# Signal Power Distribution Inspection and Maintenance

## Course 207

PARTICIPANT GUIDE

SIGNALS TRAINING CONSORTIUM

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# Module 1

## *SIGNAL POWER DISTRIBTUION INSPECTION & MAINTENANCE OVERVIEW*

### Outline



### Purpose and Objectives

The purpose of this module is to provide the participant with an overview for maintenance and inspection of signal power distribution inspection and maintenance.

Following the completion of this module, the participant should be able to complete the exercises with an accuracy of 70% or greater:

- Describe safety practices as related to performing inspection & maintenance for signal power distribution.
- Identify and explain the use of tools signal power distribution inspection and maintenance.
- Identify agency specific schedules for signal power distribution inspection and maintenance.
- Describe inspection and maintenance documentation for reporting as per agency regulations.


***Figure 1.2 Arc Flash, courtesy of Fluke Corporation and OSHA***

Hazards associated with arc blasts include burns, wave blasts, and equipment meltdown. Burns that occur from arc blasts are due to thermal radiation and intense light. The use of proper clothing, work distances, and overcurrent protection can help reduce this risk. Wave blasts which can occur with a 25,000-amp arc can result in a force of approximately 480 pounds on the front of the body at 2 feet away. While these wave blasts can throw individuals away from the arc and resulting thermal radiation, serious ear damage and memory loss due to concussion can still occur. The pressure waves can also send equipment flying and can knock over walls. The melting of equipment is another risk of an arc flash. As equipment melts down, droplets of molten equipment metal can be projected by the arc blast. These droplets can cause burns and/or fires even at distances of 10 feet or more away.

| | |
|---|---|
| Arc Flash Safety by Eaton Videos | https://www.youtube.com/watch?v=uJUC2_w_mms |
| Arc Flash Awareness 2007 - National Institute for Occupational Safety and Health, Part 1 | https://www.youtube.com/watch?v=ORuXr-Kjw18 |

As determined by the NFPA 70E, **approach boundaries** consist of four boundary levels determined by distance to protect from exposed live parts and arc flashes or blasts.

The three boundaries used to protect individuals from exposure to live parts include the following:

- **Limited approach boundary** – the closest approach for unqualified person unless accompanied by a qualified person.
- **Restricted approach boundary** – the closest approach without proper PPE for a qualified person. Careful attention of tools and movements that could be exposed to live parts with unintentional movement.
- **Prohibited approach boundary** – distance a person must keep from live parts to prevent flashover or arcing in the air. A person closer than the prohibited approach boundary would essentially be in contact with a live part.

| **Electric Shock Boundaries to Live Parts<br>300 – 600 Volts** | | | |
|---|---|---|---|
| Limited Approach Boundary<br><br>**3 feet 6 inches →** | Restricted Approach Boundary<br><br>**1 foot →** | Prohibited Approach Boundary<br><br>**1 inch →** | **Power Source** |

The fourth boundary is intended to protect against arc flash and is known as the **flash protection boundary**. At this boundary, PPE is required to prevent incurable burns in the event of an arc flash. In many transit agencies, only qualified persons are allowed to enter areas identified as "Arc Flash and Shock Hazard" locations.

| **Flash Protection Boundary to Live Parts<br>300 – 600 Volts** | |
|---|---|
| Flash Protection Boundary<br><br>**4 feet →** | **Power Source** |

| **Your Agency Policy and Procedures Regarding Approach Boundaries** |
|---|
| |

## Primary Power Automatic Transfer Panel and Switch

The transfer equipment (panel and/or switch or relays) is the initial point of entry for commercial AC power into the signal system for some rail agencies. In the event the commercial voltage goes outside the value that is set, the transfer switch will transfer from the primary commercial power feed to an alternate primary power either generated by a generator or provided by an alternate commercial or agency-provided primary power feed and ultimately provides protection for the signal equipment and operation.

The signal maintainer should be aware of the three types of power being distributed through the transfer panel including **primary power**, **alternate power (also known as secondary or standby power)**, and **signal circuit power supply:**

- Primary power – normal power and preferred power source
- Alternate power (also known as Secondary or Standby power) –is power supplied to the signal system when preferred power is unavailable or lost.
- Power Supply to Signal and Related Circuits – sometimes known as "**load power**", the power provided to the signal system after leaving the transfer power switch, either primary or secondary. The load side of the transfer switch supplies the CIL, and cables distribute power to the components in the signals system.


***Figure 2.2 Primary Power at the Automatic Transfer Panel***

### Inspection and Maintenance for Transfer Panels and Switches

Wire and cable tests to be completed by signal maintainers include grounds tests and insulation resistance tests.

## Wire and Cable Testing

### Grounds Tests

The term “ground” in the power distribution system means just that: earth and ground all around including the ground outside where one walks, the dirt, rocks, etc. The earth is considered electrically neutral and to be at zero for reference in voltage measurements.

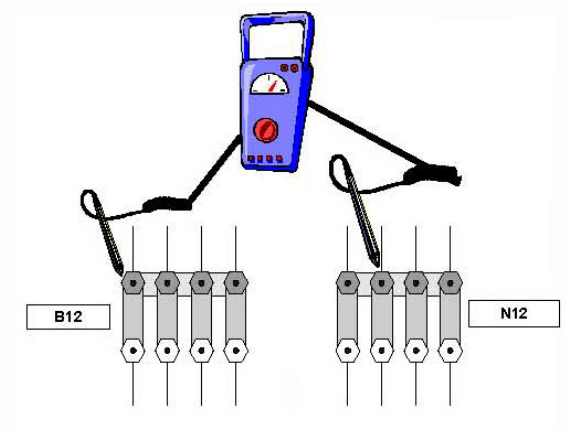
Per the National Electrical Code, a true earth ground is made up of a conductive pipe or rod driven into the earth to a minimum of 8 feet per depth.

***Figure 2.9 Wire going to Ground***

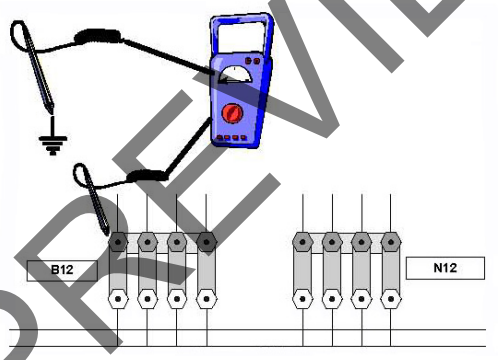
According to FRA 236.2, each circuit, the functioning of which affects the safety of train operations, shall be kept free of any ground or combination of grounds which will permit a flow of current equal to or in excess of 75 percent of the release value of any relay or other electromagnetic device in the circuit, except circuits which include any track rail and except the common return wires of single-wire, single-break, signal control circuits using a grounded common, and alternating current power distribution circuits which are grounded in the interest of safety.

For signal maintenance, two grounds tests should be performed: a traditional grounds test and a battery / energy busses grounds test.

3. Take a voltage reading on the buss being tested to verify that meter is functioning and buss voltage is at the correct level as shown below.




4. Leave one meter lead connected to one side of the energy buss and relocate the other meter lead to ground as shown in Figure 30-2. If zero voltage potential is detected, take a voltage potential reading between the other side of the buss and ground. If both sides of the buss read zero voltage to ground, a current reading to ground is not required. Record the buss nomenclature, buss voltage and current on the required ground records, and repeat Step# 3 and 4 on remaining energy busses.




5. If voltage potential to ground is detected on any energy buss, a current reading to ground must be taken.

   Note: it is recommended that before this is done, precautions must be taken to ensure that trains are not at or near the location involved.

   Maximum allowable current to ground is 0.001 amperes on a low voltage buss (less than 110V) and 0.025 amperes on a high voltage buss (110V or higher). Current readings should be taken in progressive lower scales. If current exceeding this

***Figure 2.11 Typical Signal Cable***

Test results are recorded as per agency specific guidelines for documentation. Figure is an example of a megger test documentation form used in SEPTA.

SEPTA
INSULATED RESISTANCE
C & S Test No. 2

| Line: | | Location: | | | | | From: | | | | | To: | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test Date: | | Cable Type: | | | | | Tester: | | | | | Witness: | | | | | | | |
| Conductor | Circuit | | | | | | | | | | | | | | | | | | |
| 1 | | 1 | | | | | | | | | | | | | | | | | |
| 2 | | | 2 | | | | | | | | | | | | | | | | |
| 3 | | | | 3 | | | | | | | | | | | | | | | |
| 4 | | | | | 4 | | | | | | | | | | | | | | |
| 5 | | | | | | 5 | | | | | | | | | | | | | |
| 6 | | | | | | | 6 | | | | | | | | | | | | |
| 7 | | | | | | | | 7 | | | | | | | | | | | |
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| 17 | | | | | | | | | | | | | | | | | | 17 | |
| G | | | | | | | | | | | | | | | | | | | G |
| | Minimum allowable resistance 500,000 ohms at 250 Volts<br>Conductors below 200,000 ohms must be repaired | | | | | | | | | | | | | | | | | | |

***Figure 2.12 Megger Insulated Resistance Test Documentation Form***