

**Recommended Installation and Maintenance Instructions
for Lower Frequency Range Impedance Bonds**
Revised ~~2016~~-2021 (5 Pages)

A. Purpose

This Manual Part recommends instructions which apply to the installation, maintenance and test of air cooled and compound/oil filled impedance bonds that operate in the lower frequency ~~ranges-track circuit ranges~~ (typically 25 Hz to 500 Hz). They set forth general requirements representing recommended practice.

B. General

1. Installation, maintenance, tests and repair work which may interfere with safe operation of trains shall not be started until train movements have been fully protected. Temporary repairs or adjustments, when required, shall be made in such manner that safety of train operation shall not be impaired. When repair, adjustment, change or replacement is made, tests shall be made immediately to determine that the apparatus functions as intended. When making tests of apparatus, proper instruments shall be used and it shall be known that no unsafe conditions are created by the application of testing equipment.
2. Before removing impedance bonds, protecting signals shall be secured to display their most restrictive aspects. Signals shall not be restored to normal operation until tests have been made and it is known that they function as intended and that the track is safe for train operation.
3. Before disconnecting any bond connections, proper authority shall be obtained and necessary precautions taken, including an alternate path for propulsion return current, as instructed¹, to protect personnel from high voltage which may be present when the rail return circuit is opened.

C. Installation

1. Care should be exercised in handling and transporting to avoid breakage. Impedance bonds should not be lifted or carried by any part of the windings, terminals or top cover. Bonds should be lifted or carried from the bottom of the case.
2. In handling and transporting oil filled bonds, they should be kept in an upright position to avoid leakage.

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¹The term "as instructed" as used herein refers to individual railroad or purchaser's instructions

3. Bonds shall be determined to be of the correct impedance and current rating. Where required, tuned impedance bonds should be installed as per approved plans.
4. Bonds should be mounted in a level position and securely fastened to the ties or foundations. When installed between the rails, a minimum clearance of 1 in (25.4 mm) shall be provided between the top of the case cover, or shield, and the top of the lowest rail. Sufficient clearance, as instructed, should be provided between the bottom of the case and the roadbed.
5. Connecting cables should be of a length as instructed and fastened securely to the bond terminals and to the rails. Sufficient slack should be provided in the cables to prevent strain on terminals and connectors. Cables should be secured to minimize possible damage. Connecting cables should be sized to meet the designed traction return current.
- ~~6. Impedance bonds should be installed between the running rails and secured between two ties with the connections to the rails arranged such that the insulated cables do not cross under the rail of an adjacent track circuit.~~
- ~~7. Impedance bonds placed outside of the running rails should have the connections to the rails placed in non-conductive conduit to avoid any unintended contact with the rails.~~
- ~~8. Side leads of bonds should be of equal length to avoid causing an imbalance to the circuit. To minimize traction return system resistance, all side leads should be kept as short as practicable while maintaining a neat and safe installation.~~
- ~~9. Side, neutral and tie-in cable terminations should be accessible for examination and disconnection with the impedance bond lid or cover in place but not be unduly exposed to damage.~~
- ~~10. Where required, cables should be mechanically supported to reduce the load on the termination point and cable lugs.~~
- ~~6. Prior to installing compound/oil filled impedance bonds, they should be inspected and, if required, filled as outlined in Section D.~~

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D. Filling

1. Impedance bonds using a compound, conforming to Manual Part 8.4.6 Recommended Developmental Criteria for Impedance Bond Compound should be filled as follows or as instructed:
 - a. Preheat bonds by some suitable means to completely remove moisture and provide a hot metal surface prior to filling with hot compound. Temperature should not exceed +225 °F (+107 °C). Preheating may not be necessary if all materials and assemblies used have been thoroughly dried before final assembly and kept dry until cover is installed.
 - b. Place compound required for filling bonds in a suitable metal container and heat to +200 °F (+93 °C) to +225 °F (+107 °C).
 - c. Fill preheated bonds while still hot with hot compound to a level of at least ½ in over top of coil, or as instructed. Do not overfill. Leave about 10% of vertical dimension to the top case lip to allow for expansion of compound.
 - d. After filling, allow bonds to stand until the compound is fully solidified (approximately 12 hr).
 - e. After compound is completely solidified, fill surface cracks, voids or recesses in the compound resulting from shrinkage during cooling with hot compound +200 °F (+93 °C) to +225 °F (+107 °C).
 - f. Allow bonds to stand until the second application of compound is completely solidified.
2. Impedance bonds using oil conforming to Manual Part 8.4.7 Recommended Developmental Criteria for Impedance Bond Oil should be filled as follows or as instructed:
 - a. Preheat bonds by some suitable means to completely remove moisture prior to filling with oil. Preheating may not be necessary if all materials and assemblies used have been thoroughly dried before final assembly and kept dry until cover is installed.

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- b. Fill preheated bonds while still warm with oil to a level at least $\frac{1}{2}$ in over top of coil or as instructed. Do not overfill. Leave about 10% of vertical dimension to the top of the case lip to allow for expansion of oil.
3. Impedance bonds using fire-resistant dielectric conforming to Manual Part 8.4.8 Recommended Developmental Criteria for Impedance Bond Fire-Resistant Dielectric Fluids should be filled as follows or as instructed:
 - a. Preheat bonds by some suitable means to completely remove moisture prior to filling with fire-resistant dielectric. Preheating may not be necessary if all materials and assemblies used have been thoroughly dried before final assembly and kept dry until cover is installed.
 - b. Fill preheated bonds while still warm with fire-resistant dielectric at least $\frac{1}{2}$ in over top of coil or as instructed. Do not overfill. Leave about 10% of vertical dimension to the top of the case lip to allow for expansion of liquid.

E. Maintenance

1. Inspection should be made, as instructed, to ensure:
 - a. Bond terminals and rail connections are intact and tight.
 - b. Bonds and cables are properly secured in place.
 - c. Compound or oil is at the proper level and devoid of impurities.
 - d. Coating, potting or encapsulation compound is devoid of cracks and signs of deterioration or deep erosion.
 - e. Cover is tight and gaskets are in good condition.
 - f. Clearance, as instructed, exists between the top of the case cover or shield and the top of the lowest rail and between the bottom of the case and the roadbed.
 - g. No cracks or excessive rust exist on the bond case or cover.
 - h. Mounting hardware is not missing and is tight.

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2. If there are signs of some deterioration as discovered by following steps of E.1, it may be necessary to remove bond from service and refurbish according to manufacturer's instructions.

F. **Testing**

1. ~~1. Impedance Bonds shall be tested in accordance with manufacturer's instructions.~~
2. ~~For additional testing guidelines, refer to Manual Part 8.4.3 Recommended Test Procedures for Low Frequency Tuned and Untuned Impedance Bonds.~~
2. ~~Factory test reports should be obtained to be able to compare original performance with suspect bonds after they have been in service for a time.~~
3. ~~Because performing comprehensive tests is impractical, the following field tests are recommended at the receiving or refurbishing stages:~~
 - a. ~~Dc resistance rail to rail and rail to center tap.~~
 - b. ~~Insulation resistance.~~
 - c. ~~Dielectric withstand voltage at 70% of factory test.~~
 - d. ~~Impedance with no dc current. For this test a low ac voltage (0 V to 5 V and 10 A, 60 Hz capability) source will be required. This test will be adequate to ascertain that the gap has not changed. Dc unbalance capability can only be measured with a significantly more complex test setup.~~
 - (1) ~~Untuned bonds should be tested by applying specified voltage across rail terminals, measuring current and calculating the resultant impedance. Make sure that the bond is rated for 60 Hz operation.~~
 - (2) ~~Tuned bonds should be tested similarly except taking extreme caution that the bond is tuned for 60 Hz operation.~~

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~~If any of these tests yield deviations from the results of the original factory test results or if more complete tests need to be performed, the manufacturer should be consulted.~~