while lock lever is normal with its latch held up.

After obstruction has been inserted, attempt to lock switch. Repeat for each position of each switch.

**TEST 16—DRAWBRIDGE LOCKING:**

The purpose of this test is to insure that rail locks, wedge locks, bolt locks, circuit controllers, electric locks, etc., are in good condition and functioning properly to provide protection in accordance with approved plans.

For center pivot type bridges, test each lift rail by inserting 1/4" inch gauge under mitre end. Rail should not lock. Check each wedge lock or circuit controller connected to wedges. Wedge should not lock, or contacts in circuit controllers make, unless wedge is within 1 inch of full position. Check bolt locks and electric locks to insure that levers are not released for operation until all functions involved are in proper position.

Contacts in circuit controllers attached to drawbridge apparatus to be adjusted as follows:

<table>
<thead>
<tr>
<th>Surfacing wedges</th>
<th>Driven</th>
<th>1 in. full stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Withdrawn</td>
<td>1 in. &quot; &quot;</td>
</tr>
<tr>
<td>Rails or rail beams</td>
<td>Raised</td>
<td>Mitre Rails clear 2 in.</td>
</tr>
<tr>
<td></td>
<td>Lowered</td>
<td>3/8 in. from seat.</td>
</tr>
<tr>
<td>Rail Locks</td>
<td>Locked</td>
<td>1/2 in. full stroke</td>
</tr>
<tr>
<td></td>
<td>Unlocked</td>
<td>Bar clear 1 in.</td>
</tr>
<tr>
<td>Latches</td>
<td>Raised</td>
<td>1 in. from seat.</td>
</tr>
<tr>
<td></td>
<td>Dropped</td>
<td>1 in full stroke.</td>
</tr>
<tr>
<td>Bridge Locks (Plan S-372 and S-375)</td>
<td>Locked</td>
<td>1 in. full stroke.</td>
</tr>
<tr>
<td></td>
<td>Unlocked</td>
<td>1 in. &quot; &quot;</td>
</tr>
</tbody>
</table>
Contacts in circuit controllers attached to drawbridge apparatus to be adjusted as follows:— (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Locked</th>
<th>Unlocked</th>
<th>Driven</th>
<th>Unlocked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Locks (Plan S-372 and S-375)</td>
<td>1 in. full stroke.</td>
<td>1 in. ““ “ “</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge Couplers</td>
<td>1 in. full stroke.</td>
<td>1 in. ““ “ “</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catenary Blades</td>
<td>3/4 in. full stroke.</td>
<td>3/4 in. full stroke.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead weight rollers on bridges so equipped.</td>
<td>Each position</td>
<td>As near end of stroke as possible. Weight of bridge must be off rollers before contacts make.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TEST 17—SWITCH AND TRAFFIC LEVER LOCKING:**

The purpose of this test is (a) to insure that the locks are in proper condition mechanically, free from chattering, etc., and that they will block the lever operations; (b) to insure that the controlling circuits are functioning properly and that locks will not release with a train occupying any portion of the protecting track section.

(a)—With track circuit unoccupied and no train approaching the switch or traffic section; open the lock circuit (not at lever latch), move lever sharply until locking tooth on segment engages latch, closely observing action of locking parts. Test to be made for each lever position in which the locking is effective.

(b)—With track occupied; move latch sufficiently to close latch contact or step on floor push. As each track section in the route or territory is occupied see that the lock remains de-energized, being sure not to move lever if lock should pick up. If not practicable to get track occupied test with a train in the circuit, proceed as above, having each track section involved shunted successively and carefully observe results.

(c)—Where traffic locking protection for opposing movements is provided by means of stick relays, signal lever locks, etc., test and observations should be made in accordance with the above instructions insofar as they apply.

(d)—In CTC type or relay type interlockings open the track relay of each protecting track circuit and note if switch can be operated.

This test must not be made with track circuit occupied.

Test each switch in each route with the “KM” relay, for the signal governing that route, open.
TEST 18—FRICITON TORQUE, POWER OPERATED SEMAPHORE SIGNALS:

The purpose of this test is to insure that power operated semaphore signals are free from friction or other interference which might prevent return to most restrictive aspect.

Test must be made in accordance with C. E. 231 (formerly C. S. E. 31).

TEST 19—GROUND DETECTOR READINGS:

The purpose of this test is to detect any leakage between switch or signal circuits and earth, or interlocking machine frame.

Observe ground detector meter daily, checking different sets of batteries with dial switch where provided. Record readings.

NOTE:—Maintainer should, as far as practicable, observe the ground detector meter while levers are being operated.

TEST 20—FOULING CIRCUITS ON SWITCHES:

The purpose of this test is to insure that fouling wires provide good electrical connection between main rails of a track circuit and sections of rail blocked off by insulated joints in turnouts, crossovers, etc.

Make thorough visual inspection of all parts of fouling wires on interlocked and hand-operated turnouts and crossovers which are open to such inspection. Where any part of fouling wires are concealed, connect voltmeter across main track rails and apply shunt to turnout or crossover rails, checking meter.

TEST 21—SWITCH CIRCUIT CONTROLLERS:

The purpose of this test is to insure that switch circuit controllers are in good condition and proper adjustment, as follows:

Circuit controllers directly connected at the point to hand-operated switches, without facing point lock, should function with switch point open 1/4 inch.

Circuit controllers directly connected at the point to hand-operated switches equipped with facing point lock or to interlocked switches should function with switch point open 3/8 inch.

Circuit controllers connected at mid-point of 45 ft. switch points should function with obstruction of 1/2 inch, with a maximum tolerance of 1/8 inch over, between point and stock rail at or opposite connection of switch circuit controller rod.
Circuit controllers which are a part of switch throwing and locking or locking mechanisms should function before the operating lever has been moved far enough from normal to mechanically release the lock rod.

Point detectors with latch should function when point is forced open 3/8 inch, with a maximum tolerance of 1/8 inch over.

Point detectors without latch should function when point is forced open 1/4 inch.

Connect voltmeter across binding posts of circuit controller. On normally open contacts, with all other contacts in the circuit closed, it should read circuit voltage and change to zero when controller functions; on normally closed contacts zero reading should change to circuit voltage when controller functions.

**TEST 22—VOLTMETER TESTS FOR GROUNDS WHERE APPARATUS HAS BEEN BURNED OUT BY LIGHTNING:**

The purpose of this test is to detect any grounds which may have developed and prevent subsequent signal failures.

When apparatus has been burned out by lightning, voltmeter readings shall be taken on all associated wiring and apparatus to determine if grounds exist.

**TEST 23—(a)—ADJUSTMENT OF CONTACT SPRINGS WITH RELATION TO SAFETY TEETH ON SEGMENTS OF POWER MACHINES:**

The purpose of this test is to insure proper contact adjustment.

Test shall be made in accordance with C. S. E. 23.

**(b)—QUICK SWITCH:**

The purpose of this test is to insure proper operation of quick switches.

Test each quick switch by operating lever from normal against reverse indication tooth and from reverse against normal indication tooth. Quick switch should not operate.

Test each quick switch by operating lever against 3/16 inch gauges placed against the normal and reverse shoulders of the lever quadrant. Quick switch should operate to full normal and reverse positions.

Manually place each quick switch in center position and operate lever between indicating positions. Quick switch should shift to normal or reverse positions.
Failure of the quick switch to operate under either of the above tests may be due to dirty or worn parts, improper lubrication, weak toggle springs, lever not properly centered with relation to roller, contact springs too tight on quick switch roller, or quick switch resting on top of supporting brackets on frame of machine.

Any defective condition developed should be corrected.

**TEST 24—INTERLOCKINGS, AUTOMATIC SIGNALS AND HIGHWAY CROSSING SIGNALS:**

The purpose of this test is to insure good physical condition and satisfactory operation of the signal plant, proper application and maintenance of suitable material and devices, and that work in service agrees with approved plans and specifications.

**Layout Plan:** Check conditions on the ground for agreement with plan as to track arrangement; number, location and frog angle of crossovers and turnouts; location, type, aspects and routing of signals; location of tower and other structures which affect signalling.

Inspect physical condition of tracks and switches, signals, signal bridges, foundations, pipe lines, machine, tower and any other buildings involved. Check tower and other buildings for fire hazard.

**Locking and Dog Sheets:** Test in accordance with Test No. 1.

**Circuit Plans:** Check should be made as to condition and location of insulated joints, fouling wires, battery, transformer and relay connections, wires and cables, switch circuit controllers and rods, transformers, relay locations, switch movements, electric switch locks, and other apparatus on or about the tracks.

Check should be made of each relay location, including tower case, to see that it contains all the apparatus called for on plans and that there is no excess apparatus or foreign material, that apparatus is of proper type and has proper inspection dates, and that power and battery supplies are provided, and fused and designated according to plan.

Check should be made of groundmeter readings and volt and ampere readings as may be necessary.

Check should 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 and wire numbering of wires to controls and contacts.

Check should be made of interlocking machine spring combination condition and adjustment, type of quadrants, type and adjustment of segments, and cutting and adjustments of segments in electric locks.
Test should be made of all circuits to insure that the opening of each contact in a control circuit cuts off the control current under conditions shown on plan, following through all multiple circuits and cut arounds. 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 for test in addition to the opening of the relay.

Where conditions are found that are not in accordance with approved plans these shall be corrected at once or steps taken for a revision of the plans to agree with the work.

When making this check and test, if conditions are observed in which the approved plans do not seem to provide proper protection or flexibility of operation, such conditions shall be reported to the Supervisor of Telegraph & Signals.

**TEST 25—TRACK CIRCUITS:**

(a)—Voltage at Relay.

The purpose of this test is to insure that track relays are not overenergized in accordance with instructions in C. E. 232 (formerly C. S. E. 32), or subsequent instructions.

Read track circuit voltage at relay terminals, record on proper forms, and arrange for prompt correction where voltage is high.

(b)—Polarity.

The purpose of this test is to insure that the polarities of adjoining track circuits are in accordance with approved plan or specification, and so arranged that least favorable signal indications will result from broken down insulated joints.

D. C. track circuits shall be tested by voltmeter which will show the actual polarity of the circuit.

A. C. track circuits shall be tested by polarity meter which will show the relative polarity (like or staggered) of the two adjoining track circuits.

Arrange for prompt correction where necessary.

**NOTE:**—In electrified territory where centrifugal relays are fed through resistor or reactor, or both, the polarity meter may not give definite indication. Under these conditions disconnect feed end of circuit being tested or place a good shunt across the track circuit at least 500 feet from the relay end and after the relay rotor has come to rest, bridge each insulated joint, separately, observing relay. If rotor turns backward toward or against the stop the polarity is satisfactory.
TEST 26—SIDING PROTECTION FOR INFLAMMABLE LIQUIDS:

The purpose of this test is to determine if the protective apparatus installed is operative and in good condition.

Ascertain by observation and tests that insulated rail joints, ground wires and other protective apparatus are intact and functioning as intended.

TEST 27—HIGHWAY GRADE CROSSING SIGNALS:

The purpose of this test is to be certain that all the equipment in connection with each installation is in good order and functioning as intended.

Make inspections and tests as prescribed in Instruction 80, Special Instructions Governing Construction and Maintenance of Signals and Interlocking Plants, Form C. S. E. 23.

TEST 28—INSULATED RAIL JOINTS AND SWITCH INSULATION:

The purpose of this test is to insure that all fibre insulation is in good condition and test shall be made as indicated on Plan S-818.

TEST 29—SHUNT TEST—HAND-OPERATED SWITCHES IN CAB SIGNAL TERRITORY:

The purpose of this test is to insure that cab signals are operating efficiently approaching non-interlocked switches in the unlocked or open position in coded track circuit territory, to develop the distance from the switch at which an engine receives a more favorable indication than caution-slow-speed. The distance in no case should exceed 100 feet. When shunt is not properly effective, corrective action must be taken promptly.

TEST 30—SHUNT EFFICIENCY—GAS & ELECTRIC AND SIMILAR SINGLE UNIT EQUIPMENT:

The purpose of this test is to insure that track circuits are effectively shunted by light weight equipment and must be made not less frequently than indicated at points where it is known that trouble may be experienced due to poor shunting.

Tests should be made by observing proper electrical meter connected in the circuit when the track is occupied by the light weight equipment moving through the entire circuit.

TEST 31—DRAGGING EQUIPMENT DETECTOR CIRCUITS:

The purpose of this test is to insure that the dragging equipment detector circuits are in proper order to sound alarm and display restrictive signal aspects.
Disconnect battery wire at the detector unit and check that alarm is sounded, that proper wayside signal aspects are displayed and that the proper code is fed to the track circuits involved. Any improper operation must be corrected at once.

**REPORT OF TESTS**

Report Test No. 19 on Daily C. E. 204 (formerly C. S. E. 4) Report.

Report Test No. 15 on Form C. E. 40. Report all other tests on “Report of Tests of Signal Apparatus” Form C. E. 247, as follows:

Keep running record of tests as performed, using one sheet for tests due weekly, one for semi-monthly, one for monthly and one for quarterly and longer intervals.

Date sheet for end of period covered, filling in name of Division, Headquarters, or name or number of section.

Column 1. List tests by number in numerical order. If there is nothing in service which is covered by any test, report should so state.

Column 2. Give name of cabin or territory covered: From .................................................... To ....................................................

Column 3. Show date of each test.

Column 4. If test is not complete, name cabin or limits of territory covered.

Column 5. Report conditions. If defective state whether corrected or requiring attention.

Tests under Nos. 2, 3, 5, 6 and 7 (handled by test forces) should be reported on a percentage basis for each of the tests involved instead of by locations.

APPROVED:  

H. L. STANTON  
Asst. Chief Engineer—Signals

W. D. WIGGINS  
Chief Engineer

October 5, 1937.