

MS 401
DRAGGING EQUIPMENT DETECTOR

Initial date 05/25/93-Revised 11/23/09

PURPOSE:

The purpose of this test is to ensure that the dragging equipment detector is operating properly.

This test is applicable for dragging equipment detectors that are stand alone, with track side analyzers, and with Sentry Systems hot box detectors.

FREQUENCY:

Inspection and test is to be made quarterly and annually as indicated.

DESCRIPTION OF INSPECTIONS- FOLLOWING EVERY SNOW / ICE EVENT

Inspect and clean DEDs following any accumulation of snow or ice.

DESCRIPTION OF INSPECTION – Quarterly:

Instrument Housings and Equipment:

1. Check that electronic equipment is properly and securely mounted.
2. Check electronic equipment for proper voltage.
3. Make visual inspection for loose connections on all equipment.

Detector:

1. Make sure ballast and trash are not touching the bottom of the main shaft. Do not remove so much ballast that the bottoms of the ties are exposed. Assure that no anchors are attached to the rail in a place that can hold the blades down preventing the blades from restoring to normal position.
2. See that mounting ties are in good condition, well tamped, and the detector is securely mounted.
3. See that wiring, conduits, and fittings are tight and in proper place.

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DESCRIPTION OF TESTS – Quarterly:

1. Activate the detector by simulating a train movement. Operate detector into detecting position. In TC or Remote Control territory, it may be necessary to have the control point route lined. See that radio announces detector alarm, or signal indication operates properly.
2. Check each battery and charger to include DC and AC voltages, charge rate and solution level where applicable. Ensure that battery is clean, dry and all connections are tight (SP-201).
3. Where Applicable, Test for grounds and inspect all ground connections and lightning arresters (Test 236.107, SP-702, & SP-1201). Batteries for detectors not connected to the signal system may have the negative side strapped to ground.

DESCRIPTION OF INSPECTION – Annually:

1. See that blade height meets requirements on page 6. Replace those blades that cannot be properly adjusted.

DESCRIPTION OF TEST – Annually:

Detector:

1. Open contact compartment and check to see that contacts have sufficient squeeze when in normal position. (Note: make sure that the contact does not adjust past a 50% over wipe). Make sure the contacts have a 1/8-inch opening when in the detecting position.
2. Inspect the open contact compartment for moisture, corroded wire connections and loose components.
3. Move the blades in both directions, feeling for lost motion or low torque to move blades from the vertical position. To eliminate lost motion or to increase initial movement torque to move the detector, for Harmon Dragging Equipment Detectors, remove the detent mounting and switch assembly and check to see that the unit is in compliance with the DETENT MOUNTING ADJUSTMENT procedures on page 4.

NOTE: There is no adjustment on the NS dragger.

4. Use at least an 18-inch pipe wrench to move the blade. Insert a slightly open pipe wrench in the open end of the outside blade to rotate the detector. Adjust the contact to open at 1 1/2-inch of blade travel, plus or minus 1/2-inch tolerance. Use a voltmeter to determine when the contacts open, and mark the rail where the contact opened. Check operation in both directions.

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5. Lubricate the bearings. They should take just a couple of pumps to be fully lubricated. If more grease is required, it may indicate damaged grease seals. Push DED in each direction several times to ensure that grease is evenly distributed over the bearings.

MISCELLANEOUS:

1. Instrument house is to be kept clean and orderly.
2. Check area and see that all scrap material is removed.
3. Keep all weeds and natural growth removed from immediate area.
4. See that all equipment has sufficient paint to prevent rusting and deterioration.
5. Check that cable entrances are sealed.
6. Check that all gaskets, hinges, latches and padlocks are kept in place and lubricated.
7. Ensure that circuit plans are kept correct and legible.
8. Check that vents are properly set for season and protected.
9. Ensure that trees are cut to prevent blocking train crew's view of signal indication.

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DETENT MOUNTING ADJUSTMENT: (reference from page 2)

Remove the four bolts holding the detent mounting assembly. After cleaning and inspecting the assembly, insert the bolt in the top two holes only. Slide the detent mounting and switch assembly onto the bolts, observing cam bearing as it comes into contact with cam race.

At the initial point of contact between cam race and bearing, dimension "A" should be observed. This would assure proper pressure between cam bearing and race after all bolts and nuts are securely tightened.

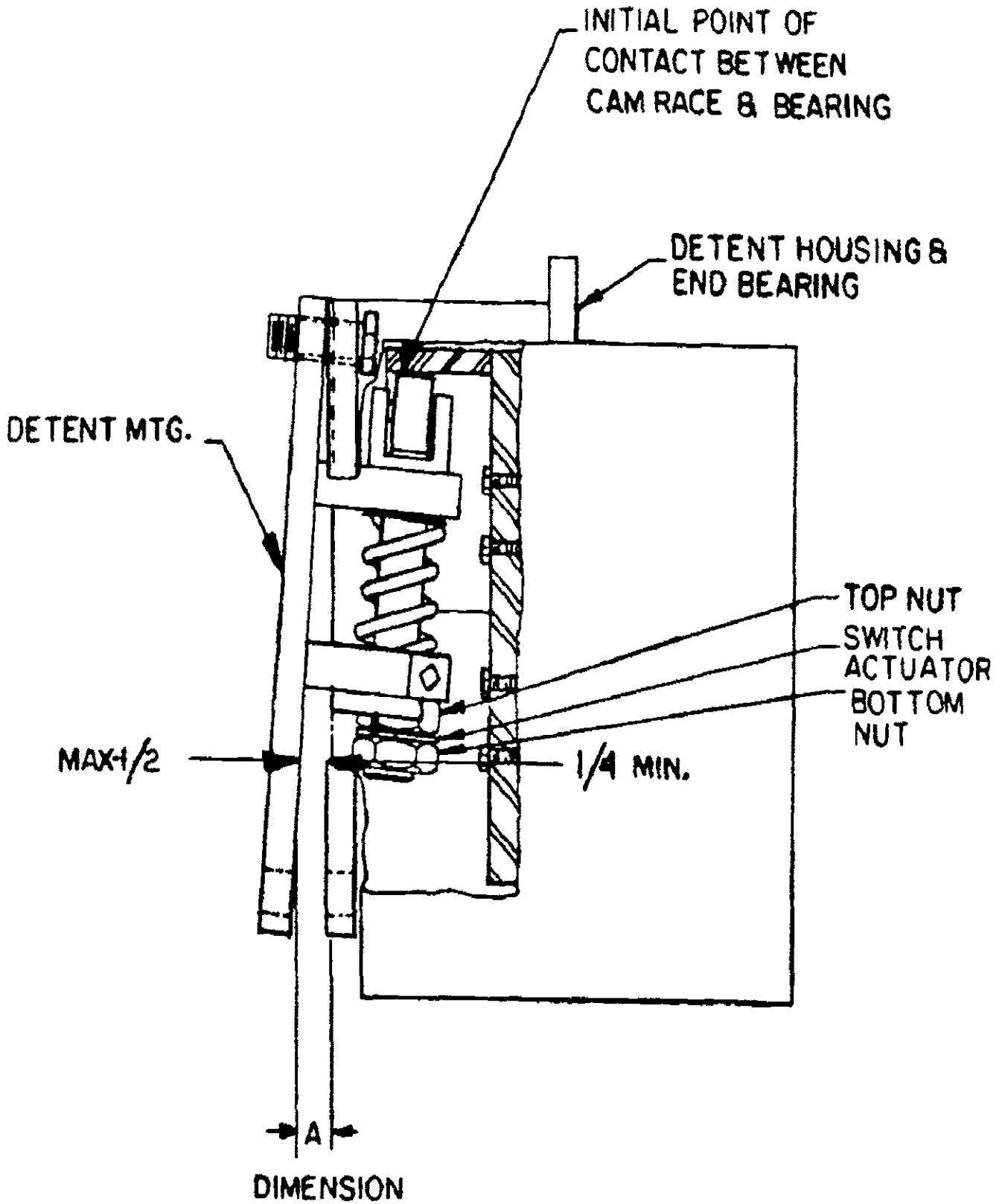
For best results dimension "A" should be no more than, or less than 1/4- inch. This will give the maximum starting torque on the D.E.D.

If dimension "A" is something other than 1/4- inch correct as follows:

1. Loosen bottom nut.
2. Drop switch actuator, so you can place a wrench on the top nut.
3. Turn top nut counterclockwise. Each half turn equals approximately 1/16-inch increase in dimension "A".
4. Turn top nut clockwise. Each half turn equals approximately 1/16-inch decrease in dimension "A".
5. After correction has been made, tighten the bottom nut securely.
6. Coat roller wheel, mounting bracket, and spring area, at both ends, with grease.

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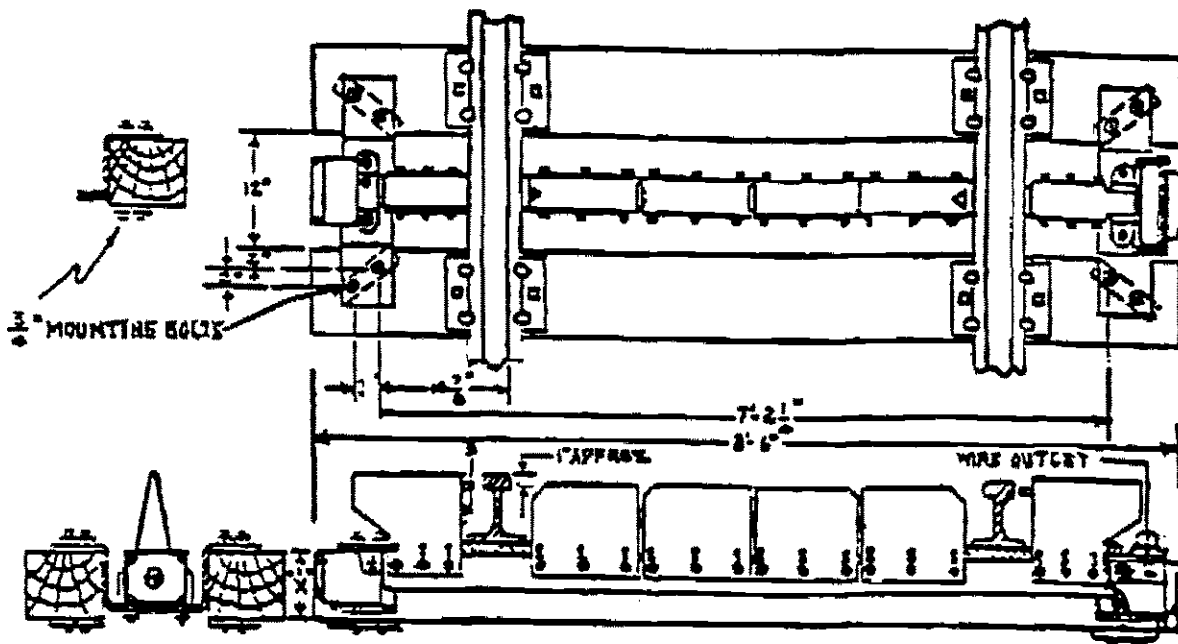
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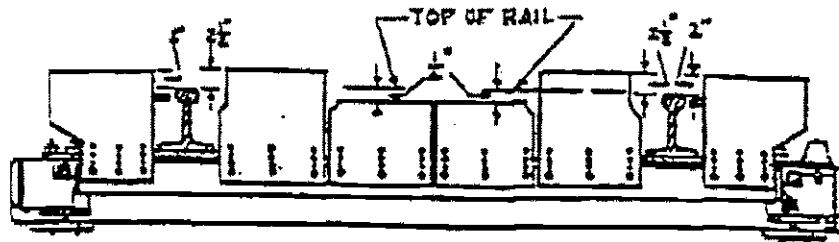
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FOR MAIN LINE

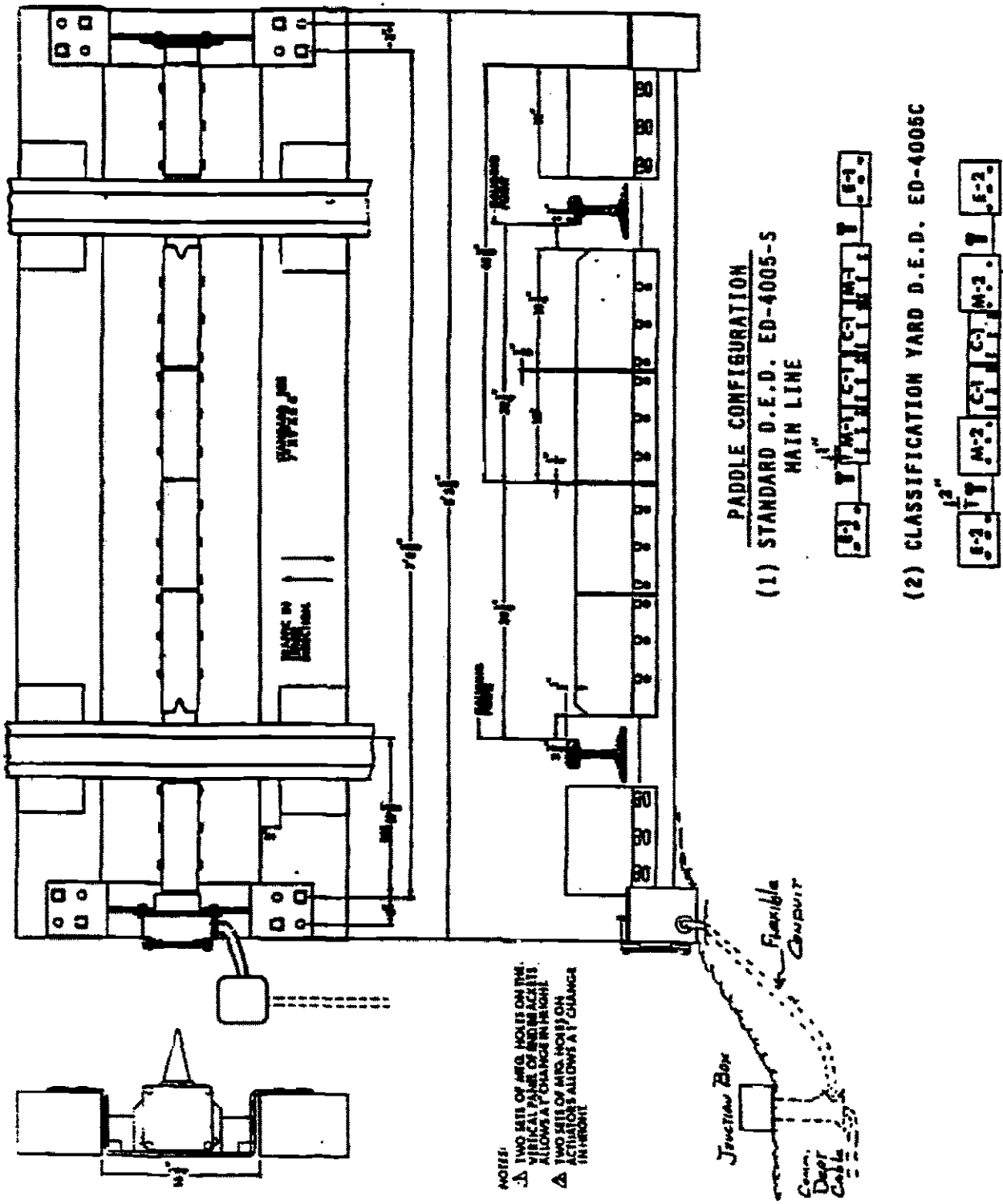


FOR RETARDER YARDS

Detector operates in both directions- For details see
HARMON ELECTRONICS MANUAL- IM-133
ORDERING REFERENCE: Main Line - GRS Cat.No. AZ6-100
Retarder Yards - GRS Cat. No. AZ6-101

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MS 402
HIGH AND WIDE DETECTOR
Initial date 05/25/93-Revised 11/23/09

PURPOSE:

The purpose of this inspection is to ensure that the high and wide detector is operating properly.

FREQUENCY:

Inspections and test are to be made quarterly per instructions below.

DESCRIPTION OF INSPECTIONS- FOLLOWING EVERY SNOW / ICE EVENT

Inspect and clean detectors following any accumulation of snow or ice.

DESCRIPTION OF INSPECTION – Quarterly:

Instrument Housing and Equipment:

1. Check each battery and charger including AC and DC voltages, charge rate and solution level where applicable. Ensure that battery is clean, dry and connections are tight (SP-201).
2. Check that all relays and electronic equipment are properly and securely mounted.
3. Check detector alarm for proper signal or radio message.

Track Side and Detector:

1. Check all wheel pick-ups or transducers to see that they are securely mounted, not damaged and will activate detector. Check track connections if an overlay circuit is used to turn on the equipment.
2. Check that the lights and receivers, mounted on signal bridge or other structure, are tight and aligned properly.
3. See that wiring, conduits and fitting are tight and in proper place.
4. Clean transmitter and receiver lens, check for foreign matter in tubes.

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MISCELLANEOUS:

1. Instrument house is to be kept clean and orderly.
2. Check area and see that all scrap material is removed.
3. Keep all weeds and natural growth removed from immediate area.
4. See that all equipment has sufficient paint to prevent rusting and deterioration.
5. Check that cable entrances are sealed.
6. Check that all gaskets, hinges, latches and padlocks are kept in place and lubricated.
7. Ensure that circuit plans are kept correct and legible.
8. Check that vents are properly set for season and protected.

DESCRIPTION OF TEST – Quarterly:

Activate equipment in instrument case to bring light beams up to full brightness. Connect voltmeter across appropriate terminals. Meter should read zero. Activate overlay track circuit. Interrupt each light beam, one at a time, to ensure that the alarm system is operating properly.

MS-403
DETECTOR INSPECTION
SLIDE FENCE - FALLING ROCK - BRIDGE ALIGNMENT
Initial date 05/25/93-Revised 01/01/01

PURPOSE:

The purpose of this inspection is to ensure that the slide fence, bridge alignment, falling rock and floodwall detectors are in proper operating condition.

FREQUENCY:

Inspections and tests are to be made quarterly and annually per the following instructions.

DESCRIPTION OF INSPECTION - Quarterly:

Instrument Housing and Equipment:

1. Check that all relays are properly and securely mounted.
2. Check detector and detector repeater circuits for proper voltage and confirm that ground tests (236.107) are current.
3. Check battery chargers and battery to include DC and AC voltages charge rate and solution level where applicable (See SP-201). Ensure that batteries are clean, dry and connections are tight.

Slide Fence, Bridge Alignment, Falling Rock, Floodwall, etc.

1. Ensure that all poles, bases, foundations, fence wire, line wire, cable drops, messenger wires, guys, clamps, insulators, plug connectors, circuit controllers, connection cables and bolts have no cracks or visible damage and all equipment is securely mounted and in proper operating condition.
2. During spring and fall inspections, check all slide fence activation cables for proper tension. Tension might require readjustment due to seasonal temperature changes.

DESCRIPTION OF INSPECTION - Annually:

Instrument Housing and Equipment:

1. Make a visual inspection for burned contacts and loose connections on all relays.
2. Inspect all ground connections and lightning arresters.

Slide Fence, Bridge Alignment, Falling Rock, Flood Wall etc.

1. Clean and visually inspect all plug connections, circuit controllers and other detection devices.
2. Open detector circuit at each detection device to ensure that all devices and repeater circuits control the alarm and signal system as intended.

NOTE: This test should be scheduled soon after the season of most activations (such as spring for slide fences).

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DETECTOR INSPECTION
SLIDE FENCE - FALLING ROCK - BRIDGE ALIGNMENT
Initial date 05/25/93-Revised 01/01/01

MISCELLANEOUS:

Applies to both the Quarterly and Annual section.

1. Check area and see that all scrap material is removed.
2. Keep all weeds and natural growth removed from immediate area.
3. Ensure that instrument house is kept clean and orderly.
4. See that all equipment has sufficient paint to prevent rusting and deterioration.
5. Check that cable entrances are sealed.
6. Check that all gaskets, hinges, latches, and padlocks are kept in place and lubricated.
7. Ensure that circuit plans are kept correct and legible.
8. Check that vents are properly set for season and protected.

MS- 404
HOT BEARING DETECTOR SYSTEMS
Initial date 05/25/93- Revised 11/23/09

PURPOSE:

The purpose of this procedure is to ensure that the hot bearing detector will notify a passing train about any (or no) defective equipment. This requires the detector to be properly calibrated, aligned, and all sensors working as intended.

FREQUENCY:

Inspection and tests are to be made monthly, quarterly and annually as indicated.

NOTE: Hot Bearing Dctector locations may also include dragging equipment, height and/or clearance detectors. Refer to the appropriate test section for their tests.

WINTER OPERATIONS:

Insulated covers should be installed and the winter cycle should be activated (Smartsan NG sites) before Deccmber 1st every year.

DESCRIPTION OF INSPECTIONS- FOLLOWING EVERY SNOW / ICE EVENT:

Inspect and clean detectors following any accumulation of snow or ice.

DESCRIPTION OF INSPECTIONS- MONTHLY

SENTRY, TSA, SERVO 9000, CYBERSCAN SYSTEMS, MICRO HBD AND SMARTSCAN NG.

General:

1. Record any repairs/adjustments/observations, tests performed, name, and date in detector site log book.

Make the following visual inspections:

1. Check house case, scanners, transducers, junction boxes, protector ramps and associated conduits/cabling for rodents and insects, damage or loose hardware. Repair as necessary.
2. Check scanner heaters for proper operation. Thermostats are set to maintain a range from 75 degrees to 105 degrees F and should be warm to the touch in cold weather.
3. Check scanner mirrors and lenses; clean as required using an appropriate glass cleaning solution and a soft cloth.
4. Inspect inside of scanner for loose or damaged wires and free operation of shutter.
5. Insure transducers are tight to rail and remove metal filings.

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Make the following visual inspections: (continued)

6. Check track connections for damage
7. Check visible ground rod connections, wiring, and lightning protection for damage.
8. During warm and hot weather, check that air intakes are not obstructed, filters where provided are clean, and exhaust fan operates properly and is set to 80 degrees F.
9. During cold weather, check operation of the house heater and thermostat settings (if provided), make sure the heater and exhaust fan do not operate at the same time.

Housekeeping:

1. Clean house air intake filter as needed.
2. Clean equipment, shelves, and floor as needed.
3. Place documentation, test equipment and fixtures, and spare equipment in the proper location.

DESCRIPTION OF INSPECTION AND MAINTENANCE- QUARTERLY

Heat Calibration:

SENTRY

1. Place heat source unit outside in the shade for 10 minutes to reach ambient temperature. The Sentry heat source unit is not adjustable.
2. Check the calibration of scanner output for both rails with the heat source, which is set at 180 degrees above ambient temperature. Calibrate using the highest temperature reading as the heat source cycles.
 - (a) Tolerance is + or - 8 degrees.
 - (b) Adjust Sentry heat gains if out of tolerance.
 - (c) Do both rails.

Cyberscan Systems

1. Place heat source outside in the shade for 10 minutes to reach ambient temperature. Under normal testing conditions, do not attempt to calibrate if ambient temperature is above 90 degrees or below 20 degrees F. If calibration is required due to repairs or replacement when ambient temperature is above or below these limits, an additional calibration should be completed as soon as possible after ambient temperature is within specified range.

Cyberscan Systems (continued)

2. Perform CALIB command operation from laptop and follow the instructions for the heat source setting for calibration. This should be 130 degrees above ambient temperature.
3. Complete calibration by accepting adjustment values. Note: These settings should be between 40 and 60. If they are not, notify your supervisor.

MicroHBD*

To calibrate the scanners with a 227294-100 SIB board ('CAL1' and 'CAL2' sub menu):

1. Allow the Function Simulator to reach operating temperature and then place it on the scanner to be calibrated.
2. Type 'CALIB' at the command prompt and press <ENTER>.
3. Type 'CAL1' to calibrate Channel 1, or 'CAL2' to calibrate Channel 2.
4. The MicroHBD will display what it thinks the outside temperature is. If an ambient temperature probe is connected to the MicroHBD, accept the value displayed by typing 'Y' and proceed to the next step; otherwise, type 'N'. The MicroHBD will prompt you to enter the ambient temperature (the value must be between -40 and 120 F). Next press any key to start the calibration.
5. The MicroHBD displays the message, "Please Wait - Zero reference alignment in progress * * * * *". After this is complete, you will see the message "Reference Complete - Starting Calibration".
6. The MicroHBD will begin calibrating. It will ask you to wait as it takes 100 heat samples and will display a brief message for each heat sample it takes.
7. Once the sampling is complete, the MicroHBD will adjust the hardware gain of the internal circuit and display the results to you. The MicroHBD will then attempt to validate the hardware gain by taking 100 more heat samples. This process of adjusting the hardware gain and then validating it could repeat as many as 10 times as the MicroHBD attempts to zero in on the correct hardware gain.
8. Once the sampling is complete, the MicroHBD will display the resulting average ADC reading, the new hardware gain factor, and the new absolute gain value.
9. Next the MicroHBD will continue with validation. Validation is the process where the MicroHBD applies a new software calibration factor to the heat channel and takes 100 more heat samples to determine if the calibration factor is within the range needed for successful calibration.

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MicroHBD (continued)

10. The MicroHBD will check the new level and then indicate whether calibration was successful. If successful, it will display the new calibration value and ask if you wish to accept it. Press 'Y' to accept the new value and proceed to step 11. (Pressing 'N' will ignore the new value and return you to the Maintenance Mode prompt.) If calibration failed, the MicroHBD will return you to the Maintenance Mode prompt. Proceed to step 1 and try the procedure again.

11. The MicroHBD will store the new value. Repeat steps 1 through 10 to calibrate the other scanner.

* Information in this section copied from GE manual.

TSA and Servo 9000

1. Check for noisy scanners as follows:
 - (a) Put the detector in heat test mode (select Test mode on TSA or attach heat source and reset as necessary with Servo 9000) with the heat source ON and in the Gate ON mode, but not on the scanner.
 - (b) Cover both scanners with a rag so no heat can be seen.
 - (c) Watch the detector heat displays (listen to read out on Servo 9000). The readings should not vary more than three (3) degrees or 1 mm on Servo 9000.
 - (d) Return detector to normal operation (select Normal on TSA or on Servo 9000 remove heat source cable and press reset on CPU board).
2. Place heat source outside in the shade for 10 minutes to reach ambient temperature. Unless absolutely necessary, do not attempt to calibrate if ambient temperature is above 90 degrees or below 20 degrees F. If calibration is required due to repairs or replacement when ambient temperature is above or below these limits, an additional calibration should be completed as soon as possible after ambient temperature is within specified range.
3. Set heat source to 130 degrees above ambient temperature. Calibrate using the average temperature between the maximum and minimum heat reading as the heat source cycles to 130 degrees (10 mm for Servo 9000). Heat source should not cycle more than 15 degrees from maximum to minimum (1.1 mm for Servo 9000).
 - (a) Tolerance is + or - 8 degrees (+ or - 0.5 mm for Servo 9000)
 - (b) Adjust heat gains if out of tolerance.
 - (c) Do both rails at temperature before going to the high heat temperature test.

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TSA and Servo 9000 (continued)

4. To check for linearity of heat readings, set the heat source to 180 degrees above ambient or maximum heat attainable from the heat source.
 - (a) Allow the heat source to cycle for three (3) cycles.
 - (b) Scanner heat reading should register 180 degrees (13.8 mm on Servo 9000)- Tolerance is + or – 15 degrees (+ or – 1.1 mm on Servo 9000)
 - (c) Do not adjust during this high temperature test.
 - (d) Call your supervisor if this test fails.

SMARTSCAN NG**

To calibrate the type2/type3 bearing scanners:

- 1 Be sure that you have on hand a STC calibrated heat source and a laptop computer.
- 2 On the control panel of the calibrated heat source, toggle the **Gating** switch off.
- 3 Plug the proper end of the calibrated heat source cable into the **six**-contact circular connector on the front of the calibrated heat source.
- 4 Plug the other end of the calibrated heat source cable into a grounded three-wire 110-120 VAC outlet in the wayside enclosure.
- 5 Cover the function connector that is not being used with the supplied dust cover.
- 6 On the control panel of the calibrated heat source, turn the temperature knob to **180**.
- 7 Put the heat source in a shady area, out of direct sunlight.
- 8 Wait about 8 minutes for the heat source to reach operating temperature and stabilize. The heat source has reached operating temperature and stabilized when the temperature meter needle remains centered. Once the temperature stabilizes, calibration may begin. Once stabilized, the temperature will change less than plus-or-minus one degree Fahrenheit.
- 9 Take the calibrated heat source to the bearing scanner on the north or east rail.
- 10 With the cable to the front of the scanner, place the calibrated heat source on the scanner.
- 11 Be sure that a computer is plugged into COM1 (on the side of the Controller module), that it is turned on, that it has appropriate communications software installed, that the communications software is set to use full duplex, that the baud rate is set to 19,200, and that a LOG file is opened.
- 12 Using the serial interface, display the Main menu.

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SMARTSCAN NG (continued)

- 13 To go to the System Functions menu, type **N**
- 14 To start auto calibration, type **G**
The SmartScanNG system will now calibrate itself. Follow along on the user interface screen until you see: "Auto-Calibration Disengaged." This message is an indication that the system is finished with the calibration procedure. To abort the process, press [**Esc**] (on your computer) or remove the heat source (from the scanner).
- 15 When "Auto-Calibration Disengaged" is displayed on your computer, remove the calibrated heat source.
- 16 Take the calibrated heat source to the bearing scanner on the south or west rail.
- 17 With the power cord to the front of the scanner, place the calibrated heat source on the scanner.
- 18 Repeat steps **14** through **15**.
- 19 To return to the Main menu, type **X**
20. To exit the serial interface and return the system to normal operation, type **X**

**** Information in this section copied from Southern Tech manual.**

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METER READINGS – QUARTERLY OR AS NEEDED:

Sentry, TSA, Servo 9000, Cyberscan, MicroHBD and Smartsan NG Systems

1. For the 24 volt main battery supply (if equipped), the voltage must be between 26.75 and 27.25 volts. Voltage greater than 27.5 volts on sealed batteries makes the batteries exhaust gas, which reduces their life. See voltage curve in the Sentry System manual to ensure its 24 VDC charger is adjusted properly.
NOTE: For 12 volt system battery (Cyberscan, MicroHBD and SMARTSCAN NG systems) the voltage must be between 13.6 to 14 volts DC.
2. If a separate charger is installed, use the voltage and current meter mounted on the charger.
3. Measure detector power supply voltage if test points are available.
4. Measure bolometer / pyrometer, scanner voltage on terminal rack, if available.
5. Measure commercial power voltage.
6. Measure inverter output, if in service.
7. If any readings are not within specifications provided on equipment or in manufacturers manuals, or vary from prior readings, notify your supervisor.

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DESCRIPTION OF INSPECTIONS- ANNUALLY

SENTRY, TSA, SERVO 9000, AND CYBERSCAN SYSTEMS

General:

1. Instrument house is to be kept clean and orderly.
2. Check area and see that all scrap material is removed.
3. Keep all weeds and natural growth removed from immediate area.
4. See that all equipment has sufficient paint to prevent rusting and deterioration.
5. Clean scanners with solvent or detergent. Paint Scervo scanners with aluminum paint as needed.
6. Check that cable entrances are sealed.
7. Check that all gaskets, hinges, latches, and padlocks are kept in place and lubricated.
8. Ensure that circuit plans are correct and legible.
9. Check that vents are properly set for the season and protected.
10. Log any corrective actions, adjustments, and repairs in the detector log book. Include test date and who performed the test.

Physical alignment of rail mounted scanners:

Cyberscan, MicroHBD, 9000, and Devtronics

1. Triangulation of scanners- Pick a point equal distant between the rails at least ten feet from the scanner. Mark this point on a tie with a nail. Measure from this point to the center of each scanner. The measurements should be equal +/- 0.5 inches. If not, move one or both of the scanners. Scanners should not be touching tie plates, rail anchors, or other items that may induce noise from vibration.
2. Check transducer alignment- "A" transducer is located closest to the scanner and should be 8 inches +/- 0.5 inches from the center of the scanner to the center of the transducer. The center of "B" transducer should be 24 inches +/- 0.5 inches from the center of transducer "A". The advance transducers "C" and "D" (if installed), should be 40 feet +/- 6 inches from their centers to the center of the nearest of either "A" or "B" transducer center.

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Cyberscan, MicroHBD, 9000, and Devtronics: (continued)

3. Check scanner alignment- Procedure for all locations except Sentry, remove the scanner covers and place the mirror target over the lenses. Place the alignment fixture on the rail between the "A" and "B" transducers, approximately 20 inches from the center of the scanner. When the red dot is centered in the circle verify alignment as follows:
 - a. Cant angle alignment is good if the index mark on the slide under the upright post is at the 7 inch mark on the scale +/- 0.25 inches.
 - b. Scanner elevation angle alignment is good if the fixture bar was not moved more than 1 inch forward or back from the original setting of 20 inches.
 - c. For Sentry locations, place the optical alignment device between the "A" and "B" transducers, approximately 22.5" from the middle of the scanner rail bracket. Cant angle and elevation cant angle is good if the alignment of the scanner is at the 14.5 inch mark on the fixture and 18 inches above the top of the rail.
 - d. If alignment is necessary because criteria in a, b, or c is not met, then adjust cant nuts on scanner to achieve proper alignment. Note: both cant nuts on the same scanner must be set the same.
 - e. If proper alignment cannot be achieved, notify your supervisor.
 - f. If track gauge exceeds 57.5 inches, notify the Track Department for corrective action.

SMARTSCAN NG**

To align the bearing scanners:

1. Be sure that you have on hand a short-handle 1-1/2-inch open-end wrench, a combination 9/16-inch open-end box wrench, and a STC alignment fixture.
2. Turn off all power to the SmartScanNG enclosure.
3. On the outside of the rail, mark the midpoint between TO1 and TO2. Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.
4. Mark the center of the fourth tie ahead of this midpoint.
5. From this mark on the fourth tie, measure to the midpoint between the transducers.
6. From the mark on the fourth tie, measure the same distance on the opposite rail.
7. On the outside of the rail, mark this location. This mark should correspond to the first mark on the opposite rail. Use a permanent marker, magic marker, lumber crayon, or paint pen to mark the rail. Don't use a file or punch to mark the rail.

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SMARTSCAN NG (continued)

8. Place the alignment fixture across both rails and adjust it so that the north or east side of the adjustable gauge slide is even with the two rail marks. The fixture should be snug against the top and gauge of both rails.
9. Remove the reflector block from the vertical alignment bar.
10. Install the vertical alignment bar with the target sight tilted toward the bearing scanner.
11. Install the reflector block in the top of the scanner cover with the sloping surface facing the target. The setup for the type2 bearing scanner is shown below.
12. Look through the hole in the center of the target and note the relationship of the target cross hairs to the circle in the center of the reflector block. When the cross hairs are centered on the circle, alignment is correct.
13. If the cross hairs are centered on the circle, go to step **19**.
14. If horizontal adjustment is necessary, adjust the upper and lower nuts on the edge of the arm of the bearing scanner mount. Using a combination 9/16-inch open-end box wrench, turn both upper nuts the same number of turns. Turn both lower nuts the same number of turns. Adjusting these four nuts causes the scanner to pivot about the two shock mounts under the rail. This adjustment moves the cross hairs (on the circle) to the right or left.
15. If vertical adjustment is necessary:
 - a. Using a short-handle 1-1/2-inch wrench, loosen both nuts on the side of the mount. The inner nut is the clamping nut. The outer nut is the locking nut.
 - b. Slide the entire mount toward or away from the alignment fixture. Sliding toward the fixture raises the cross hairs on the circle. Sliding away from the fixture lowers the cross hairs on the circle.
 - c. Using a short-handle 1-1/2-inch wrench, tighten the clamping nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters). Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.**
 - d. Using a short-handle 1-1/2-inch wrench, tighten the locking nut to a **torque of 48 to 50 foot-pounds (65.1 to 67.8 newton-meters). Don't exceed a torque of 50 foot-pounds (67.8 newton-meters). Doing so can cause failure of the mount.**
16. Until the cross hairs are centered on the circle, repeat steps **16** and **17**.
17. Remove the vertical alignment bar, target sight, and reflector block.
18. Repeat steps **10** through **18** for the bearing scanner on the opposite rail.

** Information in this section copied from Southern Tech manual.

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Function Simulator:

Test the function simulator / heat generator for correct heater operation.

1. TSA, SERVO 9000, AND CYBERSCAN SYSTEMS

(a) Check heater temperature with a heat probe or optical device:

1. At 100 degrees F above ambient- tolerance + or – 5 degrees (average of heat cycle)
2. At 150 degrees F above ambient- tolerance + or – 5 degrees
3. At 200 degrees F above ambient- tolerance + or - 5 degrees

(b) Use silicon on temperature probe tip to help transfer heat. Remove silicone from heat source after test.

(c) If simulator is out of calibration, it must be repaired before adjusting the detector. Calibration of the simulators must be performed by qualified personnel with the proper test equipment.

2. SENTRY AND SMARTSCAN NG System Heat Source

(a) Verify heater temperature of Sentry System function simulator is 180 degrees + or - 8 degrees. Sentry heat source should be checked and calibrated with an optical device only.

(b) Silicone and metal probes will damage the heat source block surface. The heat source is not field adjustable. Arrange for qualified individual or facility to repair

(c) Heat source.

OPERATIONAL TEST

NOTE: This test should be performed after all inspections, tests, and necessary repairs have been made. This should be the last test performed before leaving the site.

TSA and SENTRY

1. Using a metal object to simulate a wheel passing the transducer, gate the A and B transducer 6 to 8 times (do not hit the transducer with any metal objects).
2. Operate the dragging equipment detector before the hotbox detector times out.
3. After the detector times out, listen to the radio message for quality of the transmission and correct information.

Servo 9000 and Cyberscan Systems

1. Activate the short range track circuit to simulate the presence of a train.
2. With the heat source connected and turned ON, but not placed on the scanner, turn the Gate ON to simulate wheel gates.
3. Operate the dragging equipment detector in each direction.
4. Turn the heat source Gate OFF and restore the short range track circuit.
5. Listen to the radio message for quality of the transmission and correct information.

Micro HBD*

1. To simulate a train crossing the detector, use the 'T' command. The Test Train can be used to test trackside equipment: scanners, dragging equipment detector, etc.
2. Executing the 'T' command self-induces wheel gates to simulate a train passing. Heat signals and auxiliary alarms are not simulated. However, you can inject heat into the scanners or kick the dragger to check the health of the system.
3. Test trains are added to the Standard Train Directory. They are *not* added to the defect directory. To distinguish test trains in train lists, the MicroHBD/Talker prints a "TST" after the train index number.
4. When you execute the 'T' command, the MicroHBD/Talker prompts you to enter the number of axles to simulate. You can select from 4 to 600 axles to simulate. To cancel the 'T' command, press the <Escape> key.
5. After selecting number of axles to simulate, the MicroHBD prompts you for the direction of train. To select the default direction (transducer A to B), press the <ENTER> key without entering a number.
6. Now select whether or not you want to broadcast the test train over the radio.

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HOT BEARING DETECTOR SYSTEMS
Initial date 05/25/93- Revised 11/23/09

Micro HBD (continued)

7. Next the MicroHBD prompts you to select whether or not you want to simulate a track circuit input.
8. Next the MicroHBD prompts you to select whether or not you want to filter heat. Selecting yes will apply the Median Filter during the test train.
9. Wave heat source (hot soldering iron) over scanner head and kick dragger.
10. Listen to the message (radio or speaker as selected) for quality of the transmission and correct information.
11. To cancel the 'T' command, press the <Escape> key.

* Some information in this section copied from GE manual.

SmartScan NG**

1. From the main menu select N system function.
2. Select E manual test mode
3. Test will run for 76 seconds and simulate axles.
4. Pass heat source (hot soldering iron) over scanner heads and kick dragger.
5. Alarms will sound over system speaker but not be broadcast over the radio.
6. When test is complete exit to main menu.

** Information in this section copied from Southern Tech manual.

OPERATIONAL TEST (continued)

Overlay Track Circuits

1. Test series overlay track circuits, if applicable.
 - (a) Devtronics with series overlay track circuit
 1. Apply standard shunt at 60 feet. Shutters should open. Mark rail at 60 feet for future reference.
 2. Apply standard shunt at 70 feet. Shutters should stay closed.
 3. Adjust the circuit to 60 feet if necessary.
 - (b) Harmon, Servo 9000, Cyberscan 2000 with series overlay track circuit
 1. Apply standard shunt at 95 feet. Shutters should open. Mark rail at 95 feet for future reference.
 2. Apply standard shunt at 100 feet. Shutters should stay closed.
 3. Adjust the circuit to 95 feet if necessary.

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FINAL OPERATIONAL TEST – ALL SYSTEMS

Purpose:

Perform this test after replacing any detector scanner heads or transducers that have been removed for any reason (site repair, track work, etc.).

Description of Test:

To determine the hot bearing detector is left operating properly, heat must be applied to each rail and verified with the voice message or readout that heat is detected and that the correct rail and correct track are identified.

DATA RETRIEVAL:

SENTRY

1. Unplug **AC** power to processor to load the batteries. Print the following reports while the detector is unplugged to verify capability of batteries to function under load. Remember to plug **AC** back in at the end of the print session. **Note:** Data retrieval may be done with a laptop or the supplied printer.
 - (a) Select “PRINT” mode.
 - (b) Print “EXCEPTIONS” report.
 - (c) Print “MON TO MON” report
2. Review information on each print report. Look for abnormal readings, balance in average temperature, excessive filter counts, etc.

TSA, Servo 9000, Cyberscan Systems

1. Using a laptop, review several recent long road trains. Look at bearing temperatures and average bearing temperatures for each rail. The average bearing temperature should be within ten (10) degrees (0.9 mm for Servo 9000).
2. Look for error messages, alarmed trains, or other information, which may indicate error/failure trends as provided by the detector.

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL

Initial date 8/09/93 - Revised 7/09/01

GENERAL:

Following is our Lightning Protection Standard. This document describes the basic concepts being applied to new installations. These concepts can be incorporated in existing locations. We realize each location may have unique problems but the concepts can be used resulting in improved performance during lightning storms.

CONCEPTS:

The basic engineering concept employed is to shunt all unwanted electrical surges around the signal equipment. Trying to protect the equipment from a direct lightning strike is not realistic.

When lightning strikes near the railroad property a very large electrical voltage is magnetically induced in the rails, pole line, power lines and cables of the signal system. We want to pass this electrical surge around the equipment and dissipate the energy to ground.

GROUNDING:

Refer to SP-702 and SP-703 for information concerning standard grounding specification.

The metal equipment housing will be used as the conductor for ground currents. This concept is called Faraday Shielding. The ground current in the equipment case reduces the magnetic field caused by the current due the area of metal of the case. The magnetic fields inside the case are canceled by the same current the in other walls, resulting in less surges in the case and sensitive equipment. Ground rods are connected to all four corners of the equipment case. All four ground rods are tied together to reduce the ground resistance.

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL
Initial date 8/09/93 - Revised 7/09/01

GROUNDING (Continued):

If the power feed pole is within 50 feet of the case the ground rod at the pole needs to be connected to the case ground system. If additional cases are adjacent to the signal case, the ground rods of both cases need to be tied together.

Racks inside the equipment case should be welded to the floor or bonded to the floor and nearest wall or house frame. If welding or bonding is not practical, the racks can be bolted together with bond strand. When bolting racks together or bolting bond strand to a case or rack always use star washers between the eyelet the metal rack or case. Be sure to remove all paint in the area of the connection. The connection can be painted after a good electrical connection has been made.

CLEAN WIRING CONCEPT:

Equipment in the signal case is arranged so circuits that are susceptible to lightning surges are physically placed as far away from circuits that are susceptible to lightning damage as possible. See figures 1 and 2 for typical layouts to reduce susceptibility to lightning surges.

The paths of ground wiring in a case is also arranged so high surge currents will not magnetically induce voltages into circuits that are susceptible to lightning damage. The paths of ground circuits must be kept as short and straight as possible. Remember the current in the ground wires from a conducting arrester is extremely high even though it only lasts for a couple of microseconds. The high current will build a large magnetic field about the wire. Therefore always route the ground wire the shortest and straightest route to the closest point of the equipment rack, case wall or case floor.

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL
Initial date 8/09/93 - Revised 7/09/01

CLEAN WIRING CONCEPT (Continued):

The track, code line and power lines are considered the most susceptible circuits to lightning surges. Other long line and cable circuits are next followed by short cable runs to switches and signals. However just because a circuit may be low on the susceptibility list it is not immune to lightning surges. All circuits entering a signal case must be protected.

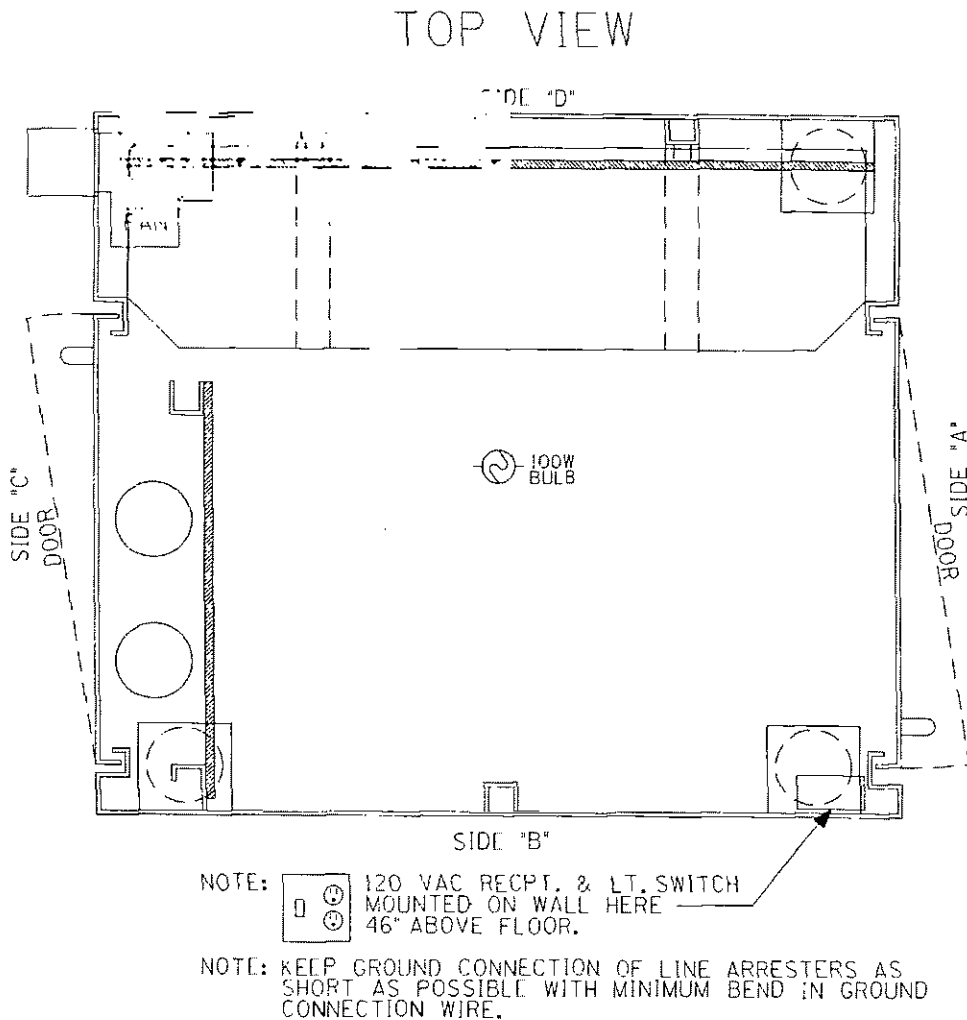


Figure 1. Typical Placement Plan

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL
Initial date 8/09/93 - Revised 7/09/01

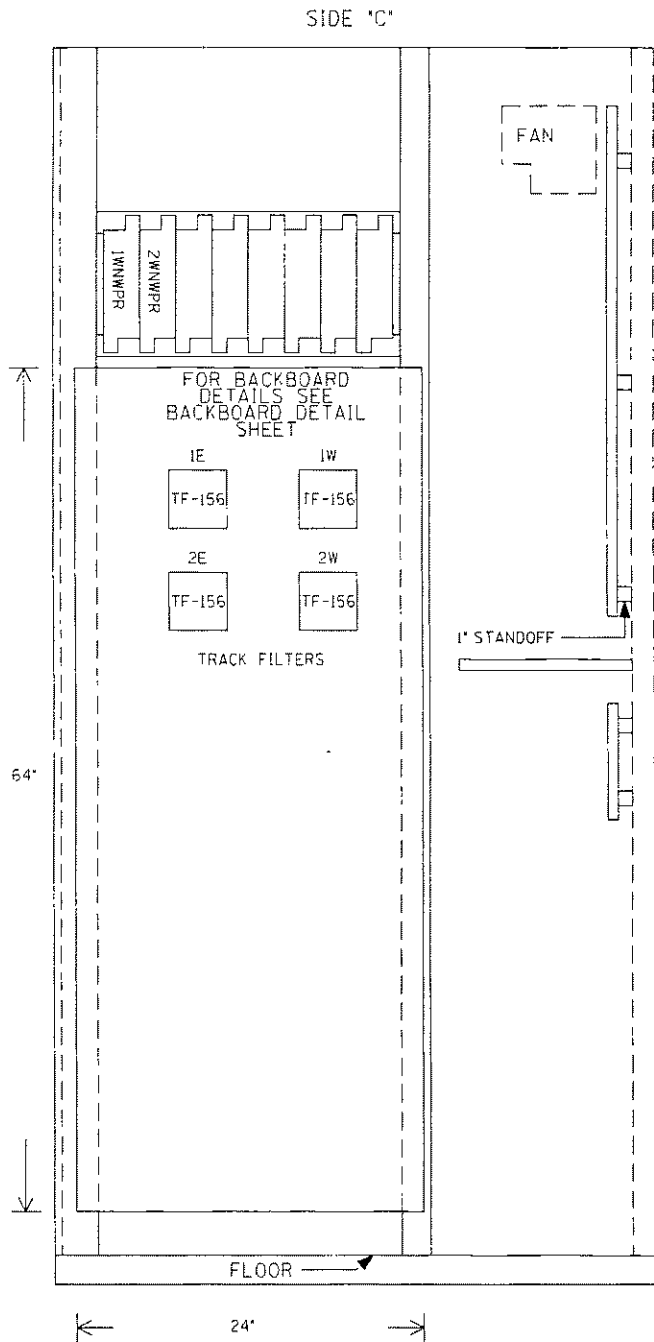


Figure 2. Typical Placement Plan

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL
Initial date 8/09/93 - Revised 7/09/01

PROTECTION DEVICES:

Primary Protectors:

These devices are usually provided by the power company and can be found on the pole with the power line disconnect switch.

Secondary Protectors:

Arrestors are used between the line and ground of a circuit. The following arrestors are commonly used by the C&S Department.

Pellet type arrestors are used on the power meter bases and also on the circuit breaker box or power distribution point in the signal case. They are commonly called "can" type protectors.

Air gap arrestors are used on track and line circuits.

Gas arrestors are used on track and line circuits.

Equalizers can be gas or solid state. The solid state types can be semi-conductors or resistor type materials.

Third Level

These devices are usually provided by the equipment manufacturer and mounted on printed circuit cards in the electronic equipment. These devices may be small gas tubes or small electronic components like MOV's, diodes, transorbs, etc.

STANDARDS AND PROCEDURES
LIGHTNING PROTECTION - GENERAL
Initial date 8/09/93 - Revised 7/09/01

SIGNAL WIRING:

The theory for signal wiring is the opposite of ground wiring. Signal wiring from the protector to the signal equipment and between signal equipment should be formed with ninety degree bends as much as possible. The bends will resist the large voltage spikes from lightning surges. If a signal wire has to be near or cross a ground wire, make the crossing at ninety degree angles and keep parallel runs as far away from signal wires as possible.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

SAFETY PRECAUTIONS:

1. Maintenance, tests and repair work which may interfere with safe operation of trains must not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, must be made in such manner that safety of train operation will not be impaired. When repair, adjustment, change or replacement is made, tests must be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

Manufacturers' literature must be relied upon to give detailed explanation of the handling and maintenance of each particular type of storage battery. Caution must be taken to prevent personnel from coming into contact with battery solution, which may be poisonous or corrosive (or both).

2. Never allow battery leads, jumpers or other metallic items to lay or fall on top of battery, or otherwise short circuit a cell or battery.
3. When wet/flooded batteries are replenished with water or electrolyte, the gasses in the cell are subject to displacement and may vent when the filler cap is removed. Before removing filler caps, battery connections must be checked for looseness and static energy discharged from the body to reduce chances of sparks.
4. Whenever possible, use tools with insulated handles when working with any type of battery or cell.
5. Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery (such as hooking up a wire from a working charger or a load wire).
6. Disconnect both load and charging circuit from a battery before removing connection leads in order to avoid arcing at the battery terminal post, which could cause an explosion.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

SAFETY PRECAUTIONS (Continued):

7. Exercise considerable care when cleaning or working with storage battery to prevent generation of sparks. All cleaning should be done with cloth, plastic or wood materials. Each manufacturer will specify a recommended cleaning method which must be followed.
8. Hydrometers, thermometers or other utensils used for one type of electrolyte must not be used for any other type under any circumstances.
9. Use only electrolyte as recommended by the manufacturer for a given type of cell. Special solutions, powders, jellies or other additives must not be used.
10. Water used to fill batteries must be clean and free of obvious contaminants. Assure that inside of any water container does not contaminate water.
11. Do not wear metallic objects that may come in close proximity to the battery.
12. Results of battery inspections and tests must be recorded as instructed.
13. When batteries are received with shipping seals or plugs in place, such plugs must be removed before placing batteries in service.
14. While working on batteries, make sure the area is well ventilated.
15. Always wear complete eye, face and clothing protection when working with batteries.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

DEFINITIONS:

Battery - A group of cells electrically connected.

Storage Cell - A secondary cell for storing electrical energy at one time for use at another time.

Rectifier - A device which converts alternating current into direct current by opposing current flow in a given direction while permitting free flow in the opposite direction. (Also called a semiconductor or diode.)

PURPOSE:

Storage battery is a source of DC power for track circuits, signal circuits, lighting, switch machine operation, etc. Charging is a means of keeping the battery in an efficient operating condition. Storage battery may be used only at locations where sufficient AC or solar charging current is available. Storage battery functions to furnish continuous energy to the signal circuits during power failure.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

DESCRIPTION:

Several types of batteries are used in railway signal applications, ranging from Lead-acid (Exide), Lead-Cadmium (C&D), Nickel-iron-alkaline, Nickel-Cadmium (Edison-NiCad), Valve Regulated Lead-Acid (GNB Absolyte), etc. Detailed instructions will be found in respective manufacturers' literature. Cells vary in physical size as a function of their capacity, stated in ampere-hours. Polarity is usually denoted by red (positive) and black (negative) markers in the vicinity of terminal post. Most storage batteries used in signal applications are assumed to provide approximately 1.5 volts per cell for Nickel-Iron or NiCad battery and approximately 2.25 volts for Lead-Acid battery, all which may vary further according to type battery, temperature and state of charge.

INSTALLATION:

1. Avoid placing battery where ambient temperature may exceed 125 degrees F. Excessive heat can affect battery performance. Battery capacity will also be less when temperature falls below zero degrees F.
2. Batteries should be placed where they are easily accessible.
3. Charger should be located as close to battery as feasible in order to simplify check-out procedures and to minimize wire resistance.
4. Before a new battery is placed in service, it should be given an initial equalizing charge if and as recommended by manufacturer.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

MAINTENANCE:

NOTES: 1. Observe all parts of the **SAFETY PRECAUTIONS** section at the beginning of this procedure before and during (as applicable) the maintenance procedures here listed.

2. Minimum frequency for battery maintenance is as specified in the MAINTENANCE PRACTICES section of the Test and Maintenance Manual under the headings for the various types of locations such as Signals and Cut Sections, Power Switches, etc. However, in order for batteries to conform to the following maintenance standards, more frequent inspections may be required. The need for more frequent inspections should be determined by experience at the particular site as well as the type of battery and charger employed. For example, a flooded cell battery with non-automatic charging and a history of having to add water more often than that specified in the MAINTENANCE PRACTICES section, should be inspected at proper intervals to assure adherence to maintenance standards.

1. Storage battery must be maintained in a good condition, with no accumulation of salts around the post or on top, with non-corroding straps and terminals, no leaks and with sufficient water (where applicable) and under proper charge to assure full charge without excessive gassing.
2. Check valves in vents, also filler caps must be kept free and non-binding. Vents and filler caps must be kept properly seated except when servicing cells or battery.
3. Battery housing or compartments must be kept clean and adequately ventilated. Before servicing battery, open vent and filler caps, and be sure area is well ventilated.
4. Battery cells and trays must be kept level and battery boards and wooden linings or metal compartments, trays, etc., must be painted with acid resisting paint.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

MAINTENANCE (Continued):

5. Battery water level must be kept between marks on battery case (where applicable). Older type cells (in metal cases) must be checked using extractor (usually a marked glass tube) as furnished.
6. For lead acid wet/flooded cells, the specific gravity of the electrolyte in each cell must be tested to determine that it is within the limits of 1.175 to 1.210 at 70°F ambient temperature. Cells must not be placed in service until given an initial charge.
7. Most types of alkaline cells (Edison, NiCad, Nife, Exide) carry a thin (approximately 1/8 inch) layer of oil on top of the electrolyte, in order to retard evaporation and salt formation. This protective oil layer must be maintained.
8. If a battery is being properly charged, water consumption will be slight. Observation of each cell in a battery over a period of time will allow calculation of normal water consumption rate. Any notable difference (single cell) in water demand may indicate leakage or defective cell. An overall increase (all cells) in water demand usually indicates a change in load with resultant need to adjust charging rate and/or battery size.
9. Battery must be kept dry in order to prevent grounding.
10. All battery and charger connections must be kept clean and tight.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

11. Assure that warning placard Form 12112 (below), C/I # 420-783415, is applied to the door/entrance of the enclosure that contains batteries (cases, bungalows, etc.)



FORM 12112 (2000) (Rev. 783415)

D A N G E R !
BATTERIES PRODUCE
EXPLOSIVE GASES.

Insure that you are
Properly Grounded
to eliminate any static
discharge prior to servicing
or placing yourself in the
vicinity of batteries.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

BATTERY CHARGING:

Charging is required in order to replace the electrical energy removed from the battery. The term "trickle charge" refers to charging required when there is no load and only the internal losses of the battery must be compensated for. A "floating charge" is a term applied to batteries in operation, in which case sufficient charge is furnished to compensate for internal losses and normal system load current.

In floating charge service, the battery is continuously connected to the charging source and the load. Since loads are not always constant, the original charging setup must be an "educated guess". The battery manufacturer will specify charge rate required to cover internal losses, usually from .001 to .002 amperes per ampere-hour capacity.

Many variations will be found in connection with battery charging systems. It is common practice to have some arrangement of switches which allow insertion of an ammeter in series with the load and with rectifier output. Observation of these readings will enable calculation of the float charge current. Connections in use are shown on local prints for the installation.

Placement of an ammeter in series with the load circuit (preferably under maximum load) will indicate battery drain. If the load is separated using more than one switch, rather than one common switch, then each load must be read and all readings totaled. This then is the total load current.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

BATTERY CHARGING (Continued):

Placement of an ammeter in series with the charging circuit will indicate battery input and total load current. Thus it can be seen that by subtracting the load current from the total current will equal the actual charging current into the battery.

Specific gravity readings will indicate state of charge of lead-acid or lead-calcium cells, where sulfuric acid is the electrolyte, but will not indicate state of charge of Alkaline-electrolyte type cells. Specific gravity readings of Alkaline type cells are used only to indicate the condition of the electrolyte, which must be replaced when specific gravity falls below manufacturers' recommendation.

The most reliable means of determining state of charge is by observing individual cell voltage. This voltage will vary slightly with temperature.

CHARGING CURRENT CALCULATION - NICKEL-IRON and NICAD:

1. If charger adjustments are necessary (and to insure proper adjustment) the AC load must be reduced to a minimum by turning off lights, heaters, fans, etc., before adjustments are made.

2. Determine the current required to balance internal loss:
 - a. Nickel-cadmium - .001 amp x ampere hour capacity
 - b. Nickel-Iron - .002 amp x ampere hour capacity

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

BATTERY CHARGING (Continued):

CHARGING CURRENT CALCULATION - NICKEL-IRON and NICAD (Cont):

3. Determine the maximum load by using ammeter "A" (see figure 1, this page).
4. Add the two above figures and multiply by 1.25 to establish an estimated charging input current.
5. Place ammeter "B" (fig. 1, this page) in series with rectifier and adjust rectifier to read current calculated in Step 4. above.

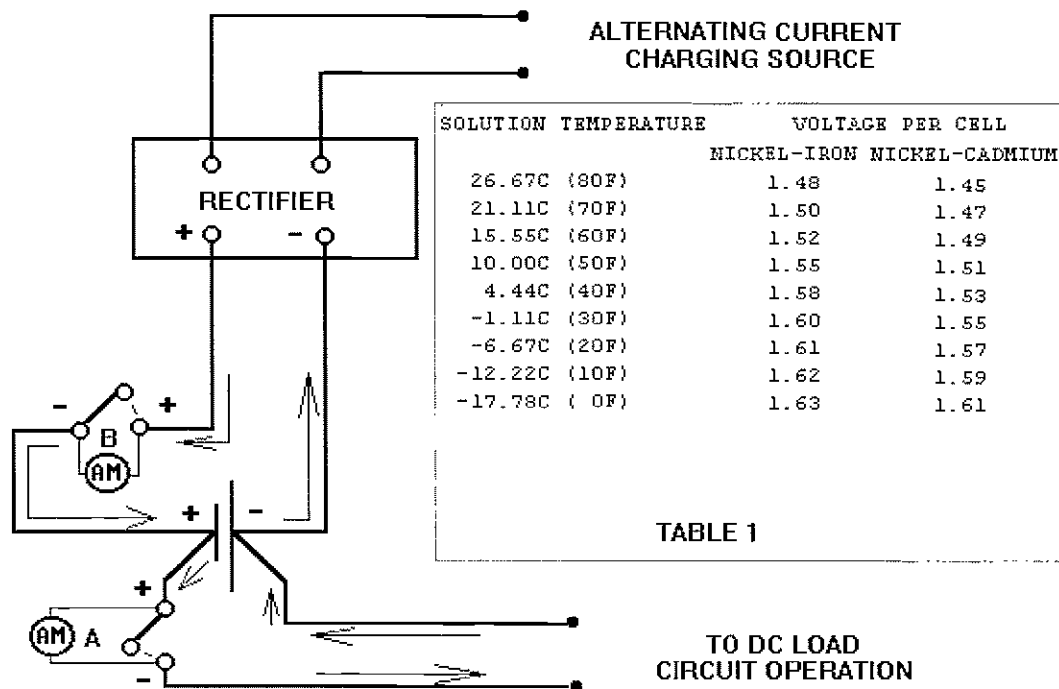


Figure 1

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

BATTERY CHARGING (Continued):

CHARGING CURRENT CALCULATION - NICKEL-IRON and NICAD (Cont):

6. Check cell voltage at 1-2 week intervals, making slight rectifier adjustments as needed to maintain battery cell voltage as shown in table 1, previous page, for ambient temperature.
7. Once "final" adjustment is set, frequent watering or further rectifier adjustment should not be required. Routine maintenance procedures must then be followed.
8. Battery record cards are provided to record cell voltages. History of cell voltage is an important aid to good maintenance. Thus, if voltage should vary significantly the cause should be determined. Note also that after an extended power failure, the charge rate can be increased for a while, to be later reset to a previously determined, satisfactory rate.
9. Battery records must be maintained as instructed and kept nearby.
10. Retarder yard batteries are "worked" harder (charged and discharged) more than "mainline" batteries. They are also more closely watched. General rules of battery maintenance as outlined above should be followed, but charging rate may not be so easily ascertained. Observation under actual operating conditions is the best way to set retarder battery chargers, most of which are now fully automatic and equipped with current limiting circuits.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

BATTERY CHARGING (Continued):

CHARGING CURRENT CALCULATION - NICKEL-IRON and NICAD(Cont):

11. Some batteries require a periodic "equalizing" charge, which is a short period of deliberate overcharge. Refer to manufacturer's instructions to determine if this is required for a specific installation.

12. Automatic chargers, such as those manufactured by Safetran, Craig, NRS and Exide, provide for proper voltage output after being set or adjusted. This provides for rapid recovery after power outage without subsequent over charging. Under conditions of varying load, the charger will assume most of the load, floating the batteries and keeping them near maximum charge at all times. Adjustments for this type of charger may vary. Manufacturers' literature must be used for detail set-up and adjustments.

FLOAT VOLTAGE SETTINGS - LEAD-ACID:

Table 2 on the following page shows the recommended float voltage for Exide EMF and GNB Absolyte batteries.

If any cells have significantly lower voltages for the cell temperature, an equalize charge to the battery bank is recommended. For equalize charging of GNB batteries, see the next part of this section. For Exide batteries, refer to the manufacturer's instructions.

If any cells voltages read higher than those listed for the cell temperature, reduce charge voltage to prolong battery life.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

**RECOMMENDED FLOAT VOLTAGE
 FOR REDUCED MAINTENANCE BATTERIES**

<i>Average Cell Temp. (Deg. F)</i>	<i>Volts/Cell - Exide EMF 40/80/120 AH</i>	<i>Volts/Cell - Exide EMF 210 - 425 AH</i>	<i>Volts/Cell - GNB - Absolyte</i>
0	2.54	2.46	2.35
5	2.53	2.45	2.35
10	2.51	2.43	2.35
15	2.5	2.42	2.35
20	2.48	2.4	2.35
25	2.47	2.39	2.35
30	2.45	2.37	2.35
35	2.44	2.36	2.35
40	2.42	2.34	2.35
45	2.41	2.33	2.35
50	2.39	2.31	2.35
55	2.38	2.3	2.34
60	2.36	2.28	2.32
65	2.35	2.27	2.31
70	2.33	2.25	2.29
75	2.32	2.24	2.28
77	2.31	2.23	2.27
80	2.3	2.22	2.26
85	2.29	2.21	2.25
90	2.27	2.19	2.23
95	2.26	2.18	2.22
100	2.24	2.16	2.2
105	2.23	2.15	2.2
110	2.21	2.13	2.2
115	2.2	2.12	2.2
120	2.18	2.1	2.2

TABLE 2

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

VALVE REGULATED LEAD ACID BATTERIES [GNB Absolyte]:

These batteries are not **Maintenance Free**. A Valve Regulated Lead Acid battery is a standard lead acid battery but the electrolyte is suspended in a sponge like material between the plates instead of water.

The battery is sealed which prevents the oxygen and hydrogen gases from escaping during charging and discharging cycles. Because of the seal, the gasses build up pressure inside the battery. A pressure release valve will let excess gas escape if the pressure is too great, preventing the battery from exploding.

Release of gas is not normal. Proper charging of the battery is essential to prevent gas from escaping. If gas does escape the life of the battery is shortened. The gas can not be replaced.

The use of Constant Voltage, Temperature Regulated chargers provides best results and longest life of Valve Regulated Lead Acid batteries.

Storage

1. Batteries shall be stored indoors in a cool (less than 77°F), clean, dry location. The storage interval shall not exceed six (6) months. The battery shall be given its initial charge before the end of the above stated interval and repeated for each six (6) month interval until the time of installation.

STANDARDS AND PROCEDURES
BATTERIES AND BATTERY CHARGERS

Initial date 9/30/93 - Revised 6/29/07

VALVE REGULATED LEAD ACID BATTERIES [GNB Absolyte] (Continued):

Charging an Absolyte Battery:

1. Determine the maximum volts that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell that is available.
2. Recommended float voltage is 2.23 - 2.27 volts per cell.
3. See the table below for charge voltages and times for initial charge and equalized charging (see I/O manual for conditions that may necessitate an equalize charge).

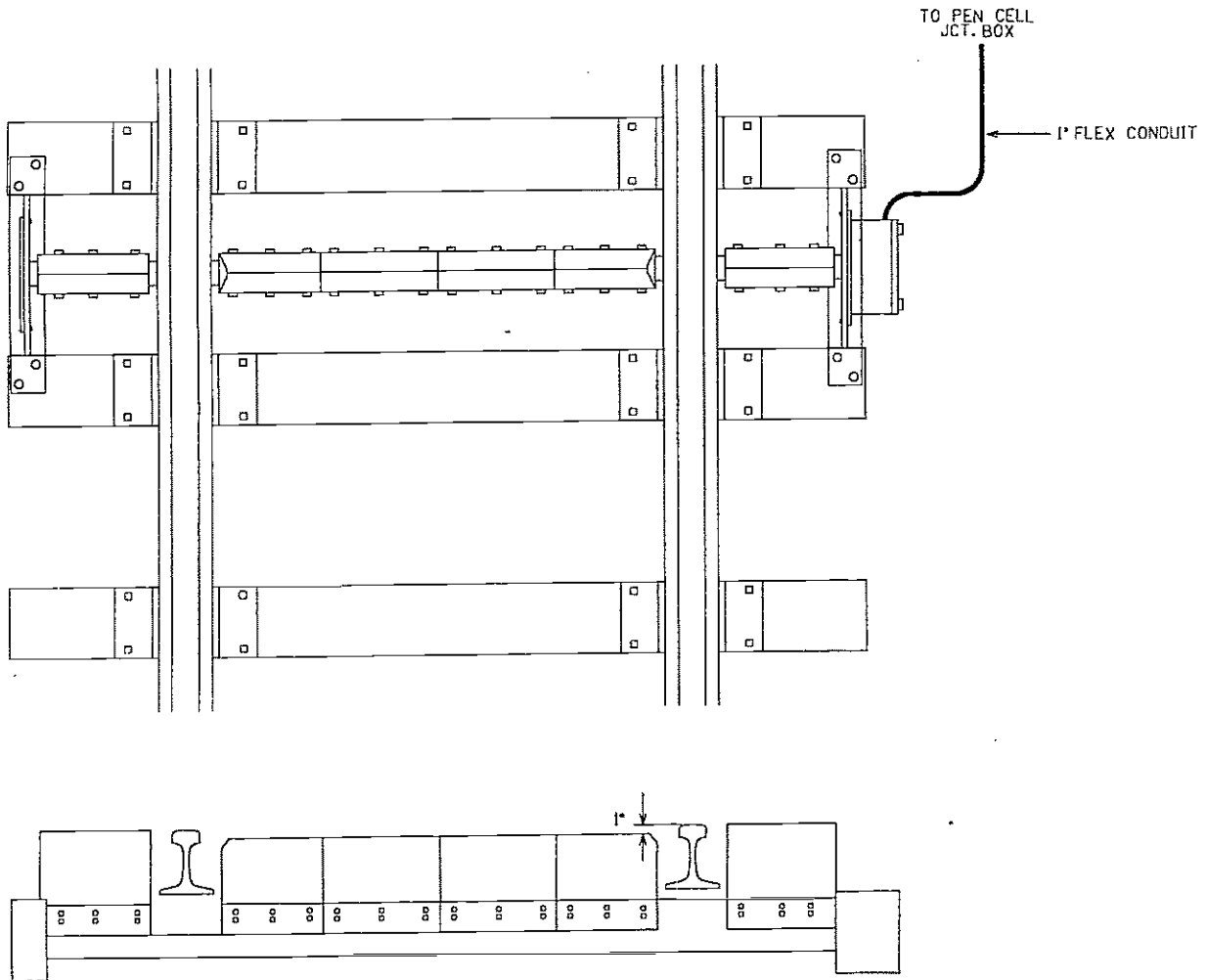
CELL VOLTS	TIME-HOURS
2.30	24
2.35	12

Time periods listed are for 77° F. For other temperatures a compensation factor of .003 V/degree F per cell is recommended. Adjust the voltage to the appropriate value. Continue charging until the charging current has tapered and stabilized (no reduction for three hours), charge for the hours shown in the above table or until the lowest cell voltage ceased to rise.

4. Operation of Valve Regulated (GNB Absolyte) cells at an average annual temperature above 77° F and float voltages higher than those recommended will result in a reduction of life. These batteries should never be operated above 122° F.

STANDARDS AND PROCEDURES
DRAGGING EQUIPMENT DETECTOR

Initial date 4/12/93 - Revised 10/09/01

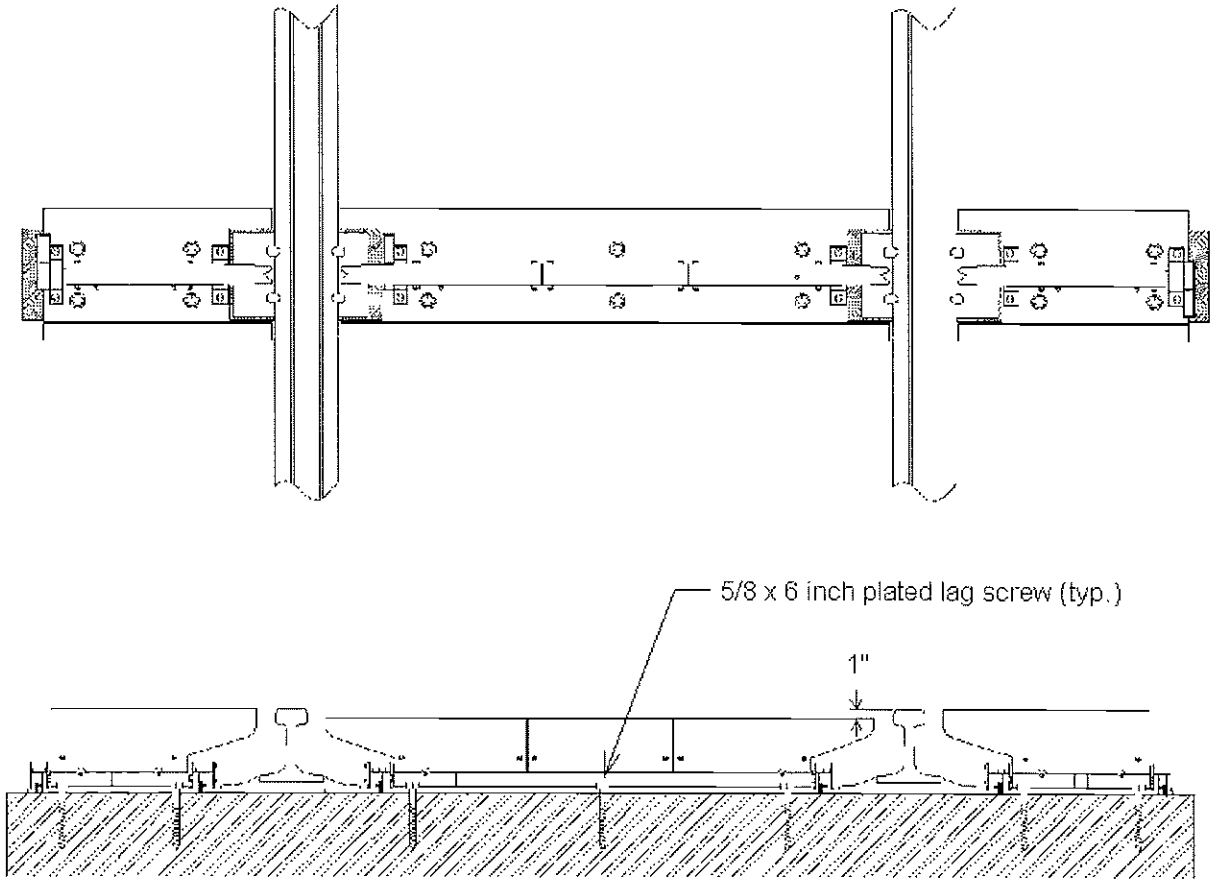


Harmon Dragging Equipment Detector

- Notes:
1. Paddle configuration shown is for mainline use, Harmon # ED-4005-S.
For classification yard use, use ED-4005-C.
 2. Tie spacing to be such to have 16 $\frac{3}{4}$ inches space between ties.

STANDARDS AND PROCEDURES
DRAGGING EQUIPMENT DETECTOR
Initial date 4/12/93 - Revised 10/09/01

New Tie-Mounted Style Dragging Equipment Detector



STANDARDS AND PROCEDURES
DRAGGING EQUIPMENT DETECTOR

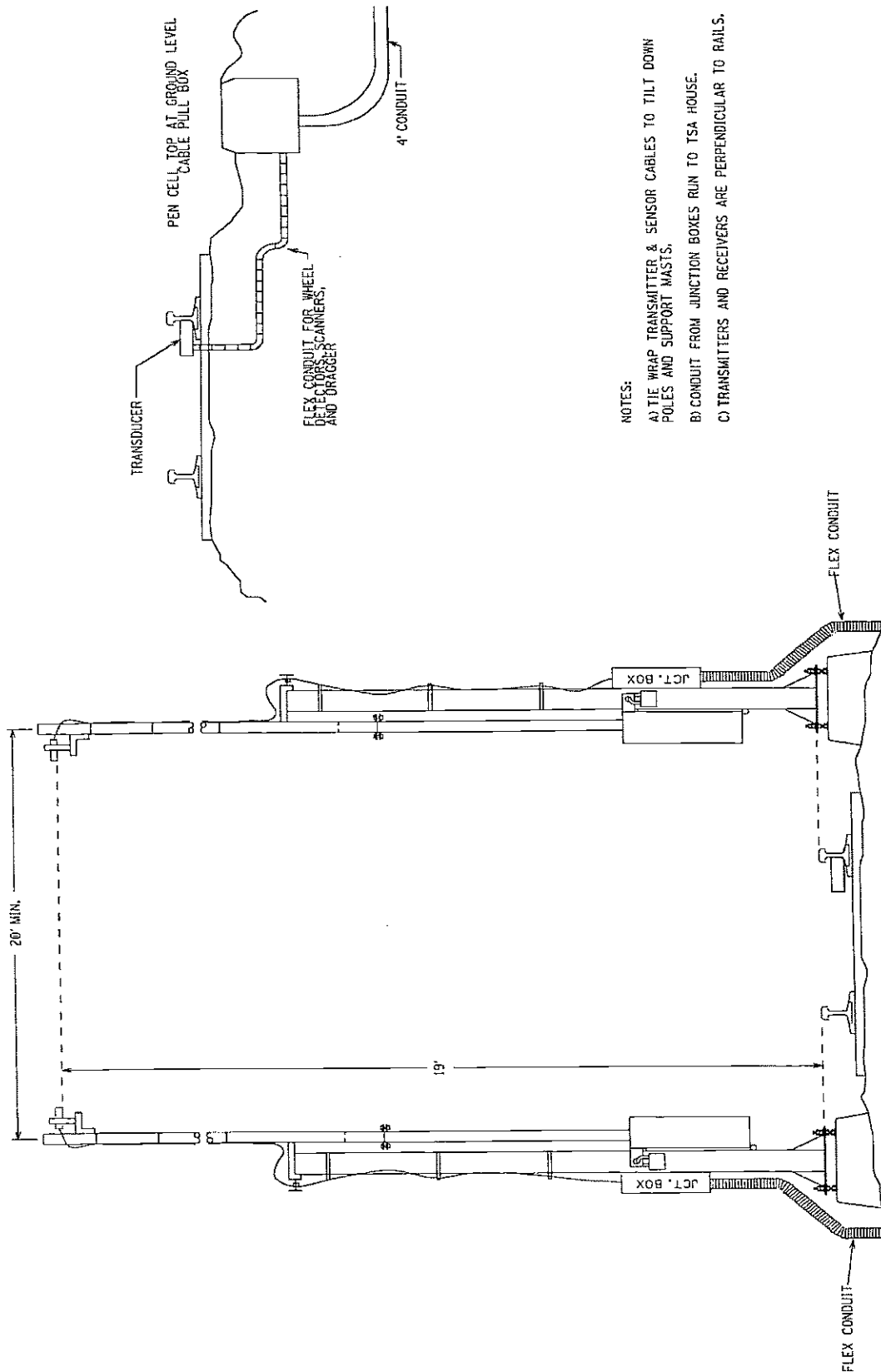
Initial date 4/12/93 - Revised 10/09/01

Installation of tie-mounted dragging equipment detector:

1. Draggers are installed on 10 foot ties. Maximum width is 9 ¼".
2. Dragger comes in 3 sections: two short outside sections and one long inside section. Each section has its own micro switch. When installing the sections, the micro switch end will be installed nearest the track-side junction box.
3. When installing, make sure there is sufficient space between inside section and gauge plate to prevent shorting of the track circuit.
4. Sections are installed on top of the tie and secured with 5/8" X 6" lag screws. Screws must be screwed in pre-drilled tie and not driven in. Outside sections use 4 screws; inside sections 6 screws.
5. Conduit should be run from junction box to near end of dragger for cable protection. Cable is run through built-in conduit on side of dragger from switches to end of dragger. Rubber hose or other suitable covering should be used under the rail between dragger sections.
6. Wire the switches in series. Each 2 conductor cable is color coded red & black. At the junction box take one wire from case and series through the 3 cables back to the return wire to the case.
Examples Black wire from case to black wire in dragger cable #1.
 Red wire in cable #1 to red wire in cable #2.
 Black wire in cable #2 to black wire in cable #3.
 Red wire in cable #3 to gray wire from case.
 NOTE: Wire color from case will vary.
7. Switches are preset by the cam. There is no adjustment to cam or switch.
8. Dragger is set to detect a 1" movement from top.

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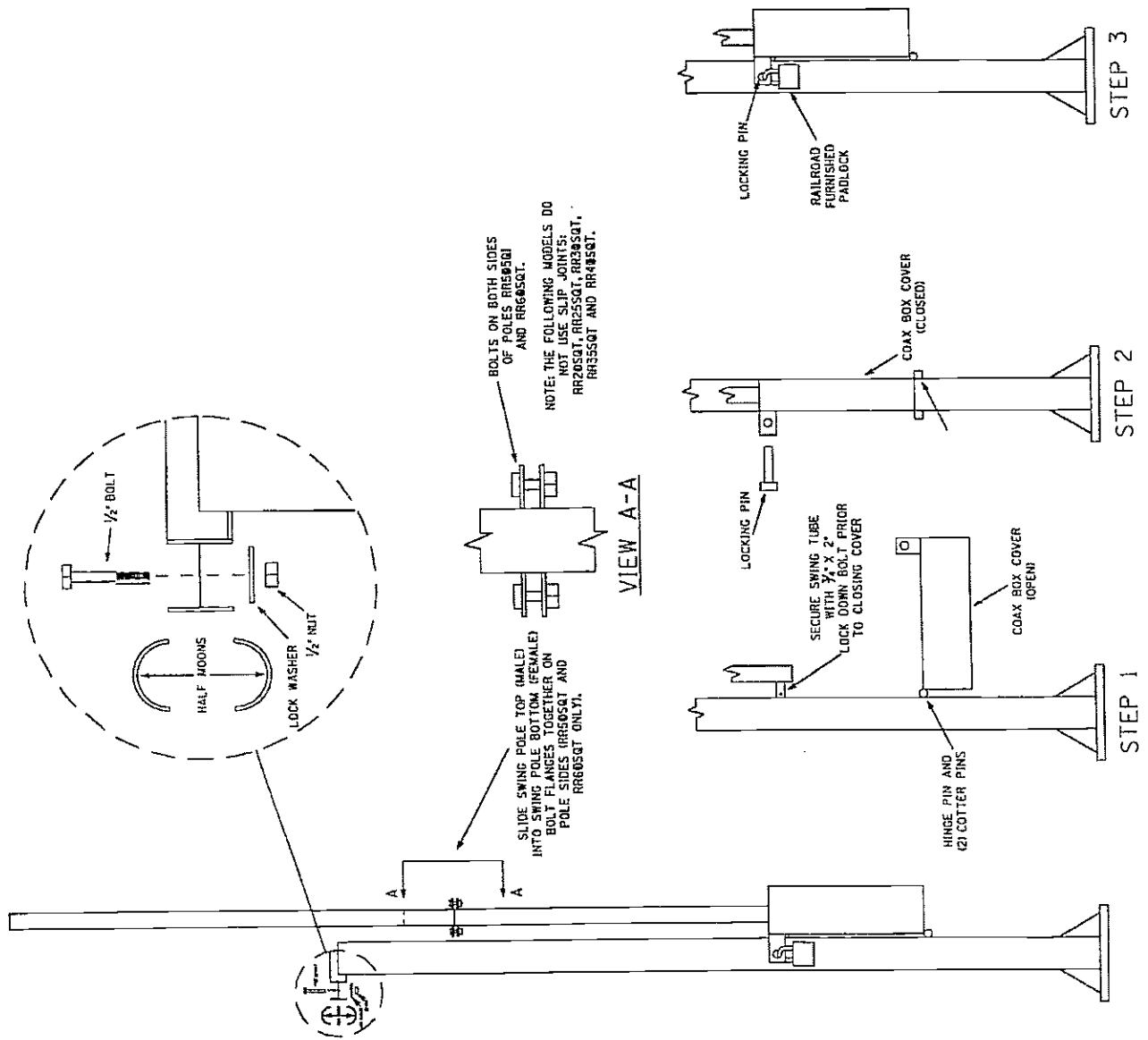
STANDARDS AND PROCEDURES
HIGH AND WIDE DETECTOR
 Initial date 4/12/93 - Revised 4/03/01



- NOTES:
- A) TIE WRAP TRANSMITTER & SENSOR CABLES TO TILT DOWN POLES AND SUPPORT MASTS.
 - B) CONDUIT FROM JUNCTION BOXES RUN TO TSA HOUSE.
 - C) TRANSMITTERS AND RECEIVERS ARE PERPENDICULAR TO RAILS.

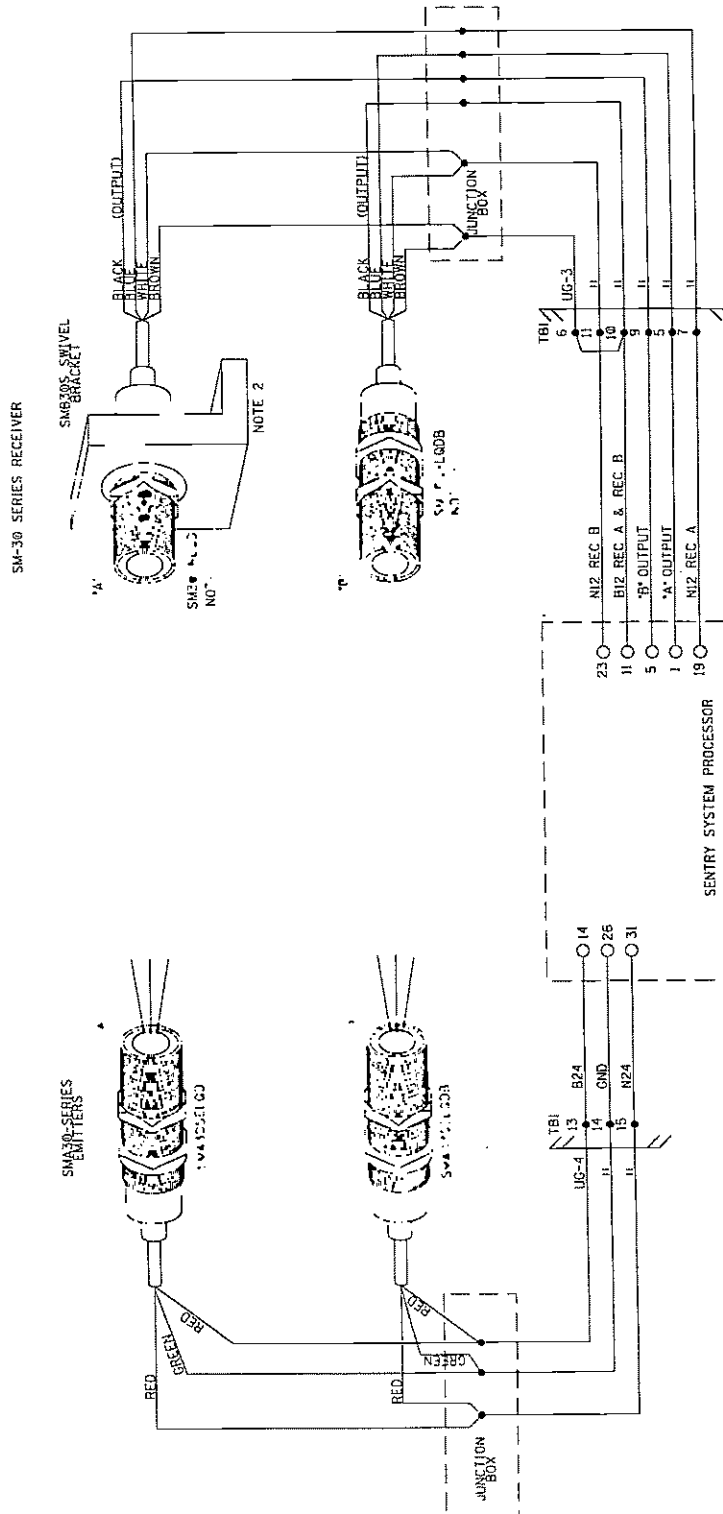
STANDARDS AND PROCEDURES
HIGH AND WIDE DETECTOR
 Initial date 4/12/93 - Revised 4/03/01

Swing Pole Assembly



COAX ENCLOSURE ASSEMBLY

STANDARDS AND PROCEDURES
HIGH AND WIDE DETECTOR
 Initial date 4/12/93 - Revised 4/03/01

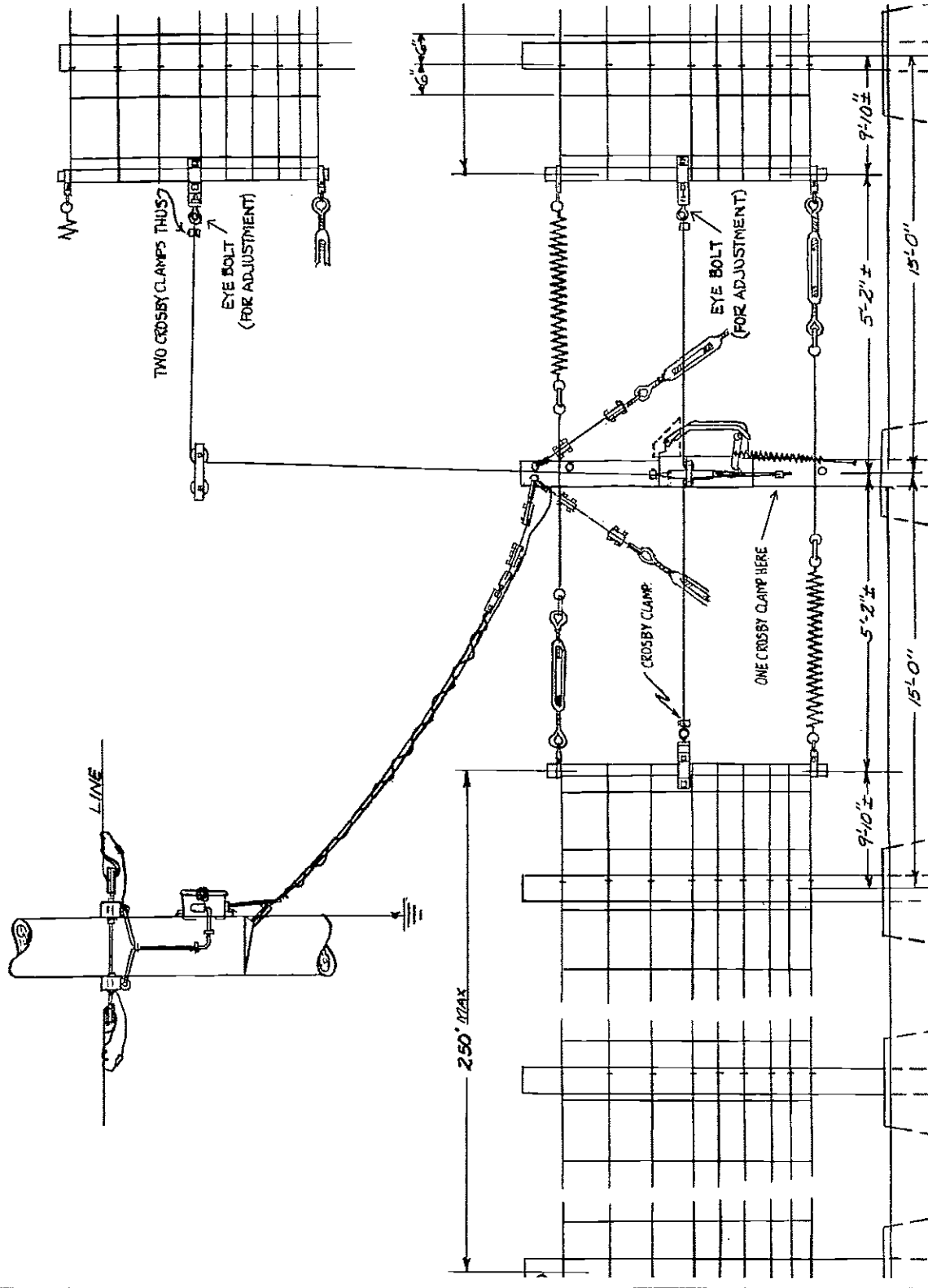


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STANDARDS AND PROCEDURES
SLIDE FENCE AND FALLING ROCK DETECTOR

Initial date 4/12/93 - Revised 10/09/01

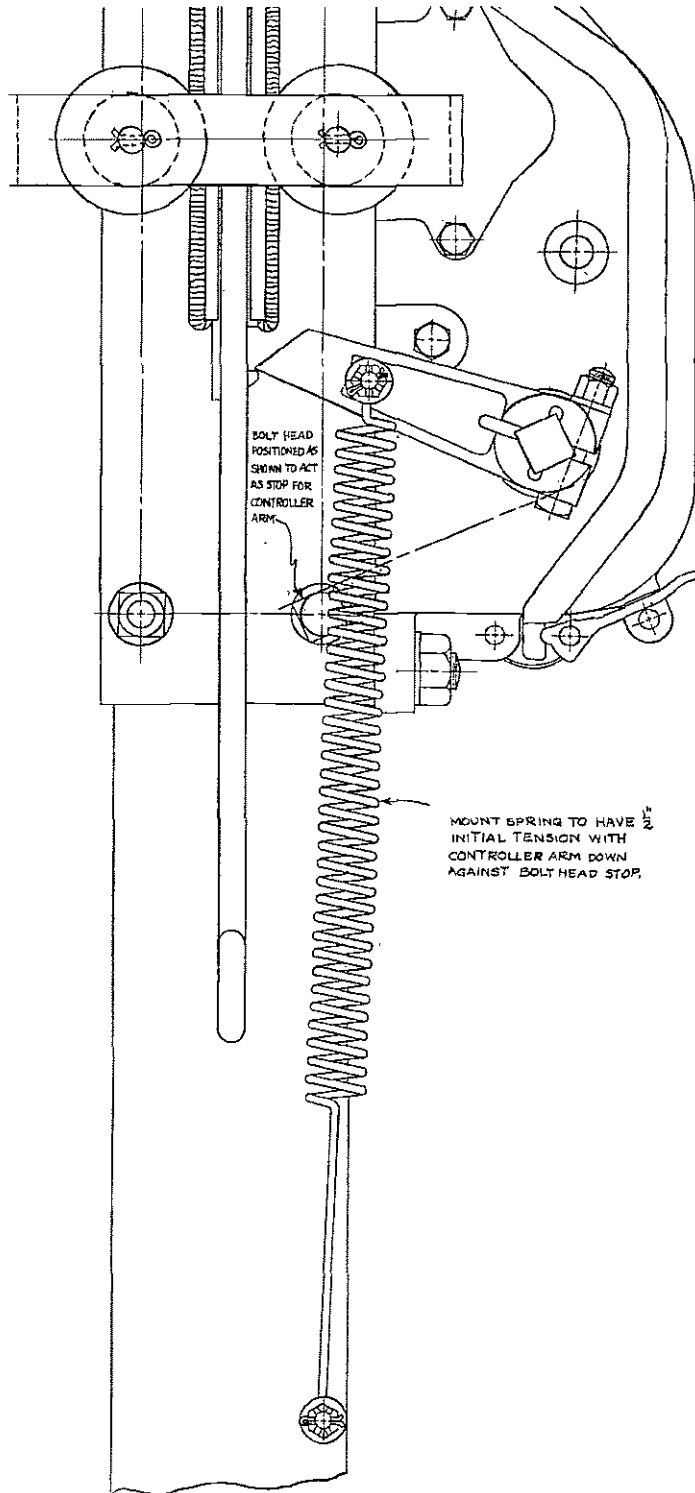
N&W Style Fence - Overview -(See N&W Dwg E-615 for details.)



STANDARDS AND PROCEDURES
SLIDE FENCE AND FALLING ROCK DETECTOR

Initial date 4/12/93 - Revised 10/09/01

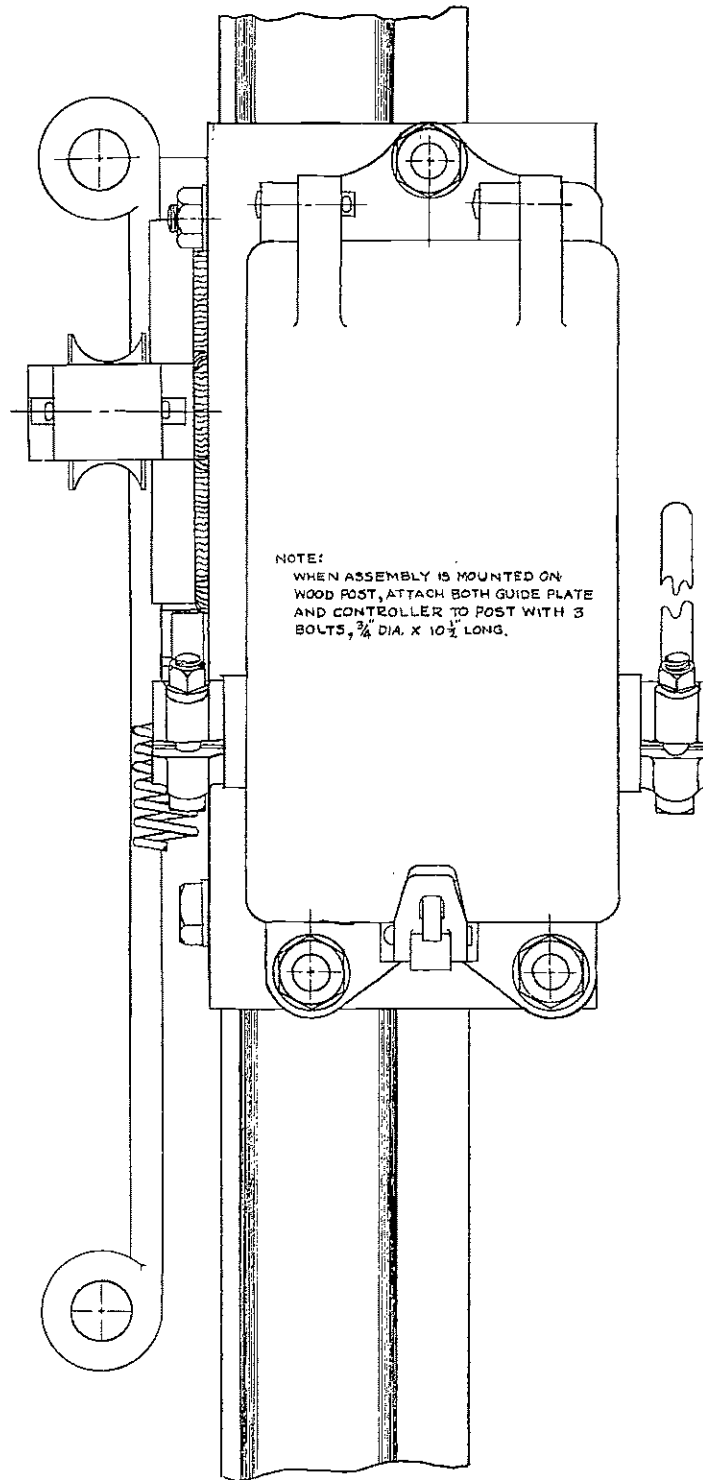
N&W Style Fence - Trigger Assembly - Side View (See N&W Dwg E-615 for details.)



STANDARDS AND PROCEDURES
SLIDE FENCE AND FALLING ROCK DETECTOR

Initial date 4/12/93 - Revised 10/09/01

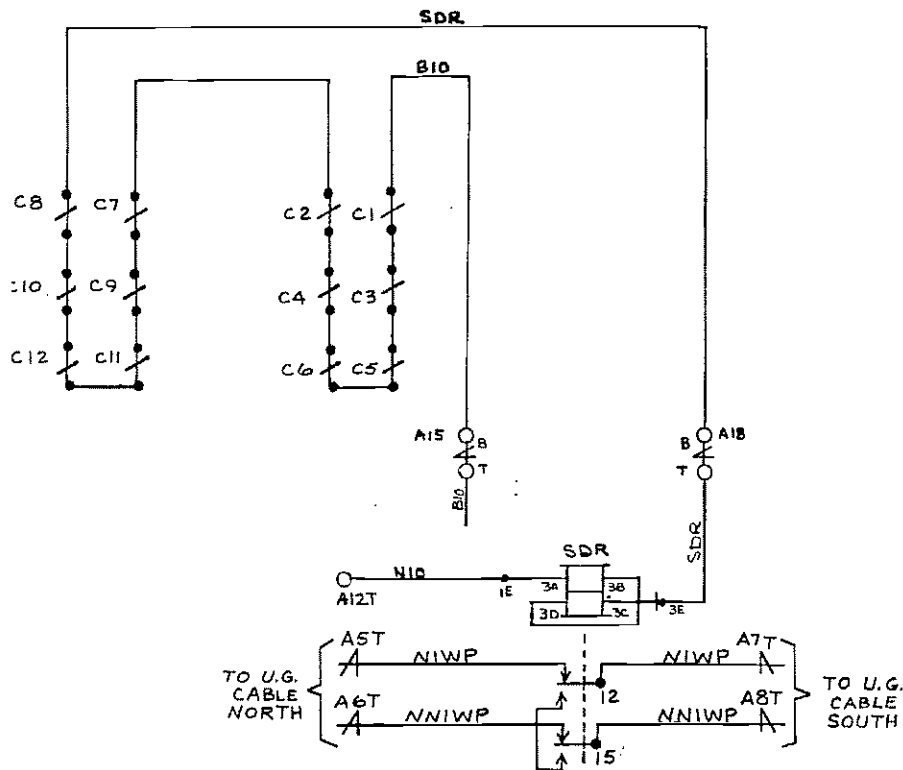
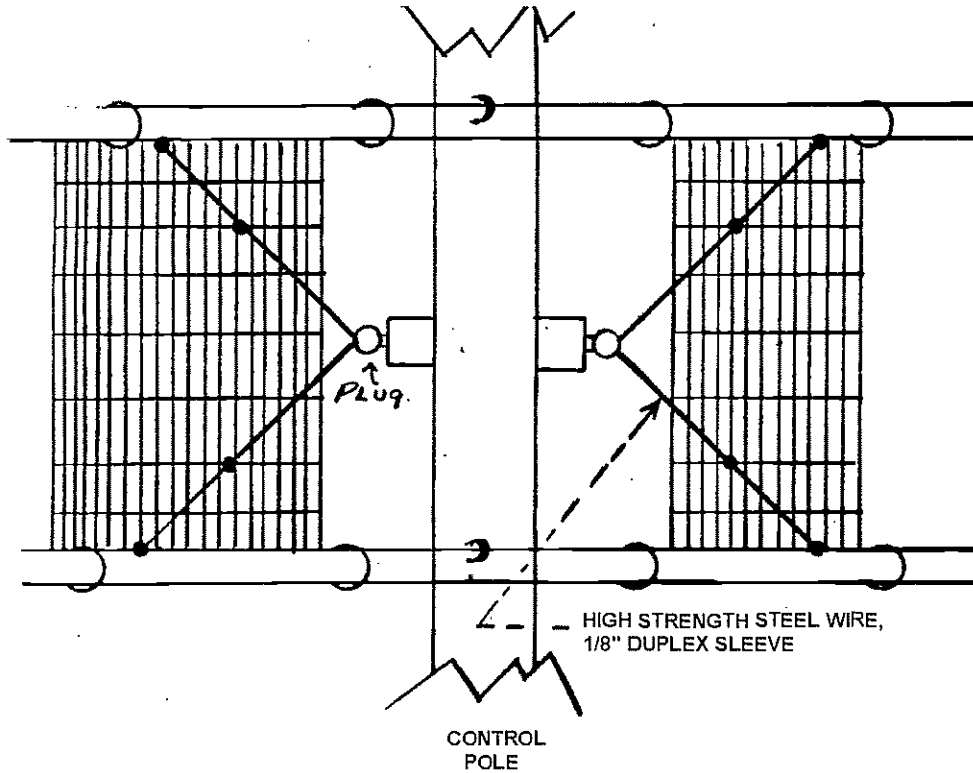
N&W Style Fence - Trigger Assembly - Front View (See N&W Dwg E-615 for details.)



STANDARDS AND PROCEDURES
SLIDE FENCE AND FALLING ROCK DETECTOR

Initial date 4/12/93 - Revised 10/09/01

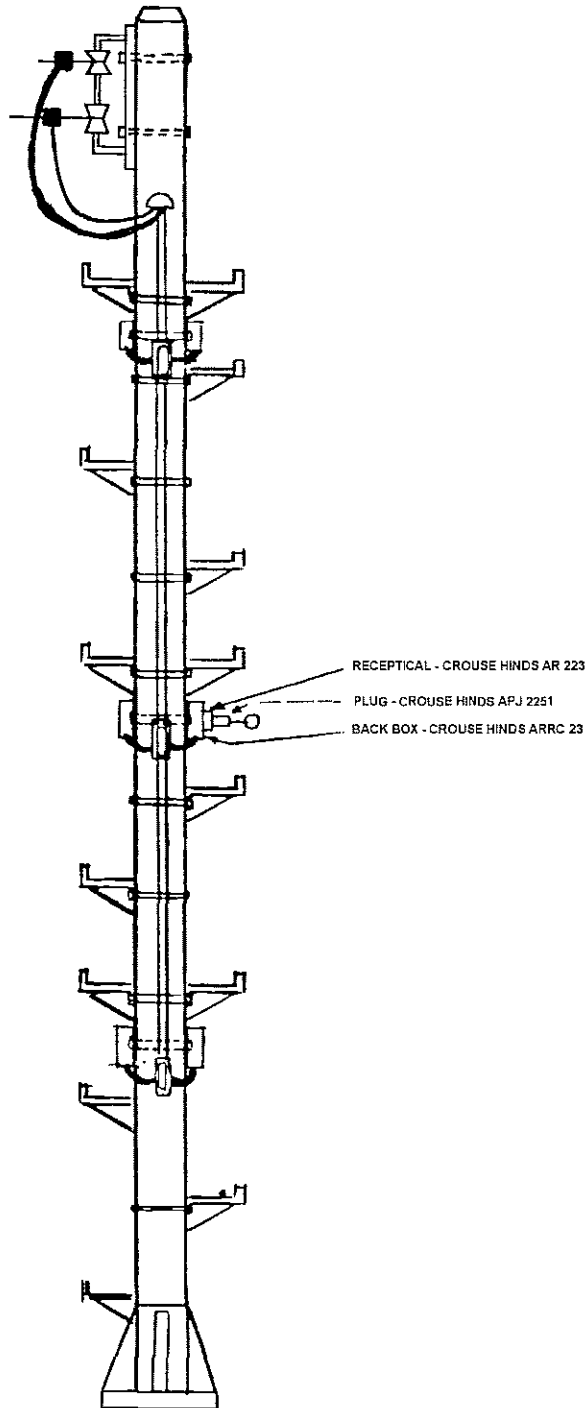
Southern Style Fence- Typical Arrangement and Circuit



STANDARDS AND PROCEDURES
SLIDE FENCE AND FALLING ROCK DETECTOR

Initial date 4/12/93 - Revised 10/09/01

Southern Style Fence - Control Pole



STANDARDS AND PROCEDURES
GROUNDING REQUIREMENTS
EQUIPMENT SHELTER
Initial date 9/1/93 - Revised 8/13/01

GENERAL:

A low resistance earth ground is essential for personnel protection and effective surge protection for electronic equipment. All ground leads must be run as directly as possible, avoiding sharp bends. Surge protected wiring must be kept away from entrance wiring and arrester ground leads. Arresters, connectors and system resistance must be inspected and tested annually. It is essential that connection wires between arresters or protectors and line wires be the absolute minimum length possible.

Electrical surge protection and grounding should comply with part 11.2.1 Association of American Railroads signal manual recommended general practices for electrical surge protection of signal systems.

GROUNDING ARRANGEMENTS - ELECTRONIC EQUIPMENT SHELTER:

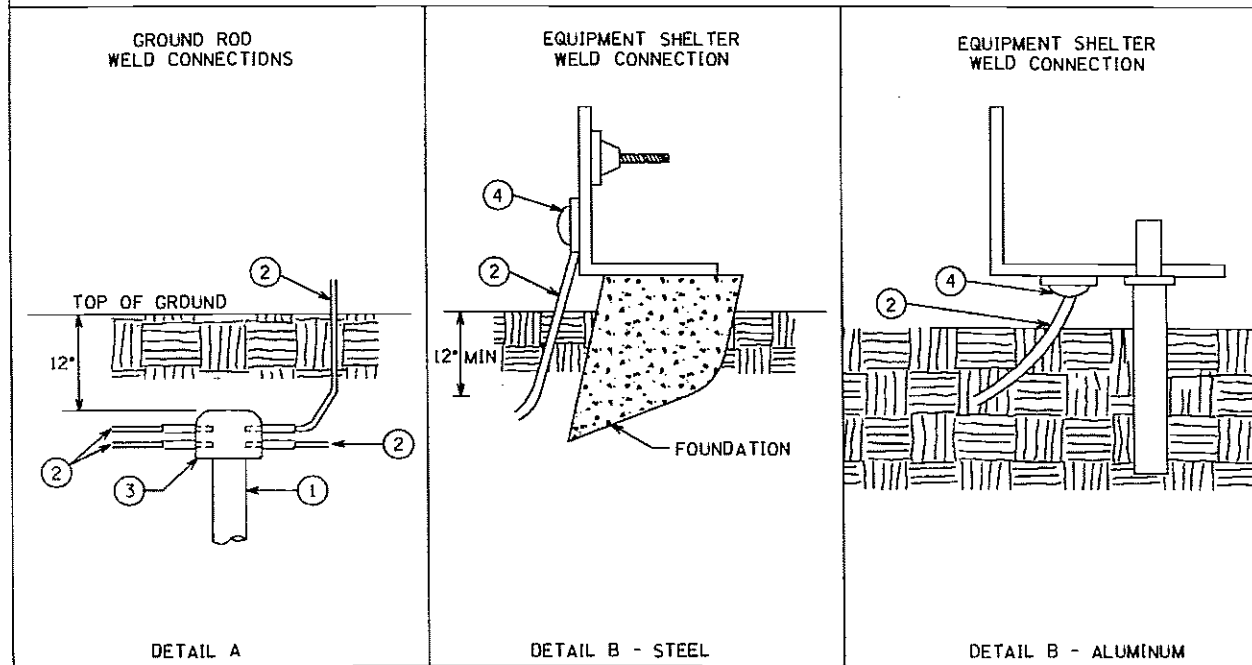
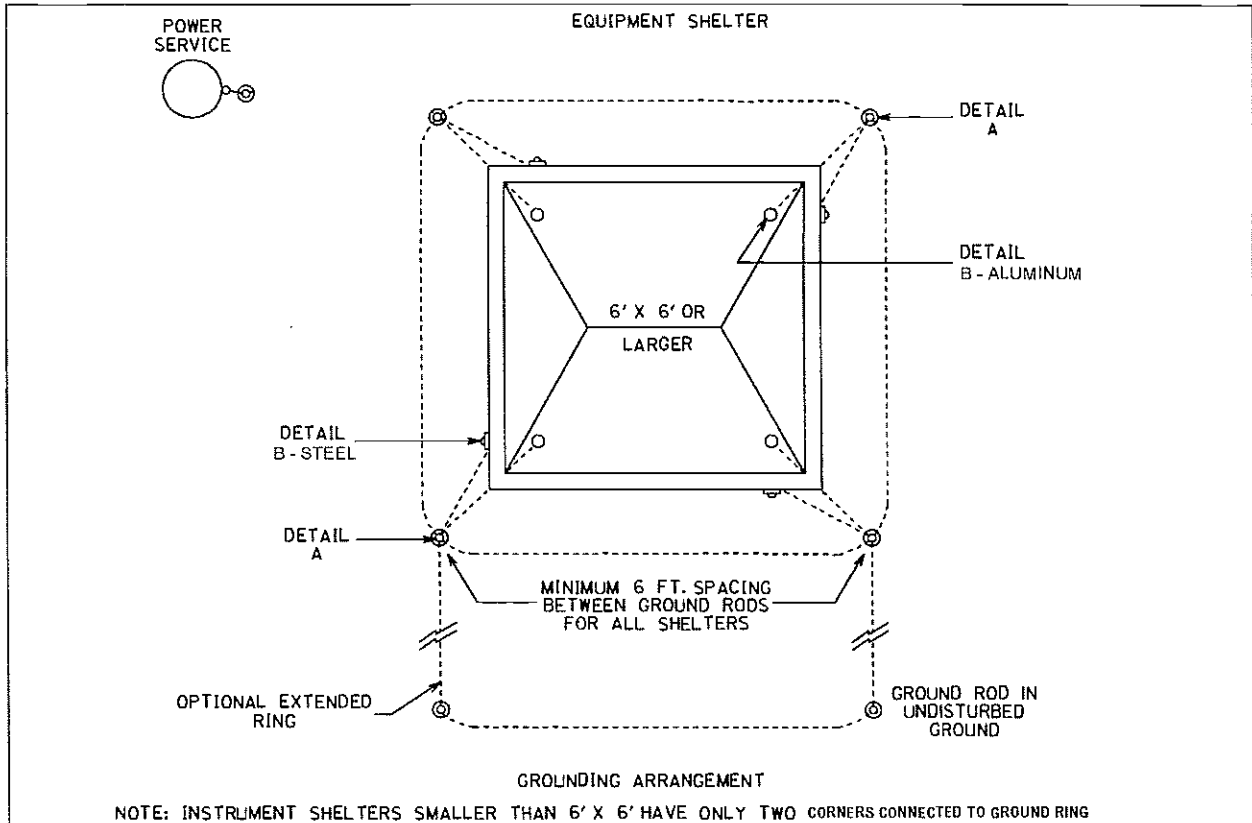
1. At each location, install 4 ground rods, one outside each corner of the equipment shelter, insuring a minimum 6 foot separation between rods. The rods should be spaced to form as square a pattern as practical. Any bungalow smaller than 6'X6' use four ground rods with two corners connected to the house. The ground ring will still be employed. (See Page 3)
2. Interconnect all ground rods using number 4 AWG bare solid, soft drawn copper wire buried 12 inches below grade, forming a ring around the outside of the equipment shelter. Connect the ground rods and ring to the metal frame of the shelter at the corners of the shelter. All ground system connections will be made with exothermic welds (Cadwelds).

STANDARDS AND PROCEDURES
GROUNDING REQUIREMENTS
EQUIPMENT SHELTER
Initial date 9/1/93 - Revised 8/13/01

GROUNDING ARRANGEMENTS - ELECTRONIC EQUIPMENT SHELTER (Cont.):

3. New ground systems should be measured with an approved ground resistance meter (such as a Vibra-Ground, etc.). Before making ground measurements use an amprobe (or other approved) meter to assure no AC current can be read between the shelter and ground. Disconnect AC power at meter base, verify AC off at shelter and then open the AC neutral at the shelter. This will separate the power company ground from shelter ground. Test both grounds for comparison purposes.
4. Grounding systems should be designed and installed to provide a minimum resistance between the metallic housing or ground terminal and remote earth. The shelter ground resistance should be equal to or less than the power company ground. To achieve this condition, additional ground rods may need to be installed in undisturbed ground, such as at the bottom of a fill, per drawing Page 3.
5. **GROUND MATERIAL KIT** - All material required to install ground system for equipment shelter may be ordered as a complete unit, NS part number 610-477991.
6. New equipment shelters are to be furnished with ground terminal studs welded directly to frame. Safety procedures and welding instructions must be fully observed when making field welds and grounding installations.
7. **Caution:** Exothermic welds shall never be applied to aluminum sheet metal. Only factory welding on aluminum sheet metal is recommended.

STANDARDS AND PROCEDURES
GROUNDING REQUIREMENTS
EQUIPMENT SHELTER
 Initial date 9/1/93 - Revised 8/13/01



STANDARDS AND PROCEDURES
GROUNDING REQUIREMENTS
EQUIPMENT SHELTER
 Initial date 9/1/93 - Revised 8/13/01

MATERIAL LIST

REF	CLASS - ITEM	DESCRIPTION	ERICO PART NUMBER	REQ
1.	670 - 000240	GROUND ROD 3/8" X 8' SECTIONAL	SB5858	6
2.	465 - 001114	#4 SOLID COPPER WIRE	SBA809A06F	160'
3.	670 - 475979	"NX" ONE-SHOT (4 WIRE)	SBNX1161L	8
1. - 3.	670 - 477991	ASSEMBLY KIT	SBK206	1

REF	CLASS - ITEM	OPTIONAL MATERIAL - ORDER AS REQUIRED	ERICO PART NUMBER
	670 - 719025	ONE SHOT SPLICE (#4 TO #4 WIRE)	PG11L
	670 - 757498	AAR STUD TO FRAME - MOLD ONLY - STEEL	
	670 - 743250	1/4" AAR GROUND STUD (10 PER BOX) - STEEL	
	670 - 726306	SLEEVE ADAPTER FOR #6 WIRE & 3/16" BOND STRAND	
	165 - 003965	FLINT IGNITER	SBT-320
	670 - 000258	3/8" GROUND ROD COUPLER	SBSC58
4.	670 - 629425	#4 WIRE TO METAL FRAME (MOLD ONLY) DETAIL B - STEEL	
	670 - 123381	WELD METAL POWDER	
	670 - 480756	ALUMINUM MAST CLAMP	8BB852A12CIK - 72
	670 - 483033	GEM MATERIAL 25# / BAG	SBGEM25A

Test 236.107
GROUND TEST

Initial date 05/25/93-Revised 06/01/08

SAFETY:

In the interest of safety, make the initial test with a voltmeter. If there is a voltmeter reading, the magnitude will determine the extra precautions necessary and the proper current scale to use.

PURPOSE:

The purpose of this test is to ensure that vital signal circuits do not have sufficient current flow to ground to cause improper operation of any relay or device in the circuit.

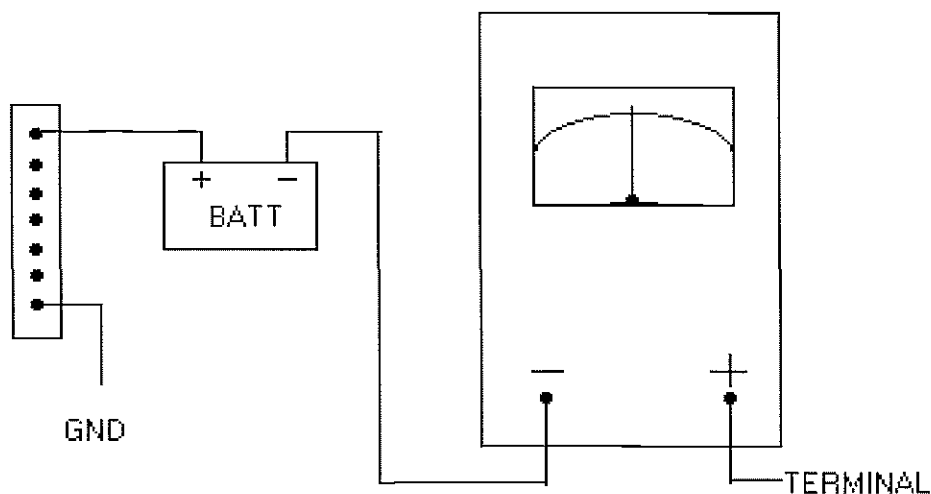
FREQUENCY:

Test to be made when system is placed in service, modified or disarranged, and at least once every 90 days thereafter (except for crossing signal locations which will be tested every 30 days thereafter per Test 234.249).

DESCRIPTION OF TEST:

AC and DC circuits

First determine that ground buss in instrument housing is connected to external ground by connecting the negative meter lead to the negative terminal of an external battery (normally a 6-volt lantern battery) and the positive battery lead to the ground buss. Connect the positive meter lead to a track wire. Meter should indicate voltage, verifying that the ground circuit is good and that the meter is operating properly.



Test 236.107
GROUND TEST

Initial date 05/25/93-Revised 06/01/08

After determining that ground buss in instrument housing is connected to the external ground rod, move the positive meter lead to each DC and AC energy buss terminal, and DC and AC terminal on the cable entrance board. The test is not required to be made on track circuit wires, AC distribution circuits grounded in the interest of safety, or detector locations where the battery buss is intentionally grounded.

If meter indicates the presence of ground, a current reading must be taken using local battery. Note: When using local battery, with meter on current, the conductor being tested must be in its normally energized state, or ground will not be detected.

If ammeter indicates current flow to ground that is equal to, or exceeds 75% of the release value of any relay or other device in the circuit, further tests shall be made to determine the cause, and such cause corrected immediately.

After completing the initial ground test as described above, if the location has power operated switches, check the prints to determine if the switch motor, magnets and armature, will be included in the test of the motor control energy buss (usually B24 or B110 buss). In some switch control circuit design, such as but not limited to GRS 5-H and US&S M-2, machines the motor control circuits are open at the controller and will not be included in the ground test. To test the entire circuit, an additional ground test is to be conducted on this energy buss while the switch machine is in motion both normal and reverse.

Electronic or electromagnetic devices designed to be free of grounds shall be kept free of grounds having a value that affects the proper operation of such devices. If proper functioning of the system is dependent on the devices being free of grounds, the system must be tested.

Record results of test on form CS-2.