Compression Accessory Concerns

Ray McCoy
ACA Conductor Accessories

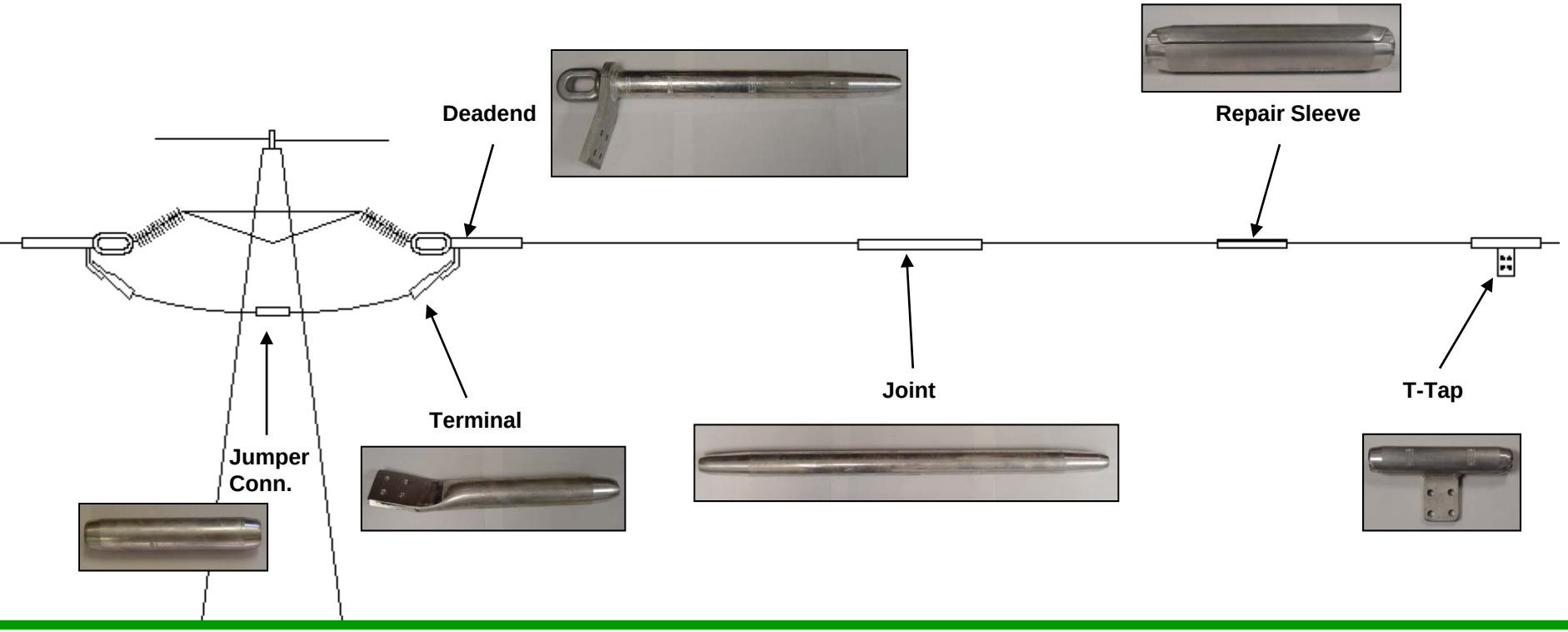
July 28, 2009
Construction WG Meeting
Telus Convention Center
Calgary, Alberta, Canada

IEEE

Agenda

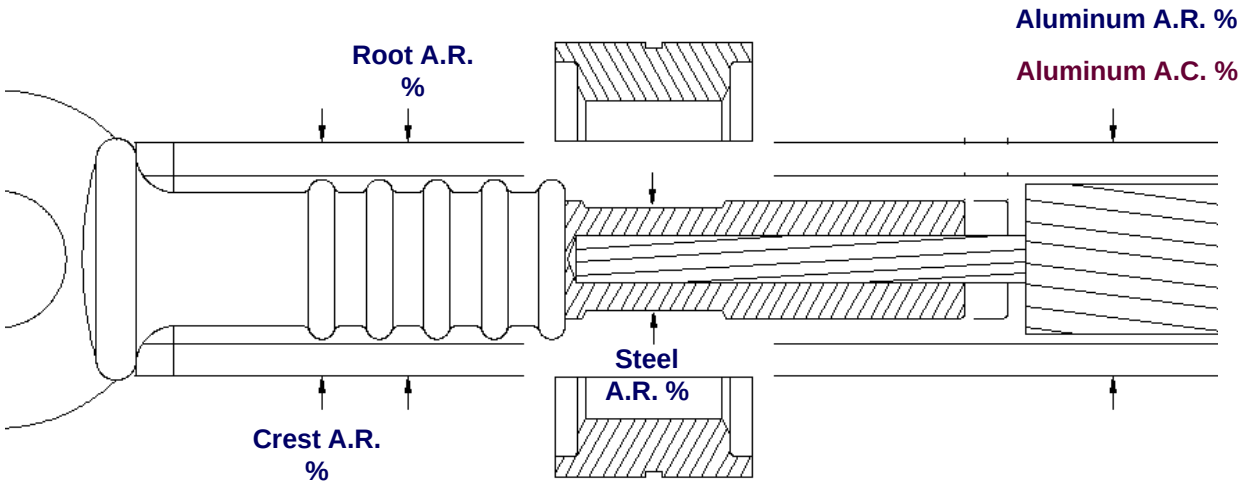
- **Installation Concerns**
  - **Reverse Pressing**
  - **Bananas & Birdcages**
  - **Filler Compound**

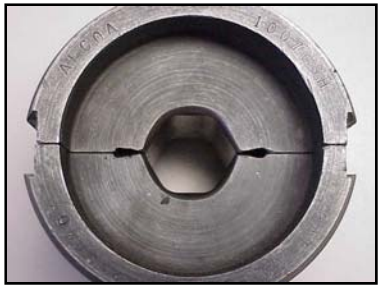
Compression Accessories



Compression Information

Based on over 80 years of lab testing, design formulas have been developed for compression accessories.





Die

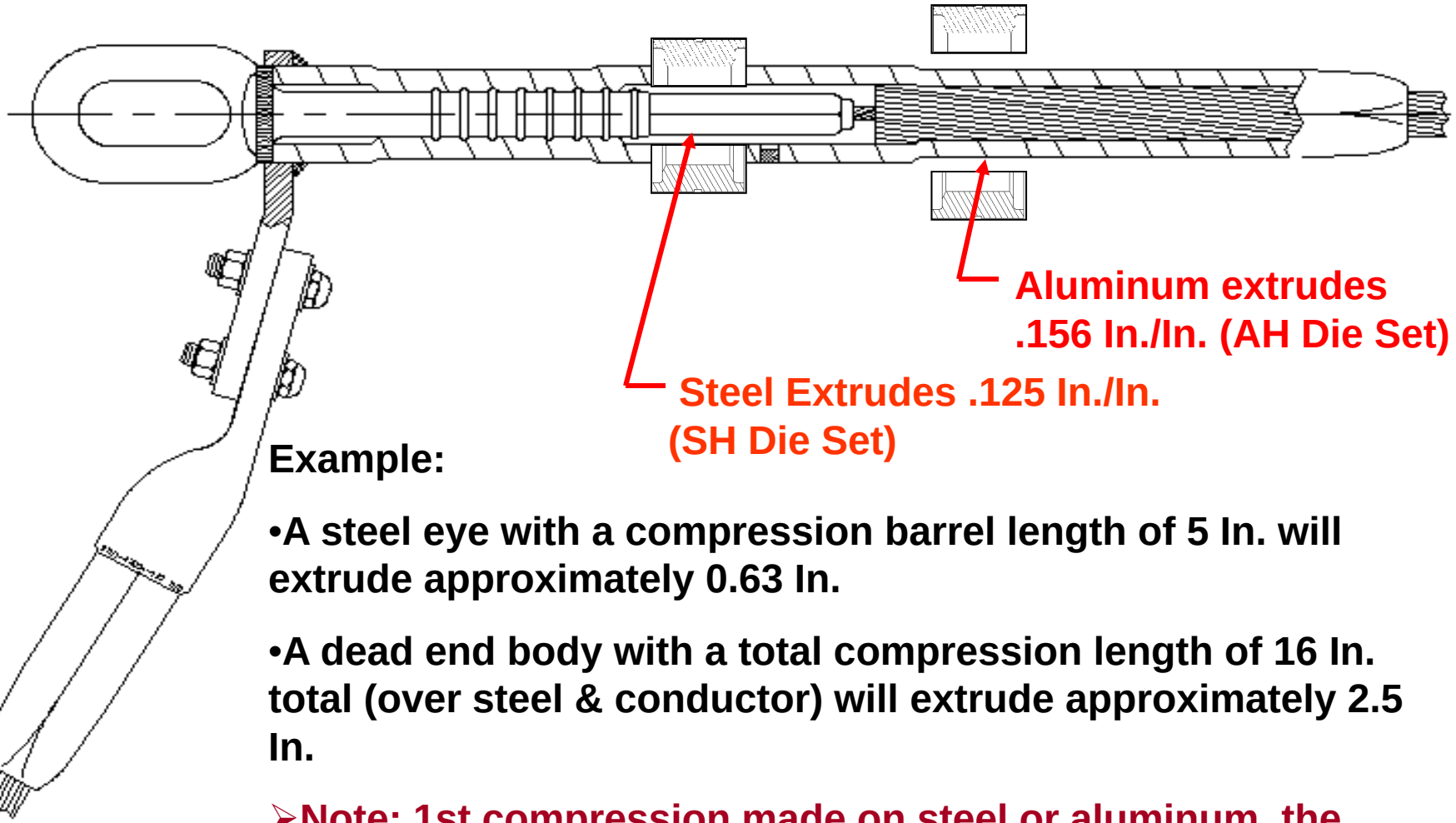
Tube + Conductor

- Area of Reduction: $\left(1 - \frac{\text{Die Area} - \text{Total Conductor or Corrugation Area}}{\text{Tube Area}}\right) 100$
- Area of Compression: $\left(1 - \frac{\text{Die Area}}{\text{Tube Area} + \text{Conductor Area}}\right) 100$

Too High % - Reduces area cross section and reduces strength.
Produces excess flash.
Prevents full die closure.

Too Low % - Insufficient holding strength and poor electrical interface.

Compression Extrusion Rates



Example:

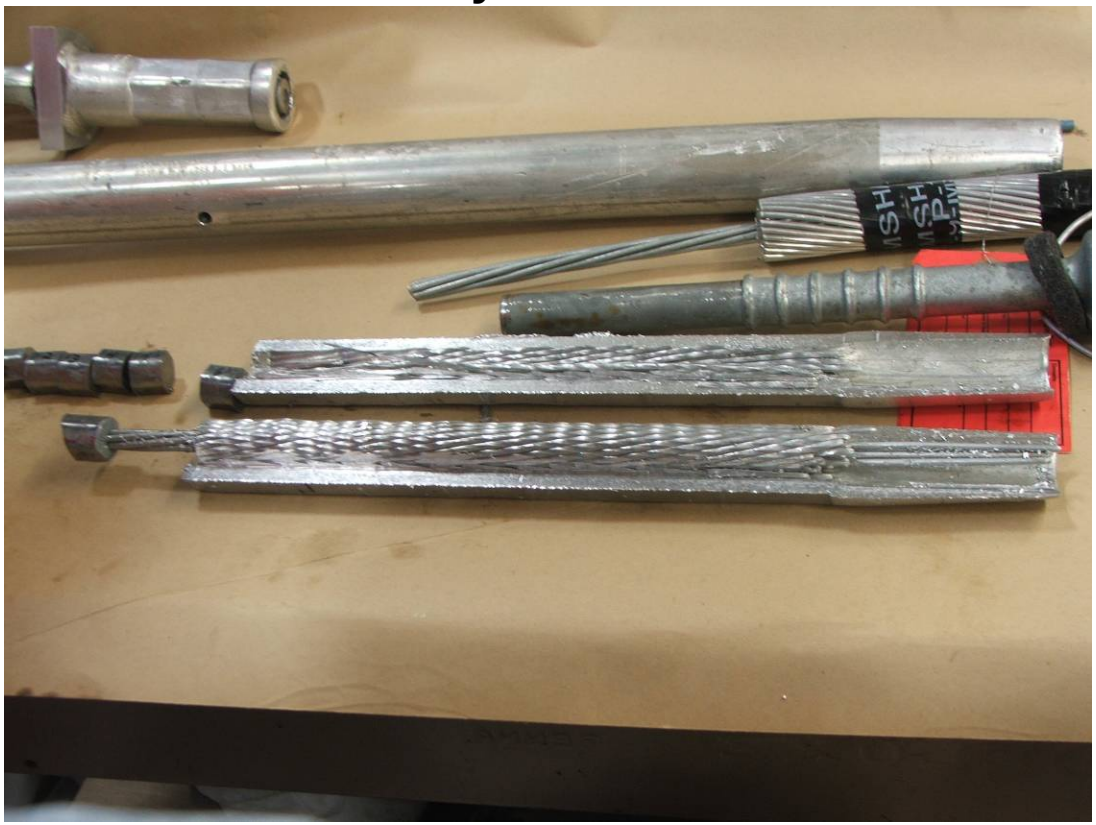
- **A steel eye with a compression barrel length of 5 In. will extrude approximately 0.63 In.**
- **A dead end body with a total compression length of 16 In. total (over steel & conductor) will extrude approximately 2.5 In.**

➢**Note: 1st compression made on steel or aluminum, the extrusion is in both directions. All others are in span direction.**

Reverse Pressing

DEAD ENDS

- **No manufacturer recommend reverse pressing of dead ends, nor warrant the dead end if pressed in this manner.**
- **There have been cases of conductor steel core or aluminum strands breaking during compression due to internal hydraulic forces.**

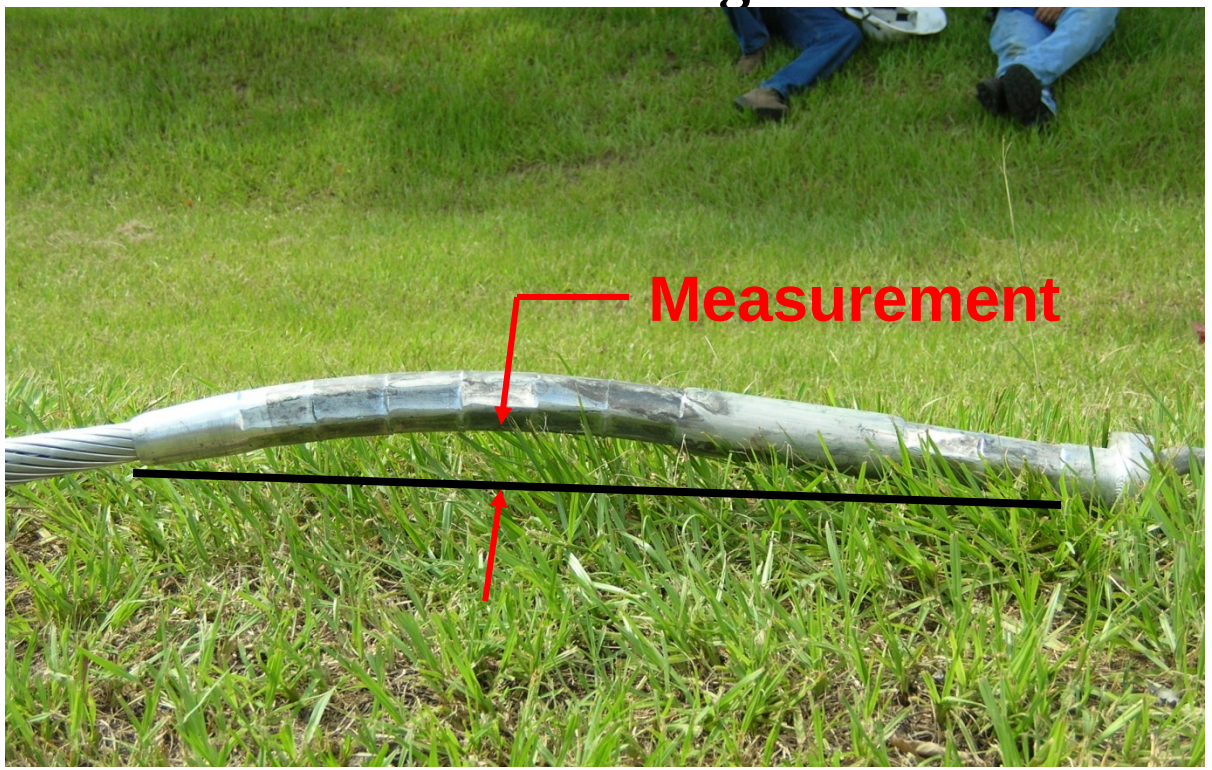


Bowed Accessories

A bow in the compressed section of an accessory does not affect the electrical or mechanical performance of the device provided the bow is not excessive.

Bowed Accessories

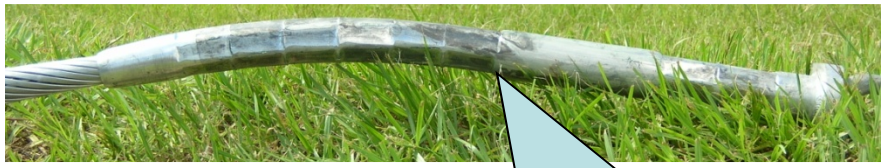
- The bow would be considered excessive if it more than conductor diameter in a splice or ½ conductor diameter in a dead end.
- This is checked by placing a flat edge from end to end of fitting and taking a measurement from the flat edge to the center of the fitting.



REPLACE DEAD END

Bowed Accessories

- **Under no circumstances should straightening be attempted by applying forces to the aluminum accessory.**
- **Subjecting the uncompressed portion of the accessory to bending forces could possibly cause stress cracks.**



Stress cracks can develop in area where compressed tube meets uncompressed area

The bowed accessory is an embarrassment to the Lineman.

IEEE

Bowed Accessories

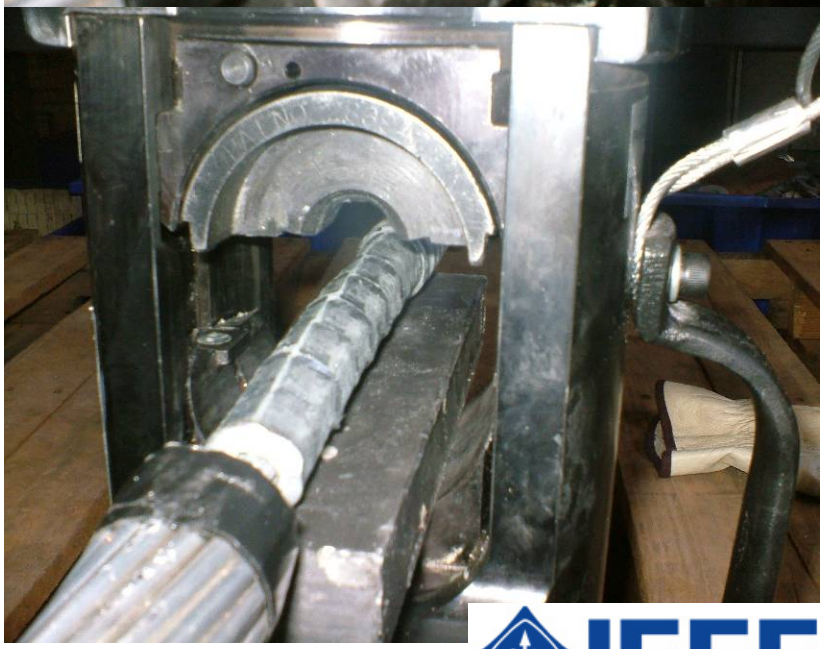
STEEL COMPONENTS

Occasionally the steel barrel of an eye or a steel sleeve bows during compression to the extent that the aluminum portion can not be slide back over it. There is a safe way to straighten these components.

- Remove the lower die half from the press. Center a steel bar (1” thick x 2” wide x 6” long in the die holder.

Bowed Accessories

- Leave the other die half in the top holder.
- Place the bowed barrel or sleeve on the steel bar with the bow pointing up and centered in the top die half.
- Actuate the press until the top die makes contact and straightens the bow.
  - This will not require complete die closure, nor should it.



The steel is now straight & the aluminum

IEEE

Conditions That Cause or Intensify Connector Bowing:

- Connector Eccentricity (consistent wall thickness of the connector)
  - Usually not a problem with transmission accessories since most are made of seamless drawn tubing with very tight tolerances.
- Die Bite Length
  - The more compressions made on a connector may cause excessive bowing.
  - The larger press used allows longer die bites.
- Die Surface Condition
  - Clear of oxidation or rust.
  - Surface should be clean, smooth and lightly oiled.

Conditions That Cause or Intensify Connector Bowing:

- **Compression Die Offset**
  - **The die retainers of the press head are worn or broken and do not keep the die halves longitudinally in line.**
- **Compression die orientation**
  - **Caused by loose die holders in the press head.**
- **Conductor Straightness**
  - **The connector will follow the direction of the conductor.**
    - **Straighten the conductor and support it outward of the area being compressed.**
    - **Keep the connector perpendicular to the dies.**

The following 3 slides will illustrate a way to reduce most bowing and birdcaging on ACSS & ACSS/TW

1. Be sure your grips are at least 10 feet from the accessory installation point. Wire brush the conductor. Trim the aluminum strands back 1 inch more than insertion depth.

2. Press the steel eye onto core, being sure to overlap each bite by at least ¼ inch. Press all the way to end.

3. Attach steel eye to insulator string or yoke plate.

4. Release tension from the grip onto the steel eye. The grip does not have to removed completely, thus maintaining a safety catch on the conductor.

5. Note that tension has been applied between the grip and yoke plate.

6. Slide the aluminum body over the steel eye until snug against the felt washer. Fill with proper amount of compound and press per manufacturer's instructions. If birdcaging starts to appear at mouth of fitting, "milk" it toward span during compression.

BIRDCAGE

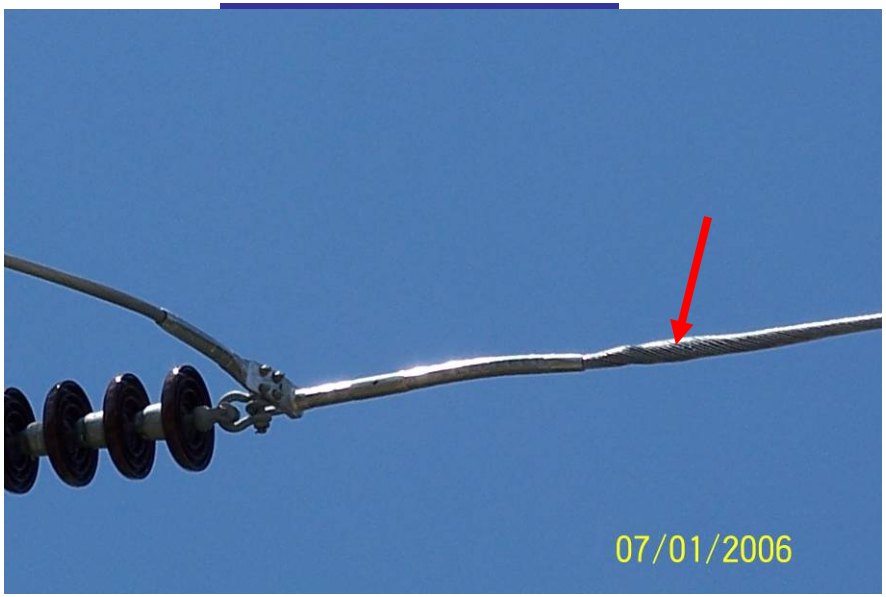
This birdcage was caused by a block that was not rolling freely.

Pulling set up and equipment can cause for a BAD day in the field!

Remember to follow **IEEE 524**

IEEE

BIRDCAGE



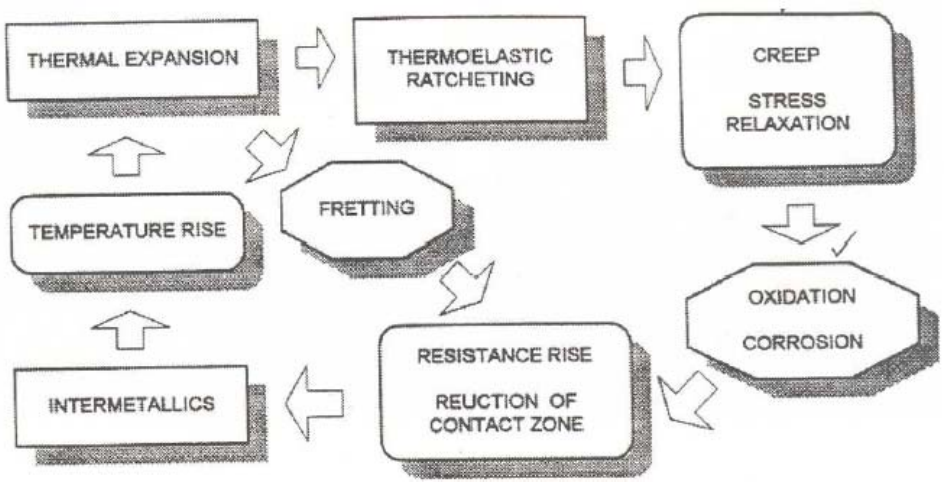
Most common type of birdcaging, caused during compression.

During compression, aluminum (both accessory and conductor) extrude at an approximate rate of 1/8 inch per inch. It has to go somewhere!

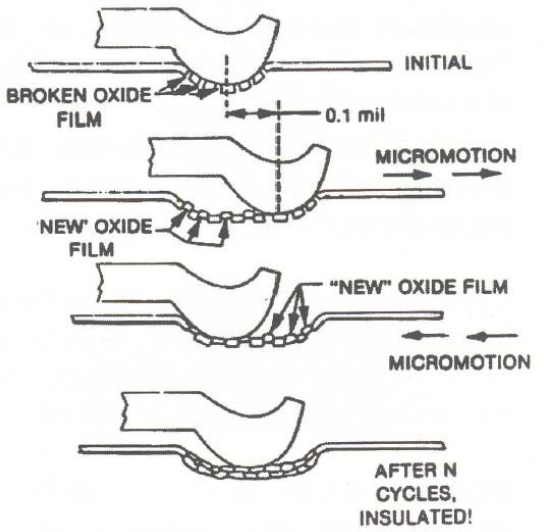
- Be sure the grip is at least 10 feet away
- Don’t attach ground clamp close to working area
- Work out birdcage as you compress

IEEE

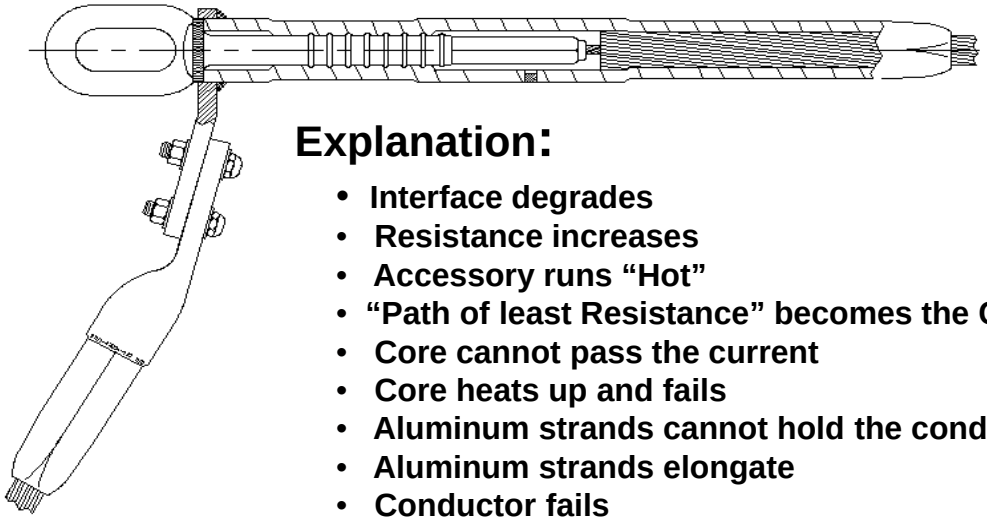
Degradation Mechanism – “Thermal Run-away”



Fretting



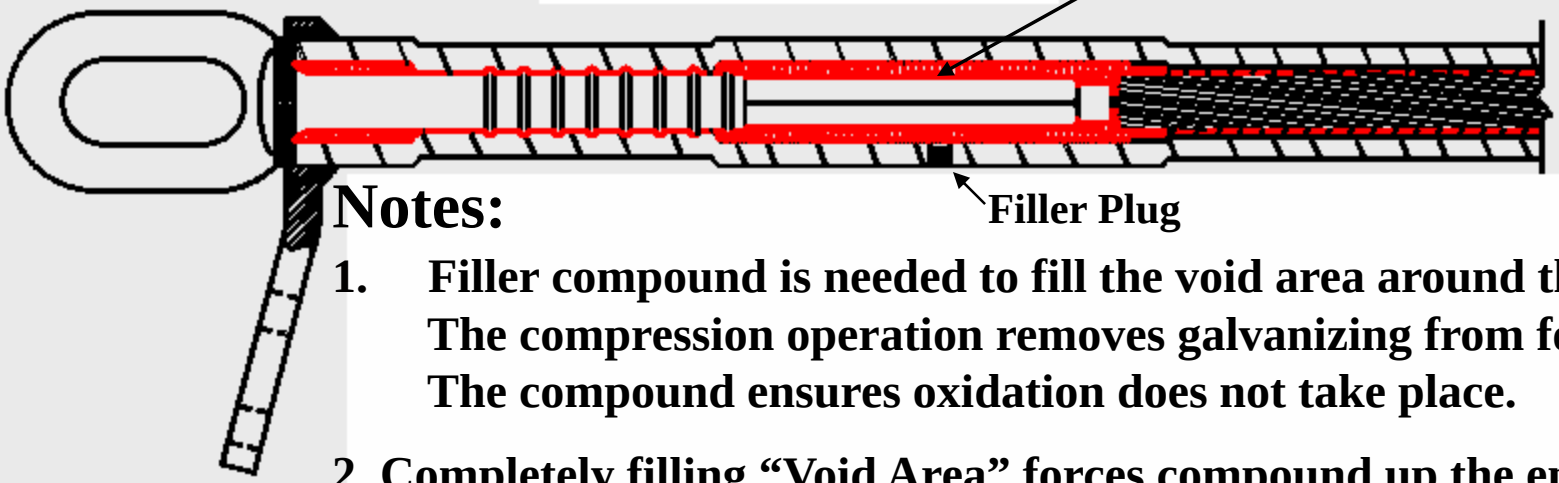
Oxidation of fretting debris leads to increased electrical contact resistance.



Explanation:

- **Interface degrades**
- **Resistance increases**
- **Accessory runs “Hot”**
- **“Path of least Resistance” becomes the Conductor Core**
- **Core cannot pass the current**
- **Core heats up and fails**
- **Aluminum strands cannot hold the conductor without the core.**
- **Aluminum strands elongate**
- **Conductor fails**

Compounds Facts:



Notes:

1. **Filler compound is needed to fill the void area around the steel barrel. The compression operation removes galvanizing from forging barrel. The compound ensures oxidation does not take place.**

2. **Completely filling "Void Area" forces compound up the end of the conductor. Filling in voids between conductor stands.**

3. **Filler compounds have hard metallic particles which improves mechanical holding strength.**

4. **Compression forces compound between strands (to the core) and "further up" the end of the conductor, sealing out air and moisture incursion.**

5. **The hard metallic particles within the compound removes oxides on surfaces of strands and barrel during the compression operation. This cleans the interfaces improving the electrical connection.**

IEEE

Examples of
Compound Related Failures

Notes:

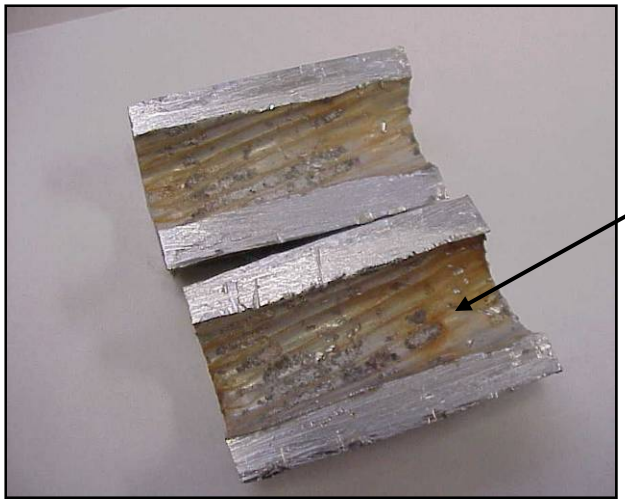
1. **The main reason for connector failure is improper installation.**
   - *** Failure to brush the conductor prior to installation.**
   - *** Failure to use adequate compound.**
   - *** Running connector “Hot” and annealing components.**

2. **Filler Compound will become dried and brittle over time when combined with water.**

Conclusion: Failure due to water intrusion and dried up filler compound.

Conclusion: Failure due to a high resistance connection as a result of corrosion due to little or no filler compound.

“Compression removes galvanizing”. Steel barrel must be protected with compound.

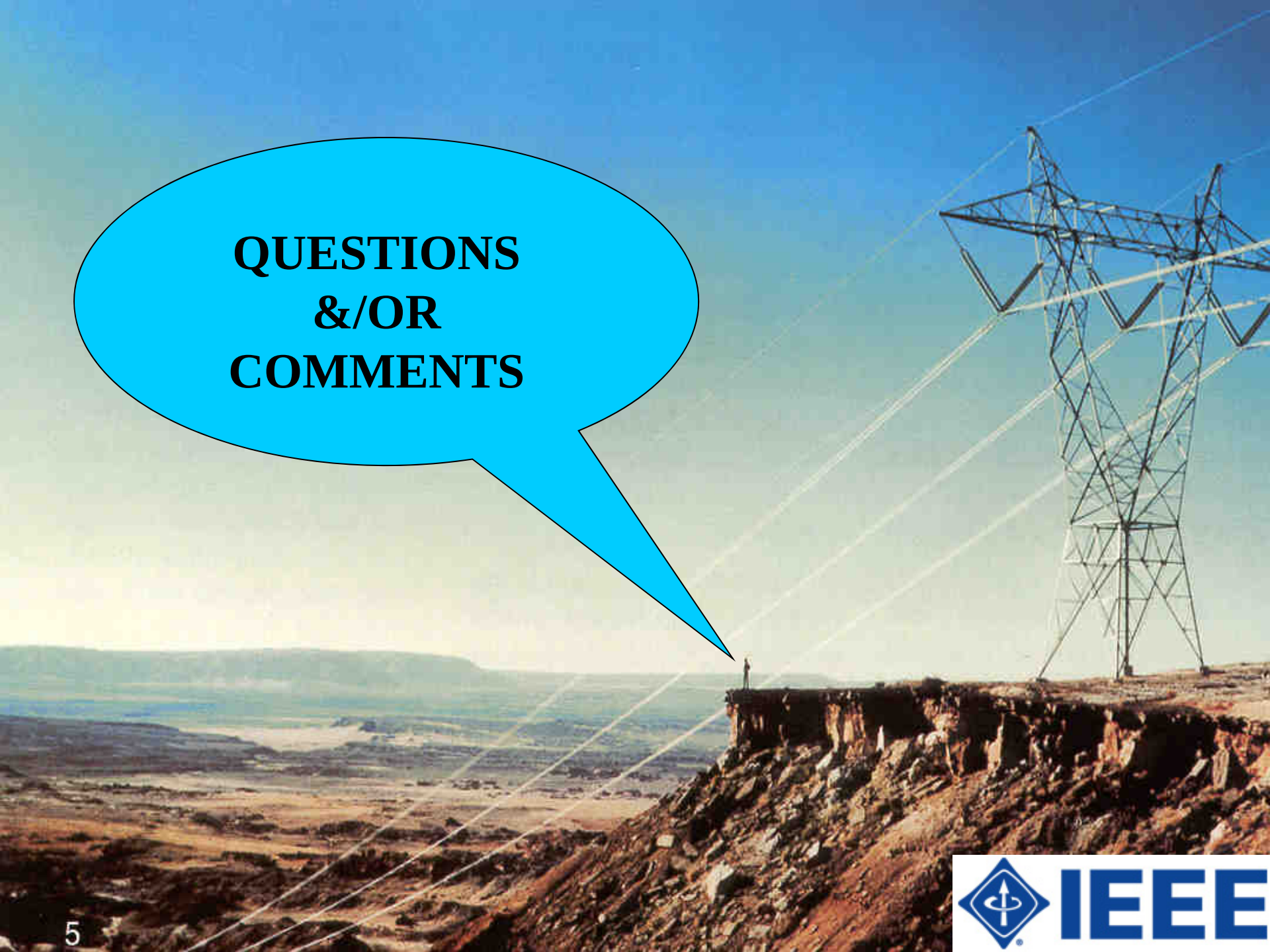


Arcing between strands and splice body

Conclusion: Failure due to insufficient filler compound and failure to wire brush aluminum stands

- Very little filler compound.
- Compound dried up and very brittle.

"Necked down" condition of aluminum and steel strands


QUESTIONS
&/OR
COMMENTS