



# Evaluating Conditions from Infrared (IR) Inspections in Transmission Lines

TD-1001M-JA19  
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Rev: 2

## PPE:

Standard T-Line PPE, including the following:

- Hard hat
- Safety glasses
- Gloves
- FR clothing

## Tools:

- Video-imaging equipment
- IR Camera

## Guidance Document References:

- [TD-1001M, "Electric Transmission Preventive Maintenance Manual"](#)

## Level of Use:

- ☐ Information
- ☒ Reference
- ☐ Continuous

## Purpose

IR inspection procedures are a key element of the preventive maintenance program.

The recommended maintenance priorities reduce the potential for component failures and facility damage and facilitate a proactive approach to repairing or replacing identified abnormal components.

## Condition Codes

Inspect the structure using the form to record issues. Determine the condition of each item.

Consider all conditions to determine the appropriate Priority Code for any notification, if required.

- **5** = Heavy damage with safety concerns
- **4** = Heavy damage
- **3** = Moderate damage
- **2** = Light damage
- **1** = No visible damage



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## IR Inspections

- Electric transmission system inspections and preventive maintenance programs use IR imaging and temperature-measuring systems to identify faulty components and initiate repairs or replacement proactively.
- Based on industry specifications, connectors should experience lower operating temperatures than their respective conductors. This means that any time the temperature of a connector is greater than the temperature of its respective conductor, a higher-resistance connection exists and a failure can be expected, but not precisely predicted. It is probable that degradation occurs faster with an increase in load or temperature.
- Conductor manufacturers recommend a usual maximum operating temperature of 185°F for tensioned, bare conductor.
- Conductor manufacturers recommend the following maximum operating temperatures for insulated conductors:
  - 167°F for high-molecular-weight polyethylene (HMWPE).
  - 194°F for cross-linked polyethylene (XLPE).
  - 194°F for ethylene-propylene rubber (EPR).
- With insulated conductor systems, the temperature measured at the surface of an insulated conductor or component could be between 20% and 50% of the actual temperature of the targeted conductor or component (e.g., if the actual temperature of the component is 212°F, the measured temperature could be between 68°F and 122°F, respectively).
- IR imaging systems detect and record all the heat being radiated in their fields of view. IR cameras use an image-scanning technique to identify heat radiated from a target and its background. IR imaging systems capture and store the heat images pictorially for immediate or future evaluation. Using IR imaging systems, the operator can pinpoint the precise location of the hottest spot on the target being observed.
- The recommended maintenance is based on the measured operating temperature of both the target and its respective connectors or conductors, the temperature differentials between the target and its respective, adjacent components, or thermal image showing component hot, as well as the operational risk associated with each.



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## Determining Maintenance Priorities

Transmission Facilities	Temperature Differential ( $\Delta T$ )	Priority/Remarks
<b>Overhead &amp; Underground Direct heat (See Notes)</b>	$\geq 100^{\circ}\text{F}$	<b>Priority A:</b> Notify supervisor and repair, replace, or make component safe immediately.
	$25^{\circ}\text{F}$ to $99^{\circ}\text{F}$	<b>Priority E:</b> Repair or replace component within 3 months.
	$\leq 24^{\circ}\text{F}$	<b>Priority E<sup>1</sup>:</b> Repair or replace component within 3 months.
<b>Underground Indirect heat <sup>2, 3</sup> (See Notes)</b>	$20^{\circ}\text{F}$ and over	Notify supervisor. Contact Underground Engineering to determine mitigation.

### Notes:

- <sup>1</sup> All IR findings with a temperature delta of less than  $24^{\circ}\text{F}$  may be prioritized as Priority E at the discretion of the inspector/CIRT reviewer, when additional evidence supports the rating (e.g., limited load, additional wind speed, photos of additional mechanical damage).
- <sup>2</sup> Underground – Upon completion of repair or replacement, perform another IR inspection to verify that the abnormal condition was corrected and component is operating under normal condition.
- <sup>3</sup> Temperature taken at underground cable terminals is illustrated in Figure 1 below: Location 1 is an indirect reading; Location 2 is a direct reading.

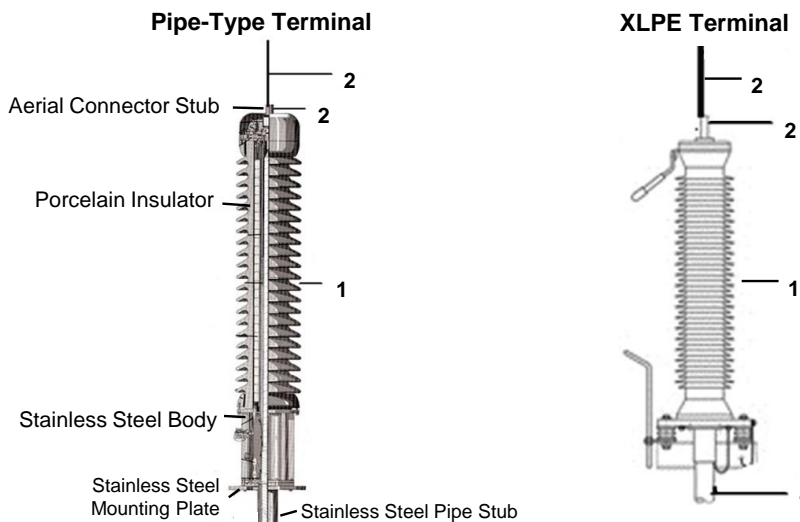


Figure 1. Pipe-Type and XLPE Terminals



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## Infrared (IR) Condition Levels and Impact (continued)

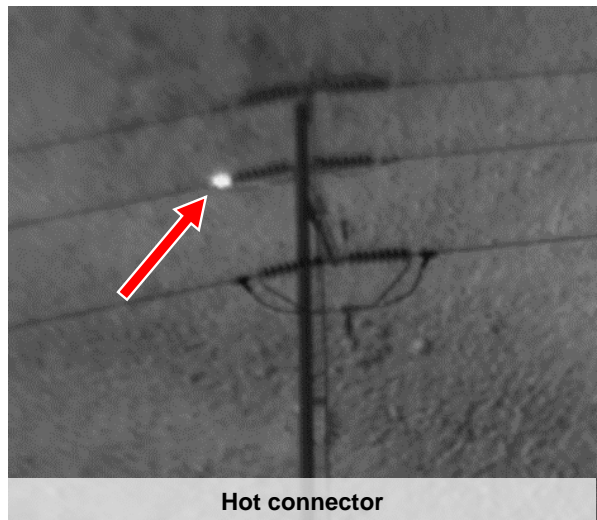
### Condition 5

**Excessively high operating temperatures** (Temperature Differential  $>100^{\circ}\text{F}$ ), or obvious physical damage observed.

- Very hot ( $> 100$ -degree differential)

#### Action:

1. Priority Code A.
2. Take pictures of damage.



**FDA: Emergency | Storm Related | Repair**

Problem area temperature	302.5°F
Adjacent energized component temperature	101.7°F
Ambient/outside temperature	80.4°F
Wind	22 mph
<b>Total temperature rise</b>	<b>201°F</b>



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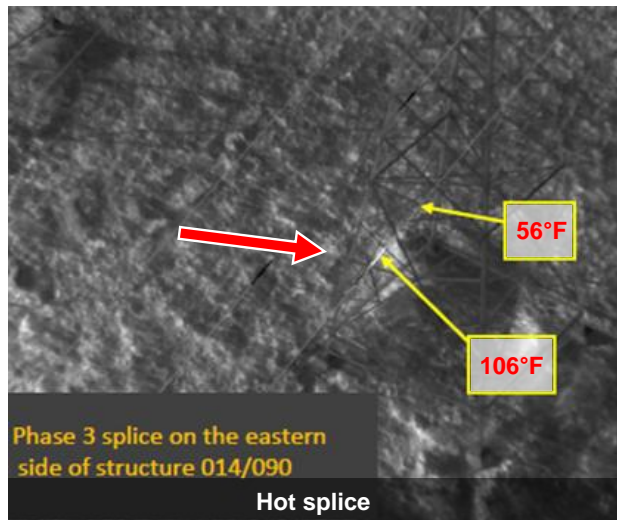
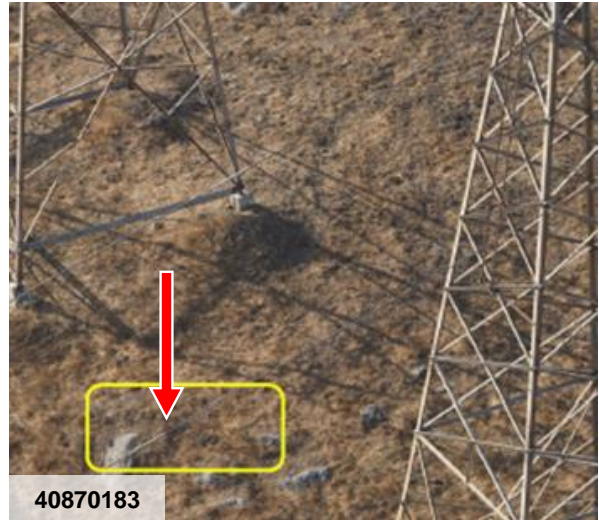
### Condition 4

**High operating temperatures**  
(Temperature Differential = 25–99°F).

- Hot (< 100-degree differential)

**Action:**

1. Priority Code E.
2. Take pictures of damage.
3. Choose 3 months due date.



**FDA: Splice-Steel | No good | Replace**

Problem area temperature	106°F
Adjacent energized component temperature	56°F
Ambient/outside temperature	59°F
Wind	0.5 mph
<b>Total temperature rise</b>	<b>50°F</b>



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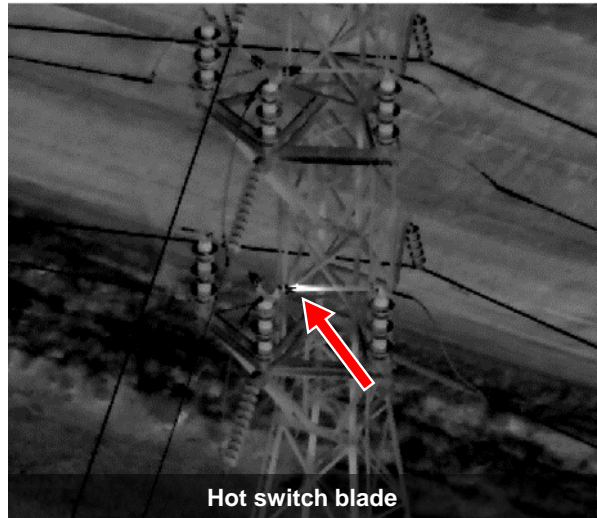
### Condition 4 (continued)

**High operating temperatures**  
(Temperature Differential = 25–99°F).

- Hot (< 100-degree differential)

**Action:**

1. Priority Code E.
2. Take pictures of damage.
3. Choose 3 months due date.



**FDA: Switch-Steel | Out of Adjustment | Repair**

Problem area temperature	129.2°F
Adjacent energized component temperature	88.4°F
Ambient/outside temperature	81°F
Wind	0.16 mph
<b>Total temperature rise</b>	<b>41°F</b>





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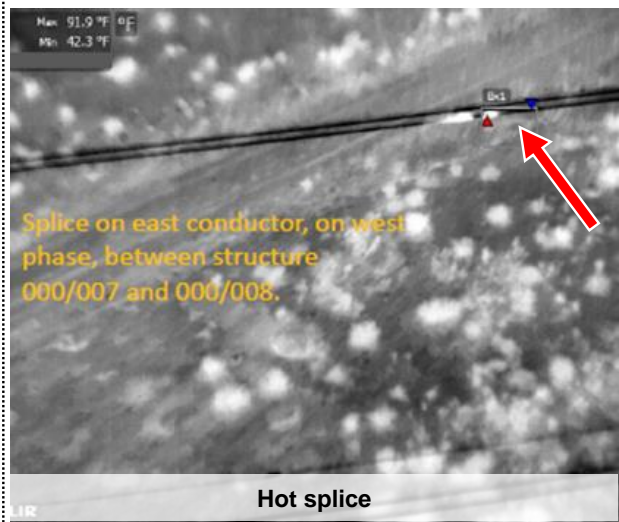
### Condition 4 (continued)

**High operating temperatures**  
(Temperature Differential = 25–99°F).

- Hot (< 100-degree differential)

**Action:**

1. Priority Code E.
2. Take pictures of damage.
3. Choose 3 months due date.



**FDA: Splice-Steel | No good | Replace**

Problem area temperature	91.7°F
Adjacent energized component temperature	42.7°F
Ambient/outside temperature	40°F
Wind	6 mph
<b>Total temperature rise</b>	<b>49°F</b>



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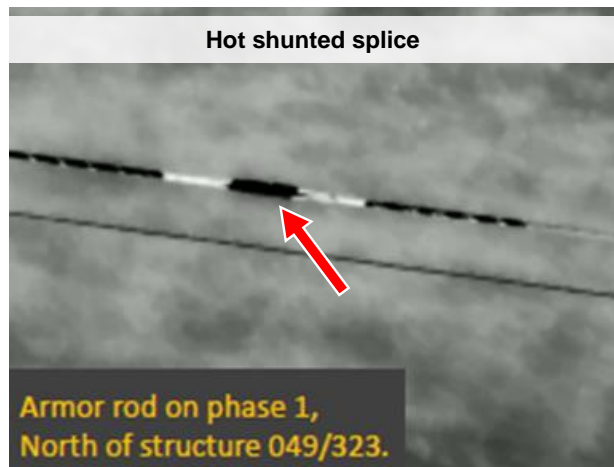
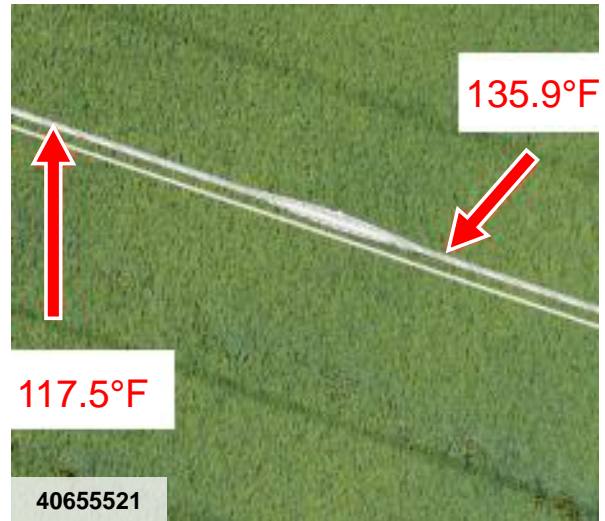
### Condition 3

**High operating temperatures**  
(Temperature Differential = 0–99°F with mitigating factors, e.g., shunted splice).

- Hot (< 100-degree differential)

**Action:**

1. Priority Code E
2. Take pictures of damage



FDA: Splice-Steel | No good | Replace

Problem area temperature	135.9°F
Adjacent energized component temperature	117.5°F
Ambient/outside temperature	95°F
Wind	0.8 mph
<b>Total temperature rise</b>	<b>18°F</b>