

**Massachusetts Bay
Transportation
Authority**



SM.2

**SPECIAL RULES, STANDARDS AND INSTRUCTIONS (RS&I)
GOVERNING CONSTRUCTION AND MAINTENANCE OF SIGNALS
AND INTERLOCKINGS**

SIGNAL MAINTENANCE

Director: Joseph T. McNeill

SM.2

SPECIAL RULES, STANDARDS AND INSTRUCTIONS (RS&I) GOVERNING CONSTRUCTION AND MAINTENANCE OF SIGNALS AND INTERLOCKINGS

INTRODUCTION:

The following Rules, Standards and Instructions (RS&I) apply to all MBTA Signal Division employees affected by them, including all Supervisory and Engineering employees.

These instructions govern the construction, maintenance, operation and testing of all signal systems and apparatus including Interlockings, on MBTA property. These instructions must be obeyed by all employees whose duties are in any way affected by them.

These instructions are essentially related to and coordinated with the E&M SM1 "Instructions for Testing Signal Apparatus and Signal Systems".

These instructions are intended to safeguard the movement of trains and must not be compromised in any way. These instructions are designed to continue to be effective in all kinds of emergencies. Authority will not be given to set them aside. In emergencies, the utmost cooperation must be given to the General Manager or his / her representative keeping up to date information as to what can be done safely, consistent with these instructions.

Revision Log:

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MBTA E&M SIGNAL DIVISION SM2
SECTION-1 GENERAL ALL SYSTEMS

Rev. 0 6/4/15

- 1) Employees whose duties are prescribed by these instructions must have a copy.
- 2) Employees engaged in the construction and/or maintenance of signals and interlockings must familiarize themselves with the current issues of the following, including all supplements:
 - a. Right Of Way Safety Rulebook
 - b. Special Orders.
 - b. Operating Rules in effect on territory for which responsible.
 - c. E&M SM.1 Instructions for Testing Signal Apparatus and Signal Systems.
 - d. E&M SM.2 - Special Instructions Governing Construction and Maintenance of Signals and Interlockings.
- 3) Signal Department Employees must be tested to maintain the following qualifications:
 - a. E&M SM.1 (Instructions for Testing Signal Apparatus and Signal Systems) - At least once in two years, not to exceed a 24-month interval.
 - b. E&M SM.2 (Special Instructions Governing Construction and Maintenance of Signals and Interlockings) - at least once in two years, not to exceed a 24-month interval,
 - c. Right of Way Safety Training - At least once in two years, not to exceed a 24-Month interval
- 4) Employees are responsible to attain and keep their qualifications up to date and will not be allowed to hold positions requiring those qualifications if they are not up to date.
- 5) Employees are responsible for the inspection, adjustment, and proper maintenance of all communications, signal, and interlocking apparatus assigned to their care. They must promptly report to their superior any condition requiring his/her attention.
- 6) Employees must cooperate with each other and with the employees of other departments to keep signal systems, devices and appliances in good working order.
- 7) Employees must observe and instruct their subordinates as to the necessity for safety, efficiency and economy, and that all work must be done in accordance with authorized practices and standards.
- 8) Alterations or additions **MUST NOT BE MADE** to any individual component or system involving signal apparatus or circuits **UNLESS PROPERLY AUTHORIZED BY SIGNAL SUPERVISION.**

- 9) Installation of experimental devices or use of unapproved material **MUST NOT BE MADE UNLESS SPECIFICALLY AUTHORIZED** By the Director of Signals.
- 10) In these instructions, Supervisor, Inspector, Signal Engineer, Foreperson, Wireperson, refer to employees assigned to the Signal Division.
- 11) Supervisors of Signals report to and receive instructions from the Deputy Director of Signals in all technical matters relating to construction, maintenance, and performance of signal systems, devices and appliances assigned to them. They must cooperate with the General Manager in all matters relating to division operation insofar as the Signal Division function applies.
- 12) Unless otherwise directed, the Line Supervisor shall have charge of signal maintenance and construction on his assigned territory.
- 13) The Line Supervisor must see that employees assigned to his jurisdiction qualify for the duties to which they are assigned and perform the work in a safe and efficient manner. He must see that these employees are provided with the required rules; plans, specifications and instructions, and that they fully understand and comply with them.
- 14) Unless otherwise directed, Signal Inspectors, Forepersons and Wire-persons report to and receive instructions from the Line Supervisor.
- 15) Unless otherwise directed, Signal Engineers report to and receive instructions from the Supervisor of Engineers.
- 16) Signal Inspectors, Forepersons and Wirepersons are responsible for the construction, maintenance, and inspection of communications and/ or signal apparatus assigned to them. They shall see that work is performed efficiently, economically, and in compliance with System Plans, Specifications, and Standards.
- 17) Employees must report to the Line Supervisor any situation or condition which may prevent completion of an assignment on schedule or within authorization.
- 18) Employees shall exercise proper care of tools, vehicles, equipment, and material assigned to them. In no event will requisitions be placed for material or tools in excess of immediate requirements.
- 19) The Line Supervisor or his representative must make frequent examinations of tools, radios and meters to ascertain that they are in proper order, of proper quality and condition. Tools, radios, meters, keys, standard plans and instructions, catalogs and technical literature must be issued to those who require their use. Employees are responsible for all tools, radios, meters, and keys issued to them. Tools, radios, meters, and keys issued by the Supervisor will be recorded on the appropriate form and signed for by the employee receiving them.
- 20) Buildings and surroundings, the care of which is assigned to the E&M Signal Division must be kept in good order. Scrap material must not be allowed to accumulate around headquarters or other facilities. Scrap must be handled in accordance with current instructions.

- 21) Deputy Director of Signals and Line Supervisors must keep the Director of Signals, Chief Operating Officer and General Manager advised of any operating changes at interlocking and/ or block stations. E&M Signal Division employees shall keep the Operator or Dispatcher informed of any activity in which they are engaged that may have any bearing or effect on the facilities in charge of the Operator or Dispatcher.
- 22) Malicious damage to signal facilities must be reported promptly to the Line Supervisor, Maintenance Control Center (MCC) and Transit Police.
- 23) Information regarding any signal material or apparatus must not be given except when authorized by proper MBTA authority.
- 24) Employees must report promptly any unusual occurrence which may require special investigation. All failures to signal equipment, regardless of impact on train delays shall be reported to the Maintenance Control Center (MCC). A complete description of the cause of the failure and action taken will be given to the employee on duty.
- 25) When special conditions exist that are not covered by these instructions, local instructions shall be issued by the Director of Signals.
- 26) When any changes or adjustments are made, all applicable E&M SM.1 tests shall be performed promptly to assure signal system is functioning as intended. This applies to adjustments made as part of response to failures. Note particularly the requirements of E&M SM.1 Test 23. All tests must be recorded on proper forms.
- 27) Before signal circuits are modified in any way, all changes must be properly authorized by the office of the Supervisor of Engineers or his designee. All changes must be clearly shown on the circuit plans for the location, for the Supervisor, and on the As-in-Service Plan to be sent to the Office of the Supervisor of Engineers for permanent circuit plan corrections to be made. If revisions are obtained via telephone or copied onto a valid circuit plan from a sketch or other authorized source, the date and initials of authorizing employee must be shown with the revisions on each field copy, and the initials of the employee in charge in the field (who is also responsible for marking the plans) must also be shown with each revision on each copy. See Rules 303 through 316. FRA Rules Standards and Instructions will govern except where MBTA requirements are more restrictive.
- 28) **PRINTED CIRCUIT BOARD HANDLING AND STORAGE PROCEDURES:**

These rules deal with the handling and replacement procedures for all printed circuit boards associated with equipment related to vital signal systems.

The following steps are to be followed in the handling and replacement of all printed circuit boards:

 - a) When circumstances permit, a proper grounding device is to be used when handling or repairing all printed circuit boards.
 - b) All affected printed circuit boards located on MBTA property are to be stored in either their respective chassis or in an 'anti-static' bag.

- c) All affected printed circuit boards containing vital software are to be tracked with a paper "Traveler Document" containing vital software data.
- d) When practical, all properly designated storage units containing printed circuit boards will be grounded in a proper manner.

29) **PRINTED CIRCUIT BOARD REPLACEMENT PROCEDURES**

Field Replacement Of Defective Printed Circuit Boards.

When troubleshooting a specific piece of equipment of the vital signal system all testing is to be coordinated through the dispatcher in charge of that territory involved.

Once the problem has been diagnosed to a particular printed circuit board and replacement is necessary, the following procedure is to be adhered to in making said replacement.

- a) Reference the 'Minimum Modification Level' documents provided by the manufacturer for that specific board and ensure the replacement board meets the necessary requirements.
- b) If a specific board contains software EPROMS that have to be 'swapped' to the replacement board, ensure that said EPROM information adheres to the application specific worksheets provided by the MBTA Signal Engineering Dept. before proceeding with change.
- c) Any discrepancies are to be fully documented and notification made to the MBTA Signal Engineering Dept. describing the discrepancies found.
- d) Replace suspect printed circuit board following applicable handling procedures as described in Rule 28 above.
- e) Verify that the replacement printed circuit board corrects problem.
- f) Test replacement printed circuit board according to the procedures listed in both the appropriate manufacturer's related service manual and MBTA procedures listed in SMI 1 completing Test Form when applicable.

30) **HANDLING PROCEDURE FOR ALL FACTORY REPAIRED PRINTED CIRCUIT BOARDS**

- a) All printed circuit boards being returned to MBTA by the manufacturer or an MBTA authorized repair facility are to be tested by an Electronic Technician either in the shop or under live field conditions to ensure said board is working as intended.
- b) Once the determination is made that the repaired printed circuit board is working as intended it will then be placed in a storage area as described under Rule 28 of this document.

31) MANUFACTURER SERVICE BULLETINS

When the MBTA Signal Engineering Dept receives a manufacturer's service bulletin related to equipment MBTA has in service, they will contact both the Deputy Director of Signals and the Supervisor of Engineers.

The Supervisor of Engineers will then coordinate with the Line Supervisors, Signal Inspectors, Electronic Technicians or other employees as directed to ensure repairs or updates are performed in a timely and efficient manner.

All paper work related to the repairs or updates will be kept on file in the office of the Supervisor of Engineers.

When all of the affected equipment has been repaired or updated, the Supervisor of Engineers will then provide a written completion report to both Director of Signal & Communications and Deputy Director of Signal & Communications with completion status.

MBTA E&M SIGNAL DIVISION SM2
SECTION-2 GENERAL INSTRUCTIONS

Date of Rev: 0 6/4/15

- 51) Signal apparatus must be kept in proper working order and maintained in accordance with current instructions and authorized practice.
- 52) The normal functioning of any device shall not be interfered with in testing or otherwise without first taking measures for insuring safety of train operation or highway traffic, which depends on normal functioning of such device.
- 53) Extreme care should be used when devices such as laptop computers and other test equipment are used for testing purposes. A check should be made to ensure that test equipment does not introduce grounds or other interference with the proper function of the system under test. It may be necessary to power such devices with an isolated source.
- 54) Defective apparatus that may endanger train movements must be immediately repaired or replaced, if practicable. If it cannot be immediately repaired or replaced, its operation must be discontinued, the train movements affected must be protected and condition reported to the Dispatcher and Supervisor by telephone.
- 55) When any function of signal system is to be taken out of service, Operator **OR** Dispatcher must be notified and documented.
- 56) Should a failure of switch, signal, highway crossing warning device, or device used in connection therewith be reported and no cause found, investigation must continue for sufficient period to insure apparatus is operating properly. Results of all tests and observations must be communicated to the Trouble Desk for follow up by Supervisor. If the condition reported is of such a nature that the safety of operation is affected, precautions must be taken as outlined in Rule 57. Tests and reports must be made under the direction of the Supervisor
 - a) Permission must be obtained from Operator or Dispatcher and a full understanding had when apparatus affecting train operation is to be removed or disconnected. When necessary to remove or disconnect such apparatus for replacement, repairs, inspection, testing, or cleaning, train movement must not be permitted over routes involved unless routes affected are properly secured or until the apparatus has been restored and operational check made to insure proper working order after repairs have been completed.
 - b) In case of changes in, failure of, or damage to signal or interlocking apparatus or highway crossing warning devices, the employee in charge must give the Operator or Dispatcher involved full information concerning the apparatus affected and arrange for the safe movement of traffic until repairs are completed.

- 57) **IN CASE OF TRAIN ACCIDENT**, immediate action must be taken as follows
- a) Secure all signals (wayside and cab) governing movements into that portion of tracks, which is or may be occupied or fouled by derailed or damaged equipment, so as to display their most restrictive aspects, by disconnecting local controls at each signal (See # 161). Supervisor must be notified promptly.
 - b) If accident is at an interlocking, the position of interlocking control functions must be recorded. If at a remotely controlled signal facility, the positions of switches, signals, and control relays for such switches and signals must be recorded. If a recorder is in service, insure that it is secured against possible tampering until proper authority obtains a valid printout.
 - c) If accident is at a highway grade crossing equipped with automatic devices, an operational test of the installation must be made to check that apparatus is functioning properly. Where apparatus has been damaged, the crossing must be protected until repairs have been made. If a recorder is in service, insure that they are secured against possible tampering until proper authority obtains a valid printout.
 - d) If accident involves personal injury or fatality, or if signals are found or suspected of having given 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 otherwise directed by the Deputy Director of Signals or his representative. A competent person must be assigned to see that the apparatus, wiring or wires are not tampered with.
- 58) Where an accident results from signal failure the Deputy Director of Signals or his representative shall be notified immediately of occurrence. If track is found unsafe due to broken rail, wide gauge, obstruction, or other conditions, signals (wayside and cab) governing movements over the unsafe track must be secured to display their most restrictive aspects, and immediate action taken to protect trains, notifying proper authorities. After corrections have been completed, signals may be restored to normal operation. When heating means for melting snow are in operation, Maintainer must assure all heating devices are in proper alignment and look for possible damage to apparatus, wire-ways, wires, and insulation at switches and action taken to prevent irregular operation of switches and signals.
- 59) Doors in housings containing signal and interlocking devices must fit tightly when closed to prevent water and foreign matter or snow from entering: all unused openings must be filled to prevent the entrance of rodents or insects. Ventilators must be kept in good condition and clean to allow free circulation of air.
- 60) Extreme care must be used when drilling, filing or chipping metal parts in or near spring combination or other exposed electrical connections, and suitable safeguards provided to prevent particles from lodging in

apparatus and producing an unsafe condition. Care must also be used to prevent tools or other metal articles coming in contact with adjacent electrical connections.

- 61) (Reserved for Future use).
- 62) Placing any object in instrument cases which is not an essential part of signal or interlocking equipment is prohibited. Flammable materials are not to be stored in or close to any signal enclosures under any circumstances.
- 63) (Reserved for Future use).
- 64) Mechanical connections shall work freely, but shall not have excessive lost motion in moving parts. They shall be kept clean, lubricated, and in alignment.
- 65) Maintenance of apparatus not specifically covered in these instructions shall be in accordance with specific instructions issued for such apparatus. When not so covered, the manufacturer's instructions shall be followed.
- 66) (Reserved for Future use).
- 67) When in the course of construction, switch points are installed in signaled track prior to placing such switch in service; the switch points must be secured in accordance with Rule 406. In addition, a switch circuit controller must be installed and wired to open the signal control circuits for both wayside and cab signals when the switch points are open $\frac{1}{4}$ of an inch or more. Circuit controllers on crossover switches shall open the signal control circuits for both wayside and cab signals on both tracks in which switches are located when either or both switches are open $\frac{1}{4}$ ($\frac{3}{8}$ if wide notch) of an inch or more.
- 68) Extreme care must be taken when painting to prevent paint from settling where it will affect the electrical, optical and mechanical characteristics of apparatus or equipment of the signal system.

MBTA E&M SIGNAL DIVISION SM2
SECTION-3 RULES, STANDARDS, AND INSTRUCTIONS FOR
FALSE PROCEED INVESTIGATION

Date of Rev: 0 6/4/15

- 100) The Deputy Director of Signals or Supervisor must be notified immediately in the case of any alleged false proceed or signal violation.
- 101) **All Reports of alleged false proceed signals or Signal Violations** must be immediately reported to a Line Supervisor and investigated. The signal or signals must be immediately taken out of service or secured so as to display their most restrictive aspects and approach signals must be arranged so they cannot display an indication more favorable than approach until investigation is complete or when it can be determined that it is safe to return them to service.
- 102) Investigation of false proceeds shall be in accordance with **E&M SM1, Test 23C. Test 23C** shall be filled out by Line Supervisor or Supervisor of Engineering for all alleged false proceeds or signal violations and submitted to the Office of the Deputy Director of Signals within 7 days of the occurrence where possible.

MBTA E&M SIGNAL DIVISION SM2
SECTION-4 RULES, STANDARDS, AND INSTRUCTIONS FOR SIGNALS

Date of Rev: 0 6/4/15

- 150) Signal lenses, glass, marker, letter, and number plates and lamps shall be cleaned as often as necessary to insure good aspects. Lamps should not be removed except for replacement or testing, or when aspect is out of service. Hoods must be maintained at all times. Backgrounds must be painted flat black and kept in good condition at all times.
- 151) Broken or cracked lenses of signals must be replaced as soon as practicable. If a red or yellow lens is broken so that the color is not plainly distinguishable, the signal must be arranged to display it's most restrictive aspect by opening the control relay circuit. If lens for the most restrictive aspect is broken, or its hood is not in place, condition must be promptly corrected and Dispatcher or Operator notified.
- 152) (Reserved for Future use).
- 153) Ladder, hand railing, platform, foundation and/ or fastenings shall be kept in good condition and securely fastened. Bolts, nuts, dowel pins, screws, binding posts, rivets, lock nuts, etc., must be kept tight and in good condition. The signal must be maintained in erect position.
- 154) Signals shall be aligned to give the best aspects for approaching trains. Conditions which may affect the reading of a signal aspect must be promptly corrected or reported to the Supervisor and Dispatcher.
- 155) Prescribed lamp bulbs must be used and maintained at the specified voltage and replaced in accordance with instructions.
- 156) All lamp units of the same signal head must have identical lenses.
- 157) Frequent inspection shall be made to avoid materials, snow, other surrounding lights, etc., interfering with view of signals. Tree limbs and foliage obstructing view of signals should be kept properly trimmed. Any evidence of construction that may eventually obstruct the view must be promptly reported.
- 158) Discolored backgrounds and hoods should be painted immediately. Adjusting bolts and door fastening must be lubricated to prevent rusting. Doors must be kept well gasketed and tightly closed to prevent water, dust or snow from entering. Where screened air vents are provided, they must be maintained so as to provide air circulation. Wire openings in signal units and masts must be sealed to prevent entrance of rodents, insects, etc.
- 159) Socket surfaces must be clean. Lamp must be pressed into socket far enough to be turned clockwise to end of slot so that contact spring may force lamp into proper place. Lamp receptacles may be changed or reset only when proper provisions are available for refocusing.

- 160) Doors or cover of lamp unit must be kept closed when trains are closely approaching. If practicable, doors on same head of color light signals shall be fastened together so that all must be opened at the same time.
- 161) To secure an electrical signal so as to display its most restrictive aspect, control wires must be disconnected from control relays.
- 162) (Reserved for Future use).

MBTA E&M SIGNAL DIVISION SM2
SECTION-5 RULES, STANDARDS, AND INSTRUCTIONS FOR
TRACK CIRCUITS

Date of Rev: 0 6/4/15

200) For new work or rail renewals in track circuit territory, insulating rail joints shall be located as follows:

- a. Wherever track circuits adjoin, insulated joints shall be located as nearly opposite one another as Track Department Standards will allow, but must not be staggered more than 56 inches under any circumstances.
- b. To provide effective route locking, insulating joints shall be located opposite the signal as closely as possible. Also, insulated joints shall be placed not more than 13 feet before signal.
- c. Insulated rail joints may be staggered in excess of 56 inches only at the end of a track circuit where there is no adjoining track circuit and no fixed signal.
- d. Insulating rail joints in crossover and turnouts shall be located in accordance with Standard Signal Plans.

201) When questionable shunting conditions exist:

In Interlocking Limits:

When the head of rail in track circuit territory, **within Interlockings**, is covered with rust, sand, or other material which may interfere with the proper shunting of the track circuits, and which cannot be immediately cleared, the Maintainer must notify the Operator or Dispatcher.

The Maintainer must inform the Dispatchers as to the affected area to protect train movement.

202) When rails, switch points, or frogs are removed, the Maintainer must ascertain that all signals governing movements through area will display their most restrictive aspects. When rails, switch points, or frogs are removed within limits of the approach circuits at highway crossings, the Maintainer must take action to prevent unnecessary operation of such devices and provide for safe movement of highway traffic.

Where turnouts are being constructed or renewed in signaled main track, signal governing movements over turnout must display its most restrictive aspect until the main track rail is correctly placed. All switch plates on the turnout side must be fully secured in correct position, the main track switch rail should be secured against its stock rail, and the free end of the stock rail fastened to prevent movement. On completion of the above work, signal system can be restored to normal operation.

203) Track circuits shall be adjusted and maintained in accordance with MBTA

SM1 instructions (as applicable).

A check must be made of relay current and cab signal levels (in cab signal territory) when tracks are raised, cleaned, or welded rail is installed, to prevent over energized condition, loss of shunting sensitivity and decrease in broken rail protection.

- 204) Before disconnecting leads of impedance bonds or removing rails, frogs, etc., care should be exercised to insure at least one return path for traction current is maintained.

When making rail or frog renewals, before rail is disconnected, a return path for traction current shall be provided by using a temporary shunt bond from rail to rail on each side of the rail section to be removed. Make sure that any insulated rail joints between the temporary shunts are bonded around to insure a traction current path...

Connections for electric traction return current shall not be made from one rail of a track to either rail of an adjacent track **except** between propulsion return rails where single rail track circuits are used.

Before rail or center tap lead is removed from an impedance bond, the rail must be bonded to the neutral or center tap lead of the impedance bond if such a lead exists. Eye and face protection must be worn when removing or installing impedance bonds and all trains in the power section in both directions must be stopped to protect against potential large arcs.

- 205) (Reserved For Future Use).

- 206) Bonding, including track circuit connections, fouling wires, and cross bonding shall be applied and maintained in condition to insure minimum resistance. Where bonds cross under rails of opposite polarity, they should be secured from movement caused by ballast or frost, which would result in an inadvertent short circuit. Bonds and track connections should be arranged to minimize hazard to damage by track work.

Care should be exercised in use of staples, nails or equivalent fastenings applied to track connections or bonds to prevent possible short circuit to a rail anchor, rail spike, or opposite the hole in a tie plate where inserting a future rail spike is possible. Fouling wires shall be installed and maintained so as to remain visible and clear of ballast, properly secured, and with adequate clearance under running rails.

- 207) All track leads shall be paired and twisted with not less than one twist per foot. Track wire pairs with same frequency shall not be allowed in the same cable. In no case shall multi twisted pair audio frequency bond line cables be installed. In no case shall bond lines twisted pairs carrying the same frequency and code rate be terminated in the same junction box.

- 208) Splitting a twisted pair to accommodate two different track circuits is strictly prohibited. Series loop carrying cab signal energy through crossovers must be located adjacent to proper rail as shown on Standard Plans. The crossover loop must have proper amount of transpositions as shown on Standard Plans. Track wires shall be installed and maintained in such a manner as to protect them from mechanical injury.

209) Audio-frequency track transmitters and receivers, or equivalent systems of like frequencies, must be mounted in separate housings (when possible). Two track circuits with the same train detection frequencies must be separated by the distance specified by the designer. Any deviation from this distance is strictly prohibited. All applicable tests shall be made when replacing audio-frequency's devices. Any change of train detection frequency during maintenance or trouble shooting is strictly prohibited.

210) Cross bondings of traction return between adjacent tracks in double rail or audio frequency territory shall be separated by 2x the length of the longest track circuit between crossbonds.

211) When electric arc welding is to be performed on rails in track circuited territory or where arc welding is to be used in the vicinity of track where welding currents may enter the rails, signals must be protected against improper operation.

Cable leads from each welding generator where used in vicinity of track structure must be laid in pairs close together to prevent interference with track circuits through induction. Both cables (electrode and ground) must be completely and properly insulated throughout their length. Ground clamps employed for welding track structure must have full copper face for bearing against the web or base of rail to insure full and proper contact. The ground clamp must be applied to the rail being welded as reasonably close to the work as possible. It may be necessary to apply heavy duty shunts across the work area to short out stray welding currents and prevent damage to signal equipment.

MBTA E&M SIGNAL DIVISION SM2
SECTION-6 RULES, STANDARDS, AND INSTRUCTIONS FOR
SIGNAL CABLES

Date of Rev: 0 6/4/15

- 250) In order to avoid the possibility of damage to insulation, wires must not be crowded or jammed. Wires must be protected from sharp edges. Wires must not be pulled around sharp corners or across sharp edge.
- 251) Wires and cables shall be without splices as far as practicable. Splices, where necessary, shall be in accordance with approved instructions for the specific type of cable to which they are to be applied. Splices, when possible should only be made in manholes or junction boxes. Direct burial splices must utilize approved splice kit.
- If vital working wires in a cable are severed, necessitating one or more splices in the cable, the following will apply:
- a) Cable conductors affected are to be opened at the termination points in the housings at each end of the cable involved.
 - b) Individual conductors are to be carefully identified and each is to be properly spliced in accordance with approved instructions to insure full restoration of the insulation on each conductor.
 - c) Prior to restoring affected vital signal circuits to service, entire cable must be meggered to ground and cross-meggered in accordance with SMI 1, Test 2, and each conductor properly identified at the terminal board at the opposite end of the cable from the Megger. Each conductor is to be grounded three (3) times, while the Megger operator watches for the appropriate reaction on his megger, to insure that the circuit tag nomenclature and the conductor number at the terminal board on each side of the splice are in full agreement.
 - d) If two or more vital working wires have been severed and disarranged, it will be necessary to open the wire on one relay contact in each circuit on the battery or energy side of the splice and see that the appropriate controlled relay drops on the other side of the splice. This should be done for each affected conductor as its test links are being closed and prior to restoring the circuit to full service.
 - e) As soon as practicable, following full restoration of service, each splice must be properly protected by an approved splice kit.
- 252) Cable conductors shall be numbered from core outward. When making splices, conductor number one shall be joined to conductor number one, etc. When reading cables, face the conductors at each end. Half or random splices of wires or cables are prohibited at any point for construction. Branch connections shall be made in instrument cases, instrument houses or terminal boxes.

- 253) Wires or cables entering interlocking buildings, instrument houses, or instrument cases shall be connected to terminals. Cables shall be terminated on a terminal board in conductor order, including spares. All local wiring shall be installed on mating terminals and test links employed to connect the cable conductors to the local wiring. Random terminations are prohibited.
- 254) Not more than two (2) wires shall be installed on an AAR terminal post. Two wires are permitted on relay posts of shelf or wall mounted relays.
- 255) Jam nuts shall be used on threaded binding posts and must be kept TIGHT. Care must be used to avoid undue strain or damage to threads on binding posts. A full complement of nuts and washers will be maintained on all terminals.
- 256) All crimped and solder less type terminals shall be checked to insure that insulation has been properly removed and that the terminal has been properly crimped on the wire. Other terminals such as slide on, clip on, etc. shall be checked for tightness and proper installation.
- 257) Wire conduits or chase-ways must be installed and maintained to prevent mechanical injury to the insulated wires and cables. Vacant spaces in wire openings of instrument cases, etc., must be packed tightly with approved sealing material. Wire and cable openings through floors, and other wire ways which could act as a flue to spread any fire which might occur, must be sealed with approved sealing material.
- 258) Exposed buried wires and cables entering bottom of cases, housings and other structures must be protected from mechanical injury and fire. Pipes, conduits, and channels must be secured to prevent slipping or settling.
- 259) Cable and wire installed within the track structure where possible and practical must be at a minimum depth of 30 inches below the bottom of the tie and within conduit where practicable. To deviate from this, approval of the Deputy Director Signals is required. All excavation within the track structure must be filled in prior to stoppage of work. Backfill must consist of sand or fine, rock-free soil, topped off with ballast compacted on top of tie throughout to a shoulder extended one foot beyond end of tie with the proper slope to toe of ballast. The ballast contours must be maintained during an excavation adjacent to or parallel to track structure.
- 260) In all cases duct lines and underground wires and cables must be identified and located on signal layout plans. In addition, cable markers may be used. Where cable is plowed, a marker tape is to be plowed in six inches above the cable.
- 261) Conduits and ducts between manholes or similar openings underground and junction boxes, instrument case or similar housing above ground, shall be sealed to prevent rodents or condensation from entering.
- 262) When working as a member of a group, each employee will observe and protect against hazards for themselves and other members of the group.
- 263) E&M Signal Division employees will be responsible for installing only authorized cable and wire. When in doubt as to the applicability of any

particular wire or cable make-up, the Line Supervisor must be contacted immediately and the material not used until certain that it is the proper material.

MBTA E&M SIGNAL DIVISION SM2
SECTION-7 RULES, STANDARDS, AND INSTRUCTIONS FOR
SIGNAL CHANGES & PERIODIC TESTS

Date of Rev: 0 6/4/15

- 300) Periodical tests of signaling and interlocking devices must be made regularly. The frequency of tests specified in SM 1 represents the maximum interval between tests. Specific conditions may make more frequent tests advisable.
- 301) Other tests that may be designated from time to time must be made in accordance with instructions that will be issued in specific terms related to such conditions specified.
- 302) **Meters and Other Test Equipment**
- a. When making electrical test of switch and signal circuits, the proper meters and other test equipment must be used and it must be known that no unsafe conditions are set up by the application of such testing apparatus. When using switch or signal circuits for temporary telephone, it must be known that the use of telephone will not, in any way, affect the circuits
 - b. Meters that are used when making electrical and electronic tests of switch and signal circuits shall be kept in good working order and must be calibrated as recommended by manufacturer's instructions or at least once every two years.
 - c. Meters that appear not to be accurate must be compared with another known accurate meter before continuing its use.
 - d. When checking grounds in current mode, meters are not to be inserted in circuits under live traffic conditions.
- 303) Alterations must not be made to any apparatus or circuits without proper authority. Plans for such change must be obtained from the Office of Deputy Director Signals or Supervisor of Engineers.
- 304) All changes must be made under the supervision of a qualified designated competent employee who is personally responsible for work under Rules 306, 308, and 310, and must know that the employees making wire changes and connections are thoroughly qualified for and have full understanding of the work assigned them. The person in charge must be responsible for the preparation of local wiring diagrams when required, on which must be clearly indicated the apparatus wiring, etc., that is in service and that which is to be added. Points, at which new circuits tie in with those in service, must be plainly marked.
- 305) At interlockings, where changes are being made that may interfere with the normal operation of the signal and interlocking system, the distant signals or speed commands must be arranged so that they will not display

an aspect more favorable than Approach and the switches clamped for all train movements until the changes are completed and checked.

- 306) Any necessary relocation of apparatus and wiring in service, either permanent or temporary, must be made under the personal direction of the employee in charge, and all circuits modified in any way must be thoroughly tested immediately after relocation and before circuits are allowed to function as intended.
- 307) New apparatus must be located and new wiring installed without disturbing circuitry in service, where possible.
- 308) Connections to wiring in service must be handled under the personal direction of the employee in charge. All new wiring to be placed in service and tied in shall not interfere in any way with live existing circuit operation.
- 309) The employee in charge must make necessary notations on wiring diagram or circuit plans to show any new wiring which is connected to working circuits or apparatus, and must clearly mark on diagrams or circuit plans conditions required for final arrangement which cannot be made prior to cut-over without interfering with work in service. Wires which are to be connected at cut-over must be marked with red tags. Wires which are to be removed at cut-over must be marked with Yellow tags. Wires, which for any particular reason, cannot be hooked up prior to in service cutover must be marked with Green tags. Wires bearing Green tags must be connected only by the employee in charge or under their specific instructions, which shall definitely state that "Green tag wires" are to be connected. On completion of changes, all colored tags must be removed. Wires taken out of service shall be removed and ends cut back to a safe position until they can be completely removed.
- 310) Before final cut-over, all circuits changed must be thoroughly tested as far as possible and final arrangement must be tested in entirety by a qualified, designated, competent employee other than the employee in charge of performing the wire work.
- 311) (Reserved for Future use).
- 312) The qualified, designated competent employee engaged in making or testing circuit changes must have full understanding with Operator or Dispatcher as to any interference with working units must obtain permission for necessary use of switches or signals and must secure switches in accordance with Rule 407. The employee in charge of changes must cooperate with the Maintainer and keep him informed at all times as to the condition of the plant. All signal testing and circuit changes must be in accordance with the other provisions of E&M SM.1 and E&M SM.2 insofar as they apply.
- 313) To provide a check against misunderstanding when the qualified designated competent employee in charge directs another to close or open wire connections to wiring or apparatus in service, it must be stated specifically what is required, using relay or device name and contact or terminal number or other definite description, and must receive confirmation from the person at the wire by that person reading the wire number back as a check. The employee in charge must indicate on the

circuit plan or the wiring diagram the connection that is to be closed or opened. If the open circuit is protected by a Green tag, the employee in charge must so state. The one who is to carry out the instruction must repeat the order exactly as received, must not attach wires protected by Green tags unless specifically directed, and after carrying out the order must advise in detail, using wire numbers or other definite description.

- 314) When circuits are to be closed only for test, the employee assigned to this work should preferably remain at the point until the test is completed and then again open the circuit, reporting to the employee in charge the exact conditions. The employee in charge must at the earliest opportunity, and before leaving the work, verify the conditions as reported.
- 315) New wiring to working apparatus, relays or circuits must be secured or insulated from making inadvertent contact with circuits in service.
- 316) Alterations or changes to vital microprocessor software at interlockings or wayside systems must not be made without proper authority. All changes to vital microprocessor Interlockings and wayside systems must be made under the direction of the Supervisor of Engineers and all testing must be done in accordance with this policy.

MBTA E&M SIGNAL DIVISION SM2

SECTION-8 RULES, STANDARDS, AND INSTRUCTIONS FOR RELAYS, CIRCUIT CONTROLLERS, AND USE OF JUMPERS

Date of Rev: 0 6/4/15

- 351) **The inverting of relays or otherwise tilting them in order to close the contacts is strictly prohibited.**
- 352) **The swapping of relays or timers as a troubleshooting tool is strictly prohibited.** Relays shall be swapped out with a replacement relay of the same type only when it is determined that the relay is not functioning as intended (i.e. high resistant coil, contamination inside relay or relay operating values not within manufacturers specifications).
- 353) The bridging of contacts on relays, or any circuit controlling device, or energizing relays or devices directly from any source which will in any way impair the protection of such circuit controlling device must be done in accordance with the following instructions:

NOTE: Use of Jumper Enable Terminals at Microprocessor Interlockings "so equipped" constitutes the use of jumpers within the meaning of this section and requires the same procedures.

- a. Jumpers will not be applied until specifically authorized by Supervision with a full and complete understanding as to the application of the jumpers by all concerned parties. Also, protection must be afforded by the dispatcher or operator to protect circuitry that is disabled as a result of applying the jumper. In addition, protection also shall be afforded in the field, if possible. Before Supervision authorizes the use of jumpers, every attempt to correct the situation by other means should be made. Generally, jumpers should not be used in conjunction with ordinary maintenance or programmed work (unless if necessary to comply with # 202), and it should NOT be necessary to pick a track relay or its repeater with jumpers under any circumstance. The application of jumpers should be the last resort.
- b. After jumper permission is granted, a log of the permission shall be made at (OCC) Operations Control Center and (MCC) Maintenance Control Center database.
- c. The sequence for applying a jumper will be in the following order:
 - 1. Permission will be obtained from Supervision. The person receiving the jumper permission will inform the Dispatcher or Operator as to what is "jumped" out and what portion of the signal system is inoperative. **The E&M Signal Division responsible employee authorized to apply the jumpers will be held personally responsible for their proper application and removal.....** The person receiving the jumper permission will inform the (OCC) Operations Control Center and (MCC) Maintenance Control Center that jumper permission has

been granted and describe the time, what is jumped, who **authorized the jumper, who is applying the jumper, what protection is provided and the name of the dispatcher or operator whom was notified. The Maintenance Control Center will log this and all other pertinent information.**

2. The Line Supervisor will follow up with the Maintenance Control Center to ensure that the jumper permission that was granted is correct as authorized.
 3. The Line Supervisor will check with the Maintenance Control Center to determine the status of all jumper permission granted periodically during the day to determine if the jumpers are still in service or removed.
 4. The Maintenance Control Center will provide Supervision with a list of all jumper permissions that were issued for the prior 24 hours and identify those still in service each morning on their respective territories.
 5. The Supervisor will verify each morning that the jumper permission is correct for their respective territory.
- d. The sequence for removing a jumper will be in the following order:
1. The person who was authorized to apply the jumper is the only one that can remove the jumper, however, if unavailable the Supervisor who was involved granting the jumper permission may authorize its removal.
 2. Before a jumper is removed a full understanding must be had with the Dispatcher or Operator as to when the jumper can be removed safely.
 3. After permission is granted by the dispatcher to remove the jumper, the circuitry involved must be checked for integrity and proper operation as intended by the approved circuit plan.
 4. Once jumper is removed, the (OCC) Operations Control Center and the Maintenance Control Center will be notified immediately by the person authorized that the jumper has been removed and the circuitry is back to normal as per the circuit plan.
 5. The Maintenance Control Center will then enter in the trouble database that the jumper is removed, by whom, date and time, circuitry is or is not back to normal per circuit plan, dispatcher or operator has been informed and all other pertinent information.

354) The guiding principle at all times must be that any protection temporarily defeated by the jumper must be provided by some other means until the removal of all jumpers is assured and the original protection is restored.

The picking of Lock Circuits or taking apparatus "off Time Locking" or the use of "Jumper Enable" features at Solid State Interlocking shall be in strict compliance with the procedures above. (See also #408)

355) Jumpers must not be less than eight (8) feet in length, of flexible wire not smaller than No. 16 AWG. and must be visible and not coiled when applied. An approved tag (SMI Authorized Jumper Tag) shall be applied to all jumpers that are applied in excess of one hour and have the following information:

- a. Name of person who received authorization and applied the jumper.
- b. What circuitry is disabled?
- c. Reason for jumper being applied.
- d. Authorized by
- e. Date and time jumper was applied.
- f. Signature of person applying jumper.
- g. Date and time jumper was removed.
- h. Signature of person removing jumper.

Tags will be retained by the employee who removed the jumpers for a period of 30 days.

356) The greatest possible care must be used in applying a jumper to keep to a minimum the amount of protection cut out by its use. The intention of these instructions is twofold: first, to guard against improper use of jumpers; second to insure their removal, even though precautions have been taken to render conditions entirely safe during their use. These instructions, therefore, apply regardless of whatever else may be done, such as disconnecting circuits, setting signals at "Stop," securing switches and levers, or other precautionary measures.

- a. **Where jumpers are to be applied in lieu of switch point protection, switch points must be clamped and must be inspected prior to each and every train movement over the affected switch.**

357) The insertion of insulating material between the contacts of circuit controllers or the insertion of similar material in other contacts which would in any way impair any protective feature of any circuit is strictly prohibited.

358) The seals on relays and other similar apparatus must in no case be broken except by an authorized person. Relays or similar apparatus removed from service due to defect must have a red tag attached stating defect, if known, and marked "not fit for service." They must not be used again until a white tag is attached by Relay Test person or Inspector indicating the relay has been shopped and tested ready for service.

359) Where contacts are visible, contact openings must be observed frequently and, if found more or less than normal or otherwise defective, apparatus must be replaced.

360) Future use

- 361) All circuit controllers must be kept clean and properly adjusted, and the original sets or bends of contact springs must, as far as possible, be maintained and any excessive setting or bending which may produce an unsafe condition is prohibited. Air vents must be kept clean and open at all times.

When work is being done on polarized circuits, only one wire must be disconnected at a time. Wires and posts must be clearly marked to avoid any possibility of reversing the polarity of the circuit.

After wires are restored, necessary checks must be made immediately to determine that all affected facilities are working properly.

- 362) Plug in relays and bases must have the proper registration plates and pins.

- 363) Relays must be kept in pristine conditions. The placing of "test date" stickers, etc. on the glass casing is strictly prohibited. Only Relay Shop personnel are responsible for the removal and replacement of manufacturer's labels.

MBTA E&M SIGNAL DIVISION SM2

SECTION-9 RULES, STANDARDS, AND INSTRUCTIONS FOR INTERLOCKINGS, TRAFFIC CONTROL SYSTEMS, AND SWITCHES

Date of Rev: 0 6/4/15

- 400) Signal Department employees must not operate controls of an interlocking or remotely controlled signal facility except for test, Row and inspection purposes or in an emergency, and then only after a definite understanding is had with the Operator or Dispatcher having jurisdiction over the interlocking or control station. Maintainers are to be familiar with operation of local control panel as required.
- a. When interlocking signals cannot be displayed remotely and the local control panel is functioning as intended, it may be used by the Maintainer (or an extra operator in extended emergencies) to control the interlocking under the direction of the OCC Dispatcher. If there is any question as to the proper functioning of the local control panel, its indications should be verified by comparison with corresponding vital relays in the central instrument house. If operating requirements can be met by fleeting signals locally, then that should be done with the proper understanding of the Operator.
 - b. When interlocking signals cannot be displayed remotely or locally, and the position of one or more switches in the route cannot be positively determined due to loss of switch indication on local control panel and vital switch correspondence relays in central instrument house, train movements must be protected by placing the switches involved in the position required by the Operator and securing these switches in accordance with Rule 407. Advise the Operator at once as to which switches have been "Clamped " and keep the Operator informed of any subsequent changes.
 - c. At a remote controlled interlocking when any code system interface relays or cards are to be changed out, the following will govern:
 1. If interlocking is equipped with functional normal and standby non-vital control units (PLC's etc.) the system shall be forced to the functioning unit while the code equipment is being changed out on the non functioning unit. If this cannot be done then the,
 2. Interlocking must be placed in local control with the permission of the OCC Dispatcher. If interlocking can be fully controlled from local control panel and trains can be moved on proper signal indications, then code system interface relays or cards may be changed out. Each function affected must be fully checked operationally, including observation of vital relays, to insure proper functioning before full restoration to remote control is permitted.
 3. If takeover to local control cannot be achieved, or if signals

cannot be displayed by local control, then remote/local control must be left in "local" position. Train movements within the interlocking must not be permitted while interface cards or relays are being changed or interface circuits are in any way disarranged, unless ALL switches in the interlocking are secured in accordance with Rule 407.

- 401) When parts of switch layouts, which may affect the adjustment and locking of the switch, are repaired or replaced, or when adjustments are made in accordance with obstruction test in accordance with E&M SM.1 Test 13 must be Made before switch is restored to normal service.
- 402) Locking edges of opening in lock rods must be square. Plungers and locking dogs must be full size and corners square at locking end. Rod must be clear of locking dog or plunger (when unlocked) and must move freely when operated without binding in its guide.
- 403) (Reserved For Future Use).
- 404) (Reserved For Future Use).
- 405) When for the purpose of maintenance or repair, or when notified a signal apparatus is inoperative or disconnected, the Maintainer must determine that approved blocking devices have been applied.
- 406) When necessary to disconnect a switch, moveable point frog or derail (hereinafter called switch) from its operating mechanism or to disconnect operating rod, the following must be done as part of providing complete protection for trains: The closed point must be held securely clamped against the stock Rail.
- 407) If necessary to disconnect both No. 1 and No. 2 switch rods, train movements must not be made over the switch until one or both rods are properly connected to the switch points and the switch has been secured. If the open point is removed, trailing movement may be made after the closed point has been secured in accordance with Rule 407. When necessary to disconnect or impair function of locks, circuits or other safeguards in an interlocking, all switches affected must be safely secured as follows before any train or engine is permitted to pass over them:
 - a. The closed point must be held against the stock rail by a clamp. On # 20 turnout switch, insert spike at the mid-point. Where possible, the spike must pass through the tie plate. Longer switch points with additional switch machines will be spiked at each switch machine.
 - b. No movements are to be made over switches affected without the consent of the employee in charge, and employee must, upon completion of repairs, test switch by manipulation before surrendering jurisdiction over the machine.
- 408) Lock relays in all relay interlockings shall not be energized by a jumper, except in case of emergency or when necessary on account of repairs, and then only upon authority of Supervision as per Rule 353.

Whenever a lock circuit is momentarily energized, notation must be made by the Train Dispatcher. After authority has been received to momentarily energize a lock circuit, the following precautions must be taken:

Where provided, jumper enable circuits, used for emergency release of locking in microprocessor Interlockings, shall be used in strict compliance with existing jumper rules 351 thru 356 and rule 408. Jumper enable circuits cannot be used unless Interlocking is in Local Control mode.

a) Signal Indication Locking

If a route in an all-relay interlocking cannot be released, the lock relay must not be energized manually until the Maintainer knows that all signals directly controlled are in "Stop" position.

b) Switch Detector and Route Locking

Switch locking relays must not be released until it is known that the signal displays "Stop Signal" and that a train has not passed the signal and that the route is not occupied or fouled by a train or car. **The picking of track relays or repeaters to release switch detector locking is strictly forbidden.** In all-relay interlockings the proper lock relay must be selected. Signal more favorable than Restricting must not be displayed until the track has been inspected, unless the switch correspondence and track occupancy light show that route is properly lined and the track is clear.

c) Traffic Lever Lock or Traffic Relay Circuits

Traffic lever locks may be released manually or traffic relay circuits poled in opposite direction only after arrangements have been made with the Dispatcher to safeguard the movement of trains in the territory affected.

d) Electric Locks on Hand-Operated Switches

Electric locks on hand-operated switches may be released by hand after permission is obtained from the Dispatcher or by timed release.

409) Machine parts, connections and devices affecting the operation of mechanical locking must be renewed as frequently as necessary to insure reliable operation.

410) The spring combination on electro-pneumatic, electric and similar machines and the adjustment of contact springs and band with relation to indication and electric locking must be carefully maintained as follows, where applicable:

a) Only contact springs with a sharp (V-shape) bend instead of a gradual curve at contact point must be used, and the main stem of the spring must be straight so that an accidental bending during cleaning, or otherwise, will draw back rather than push forward the point of contact. All springs must be secured to the insulating bed plates by bolts that pass through the bed plate, and not more than two wires are to be connected to the same spring combination terminal post.

b) Contact bands and springs must be cleaned periodically by wiping thoroughly with a clean, dry cloth free from lint. Approved commercial

cleaning cloths or chamois, moistened with oil, must be used as necessary to maintain clean contacts. Oil must be used very sparingly at relatively long intervals on the roller shaft bearings and must never be used on the bevel gears.

- c) Contact and roller surfaces which inadvertently become covered with an oil film must be cleaned by wiping with a clean cloth free from lint, to which a small amount of approved cleaning fluid has been added. These surfaces must be rubbed carefully with a clean, dry cloth free from lint to remove all traces of the cleaner and remaining residue.
 - d) Contact part of springs must meet the contact bands evenly and squarely in order to provide maximum contact. They must have sufficient pressure to provide good contact, but not enough to interfere with proper operation. Checks must be made at least annually to insure that all springs are closed or opened at the proper point in the lever movement.
- 411) Employees must not unlock switches that will in any way affect trains closely approaching or passing. Non-interlocked switches in main tracks or leading to main tracks, when not in use, must be locked in normal position.
- 412) GRS Model 9 or US&S T20 hand-operated switch machines shall be used in cab signal territory and electrified territory. Hand-thrown switches in signal territory other than above shall be equipped with an approved Maintenance of Way switch stand, circuit controller, and associated time lock circuitry and mechanism.
- 413) **Authority must be obtained from the Dispatcher before performing any work on a hand-operated switch that will affect the signal system or the safety of train operation.**

MBTA E&M SIGNAL DIVISION SM2
SECTION-10 RULES, STANDARDS, AND INSTRUCTIONS
FOR CAB SIGNAL SPEED COMMAND SYSTEM

Date of Rev: 0 6/4/15

- 450) Test circuit or test loops for speed command signals shall be maintained in good condition and current in same properly adjusted.
- 451) Test loop for speed command signals shall not be installed in signaled territory unless authorized by the Supervisor of Engineers & OCC.
- 452) Insulated joints in ATO territory must be frequently inspected and kept in good repair. In electrified territory breakdown of a single joint will allow cab signal current around the other joint through the impedance bond.
- 453) Track mapping of Cab Signals in ATO territory shall be made monthly by Signal Engineering and reports of any defects delivered to the Line Supervisor and Signal Inspector for their handling.

MBTA E&M SIGNAL DIVISION SM2
SECTION-11 RULES, STANDARDS, AND INSTRUCTIONS
FOR TRAIN INSPECTION DEVICES

Date of Rev: 0 6/4/15

- 500) Snow, ice or any obstruction shall be kept clear of detectors so that there will be no interference to the proper functioning of the detecting devices.
- 501) Self-restoring dragging equipment detectors shall be inspected monthly and after derailed equipment has passed over them to insure proper operation.
- 502) Self-restoring dragging equipment detectors shall be lubricated, cleaned and any loose parts made secure every three months.
- 503) Hot box detectors shall be maintained in correct gauge and alignment and kept free of snow, ice and other debris which could affect their operation. Specific tests in accordance with manufacturer's instructions and/ or **E&M SM.1** to insure proper operation shall be made.

**SECTION 12 RULES, STANDARDS, AND INSTRUCTIONS
FOR BATTERY CAPACITY FOR SIGNAL FUNCTIONS**

Date of Rev: 0 6/4/15

551) Table 551-1 below indicates the battery sizes that will be used for the signal functions shown.

Exceptions to this standard may be granted by the Deputy Director Signals to cover installations having unusual requirements.

Table 551-1. Battery Capacity Standards for Signal Functions

FUNCTION	CONDITIONS	STANDARD
Central Instrument House		AS per circuit plan
Code System Battery	Office and Field Locations	AS per circuit plan
B24 Battery		AS per circuit plan

552) Floating and Trickle Charging:

NOTE:

Floating Charge Floating charge is continuous input of current to a storage battery.

Batteries connected directly across rectifiers and load is under floating charge.

Trickle Charge: Trickle charge is a continuous input of current to a storage battery to compensate for internal losses only.

Do not take battery leads off until AC power to rectifier is turned off

- a.) Containers must be kept clean, level, and as dry as practicable. Spillage must be removed to prevent corrosion and/ or leakage of current.
- b.) Trays and supports must be kept clean, dry, and in such condition as to prevent surface leakage of current.

- c.) All connections must be kept clean and tight. Exposed brass or copper battery connections must be kept covered with a thin coating of Vaseline, No-ox-id or equivalent.
- d.) Battery housings and compartments must be kept clean and dry, and when batteries are located in a building, ventilation must be provided. Where the inside is of wood or metal, it must be painted with acid resisting paint.
- e.) Ventilating filling plugs must be maintained, properly secured in each cell.
- f.) Hydrometers and syringes must be properly protected against breakage and against injurious effects on the apparatus from acid. Separate syringe must be used for each type of battery.
- g.) Distilled water, or water approved for use in batteries, must be kept in covered glass or plastic containers, which must not be used for other purposes.
- h.) After tests and readings have been completed, water must be added, if necessary, to maintain proper solution level. When water is added in cold weather, solution must be agitated by use of the syringes to prevent freezing. Spillage must be removed to prevent corrosion and/ or leakage of current.
- i.) Meters shall be checked for accuracy if readings are questionable.
- j.) An exposed flame must not be allowed near a battery, as the gases being given off may explode. Care must be exercised in the use of tools near battery terminals to prevent striking an arc. To prevent drawing an arc when connecting or disconnecting cells, the load and charging circuits must be disconnected at a point away from the battery, preferably at the buss.
- k.) A battery card for each set of batteries shall be kept at each location. The battery voltage shall be recorded on the card along with the date tested. Voltage tests shall be done each time the location is visited or weekly at a minimum. (Refer to SMI 1 , Test 18 for frequency)
- l.) Once each quarter a load test shall be performed on each set of batteries by disconnecting the battery charger and monitoring the battery voltage under normal load conditions for a period of one hour.
- m.) All new or replacement battery chargers shall be of the constant voltage type suitable for the type battery applied to.
- n.) Batteries removed from service shall be properly disposed of.

MBTA E&M SIGNAL DIVISION SM2

SECTION-13 RULES, STANDARDS, AND INSTRUCTIONS FOR REPAIRING AND INSTALLING THIRD RAIL HEATERS

Date of Rev: 0 6/4/15

- 600) The following procedures are established for performing work on third rail heaters:
- a) Call line dispatcher at OCC for permission to work in designated area.
 - b) After receiving permission for said area call Power Dispatcher at 5546 for location of switches to be pulled.
 - c) Fill out Power Switching tags for each location.
 - d) Call OCC and request permission to enter Right of Way and begin Power Switching.
 - e) After receiving permission from OCC to enter the Right of Way, test live Third Rail for 600v.
 - f) After testing Third Rail call OCC to request that Power be taken out Supervisory.
 1. Pull **ALL** necessary boxes for designated section.
 2. Lock out / Tag out all switches as pulled.
 3. Call OCC to restore Supervisory power.
 4. **Check Third Rail to confirm that no voltage is present.**
 5. Call OCC to take out power supervisory on **BOTH** rails.
 6. Test rail after **EVERY** break to confirm that the section is dead.
 7. Perform all work in assigned area.
 8. Call OCC for permission to restore power.
 9. Restore all switches and remove locks and tags.
 10. When switching is completed call OCC to restore supervisory power.
 11. Test rail to make sure power has been restored

MBTA E&M SIGNAL DIVISION SM2
SECTION-14 RULES, STANDARDS, AND INSTRUCTIONS
FOR IMPLEMENTATION AND REMOVAL OF SPEED
RESTRICTIONS

Date of Rev: 0 6/4/15

700) When notified by the MOW Dept., OCC or MCC that a speed restriction is required, the Signal Inspector of the Line in conjunction with the Signal Maintainer must adhere to the following prescribed rules:

701) ATO Territory (Red and Orange Lines) Speed Restriction Implementation:

When notified that a speed restriction in ATO territory is to be implemented, the Signal Inspector/Maintainer of the line will implement the speed restriction in accordance with the following Rules & Instructions:

- A. The Signal Inspector/Maintainer shall ensure that for the track circuit(s) to be restricted that no current restrictions exist.
- B. If track circuits are currently restricted, the more restrictive of the two restrictions shall govern, however each restriction shall be recorded separately.
- C. Record the following information on the Speed Restriction Sheet in the Location Book of Plans:
 1. Date Speed Restriction to be implemented
 2. Signal Inspector/Maintainer implementing Restriction
 3. Track Circuit Name and Module Location (i.e. A12007T/R14-A1)
 4. Speed Restriction requested (i.e. 30 MPH)
 5. Name of Person requesting restriction
 6. Department of Person Requesting Restriction
 7. Reason for restriction (i.e. track conditions, switch condition, etc.)
 8. Module Tagged (yes/no) - Module shall be red tagged with the following information.
 - Date of speed restriction implementation
 - Name of Signal Inspector/Maintainer implementing restriction.
 - Speed Restriction Requested (i.e. 30 MPH)
- D. After implementing the speed restriction, notify OCC and MCC that the speed restriction has been put in place, identifying the track circuit and speed.

702) ATO Territory (Red and Orange Lines) Speed Restriction Removal:

When notified that a speed restriction in ATO territory is to be removed, the following rules shall apply:

- A. The Signal Inspector/Maintainer shall ensure that the person requesting the removal is the same person that requested the restriction. If not the Signal Inspector/Maintainer shall contact the Line Supervisor for direction.
- B. The Signal Inspector/Maintainer must ensure that there are no other restrictions implemented on the same track circuit. If there are and the restriction is higher than the one being removed then the speed restriction board or dial shall be raised to the next highest restriction.
- C. The Signal Inspector/Maintainer shall record the following information on the Speed Restriction Log in the Location Book of Plans:
 1. Date restriction lifted.
 2. Name and Department of Person requesting speed restriction to be lifted.
 3. Name of Signal Inspector/Maintainer lifting restriction
 4. Record that module speed restriction tag has been removed.
- D. After removing the speed restriction, notify OCC and MCC that the speed restriction has been lifted, identifying the location and the track circuit.