Rejuvenation Instructions

#230 – Visual Inspection & Measurements

This NRI covers the following:

- What to check for during the visual inspection.
- What to measure and record into Knomentous.

WARNING: It is dangerous working around energized high-voltage systems, pressurized systems, and chemicals. Always work in accordance to the Novinium Field Operations Safety Handbook (FOSH) or other local governing safety standards.

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Cable Information

a. Check the cable jacket for writing indicating cable size, insulation type, production year, or any other information.

b. Record all writing that is on the jacket into Knomentous.

Figure 1: Look for writing on the cable jacket/outer layer.

Inspecting the Cable

1. Remove the cable termination to inspect the cable.

2. Visually examine the cable end for defects.

- Any defects found must be corrected using methods conforming to IEEE® P1816™ cable preparation standards prior to injection.

3. Record all identified defects and corrective actions into Knomentous.

If the defects cannot be economically removed, the cable must be identified for replacement.

Defects include:

- Semi-con shield that has separated from the insulation.

Figure 2: Separated semi-con.

- Discharge marks or mechanical damage to the semi-con.

Figure 3: Damage to the semi-con.

- Cables bent more severely than the Novinium approved minimum bend radius of 15 times the cable diameter.

a. Measure the outside diameter of the insulation and multiply by 15, or use **NRI 240 The Bend Radius Template**.

b. **Under no circumstances should a section of excessively bent cable be straightened. The bent portion must be cut out and discarded.**

- Evidence of electrical discharges, surface tracking, corona, or other carbonization of the insulation.

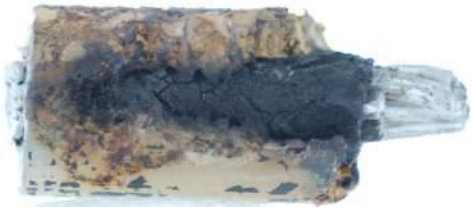

Figure 4: Electrical damage to the insulation.

- Hourglass, oval-shaped, or otherwise non-uniform thickness of the insulation.

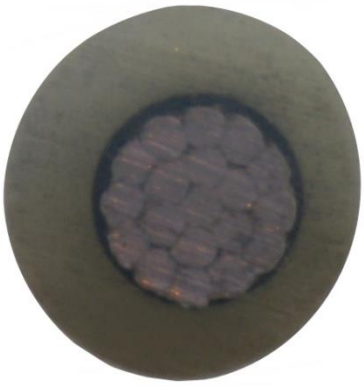

Figure 5: Non-uniform insulation thickness.

- Nicks, gouges, scratches, or cuts in the insulation.

Figure 6: Cuts.

- Excessive strand corrosion, which may cause deformation of the cable, poor electrical connection, and/or flow restriction.

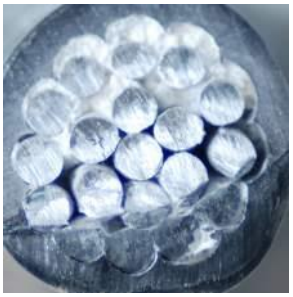

Figure 7: Corrosion.

- Nicked or cut conductor strands.

Figure 8: Damaged conductor strands.

Measuring the Cable

It is important to measure the dimensions of each cable to ensure that the components and accessories on hand will fit correctly. This ensures maximum reliability and will help reduce cable failure.

Assuming that every cable is the same may work most of the time, however, one failure caused by improper sizing can negate all productivity for the day and more.

Measuring all cables will help create accurate data for future analysis and lead to the correct amount of fluid being injected compared to the expected amount.

Preferably, use a digital caliper to take all measurements.

1. Measure the insulation.

a. Measure and record the outside diameter of the cable's insulation.

Figure 9: Insulation outer diameter.

b. Find and record the insulation thickness by using one of the two methods:
   - Measure a section of insulation without the shielding.
   - Calculate the thickness from the insulation diameter and conductor bundle diameter.
     - Subtract the conductor bundle diameter from the insulation diameter.

- Subtract 0.05” from the number. The conductor shield is typically 0.025” thick.
- Divide this value by 2 to get the insulation thickness in inches.

- Insulation thickness is usually written in mils. To convert from inches to mils, multiply by 1000.

c. Determine the voltage rating of the cable.
   - For North American cables, the voltage rating is usually accompanied by a percent value. This percent value relates to the insulation thickness.
   - Refer to Table 1 for typical insulation thickness values for percentages.

	Insulation thickness	
Voltage	**100%**	**133%**
15kV	175 or 180 mil	220 or 230 mil
25kV	260 mil	320 mil
35kV	345 mil	420 mil

Table 1: Insulation thickness.

d. Record the insulation type of the cable.
   - Polyethylene (PE) insulations can range from yellowish to blue-grey. It is also translucent.
   - EPR insulation varies in color, including pink, orange, and black. It is also opaque.

Figure 10: Insulation types.

e. Record the type of cable jacket.
   - Record its basic design (encapsulating or non-encapsulating) and the material of construction, if known.
   - If the cable is unjacketed, record it as “Unjacketed.”

Figure 11: Encapsulated PE jacket.

Figure 12: Non-encapsulated PE jacket.

Figure 13: Non-encapsulated PVC jacket.

2. Measure the conductor.

a. Record the type of conductor metal.

b. Record if the type of conductor shielding is “Extruded” or “Taped”.

- Taped conductor shields are not common.
- If the shield is taped, fluid usage will be significantly higher than indicated by **NRI 302 The Cable Table**.

Figure 14: Tape shield leave gaps between strands.

Figure 15: Extruded shields form around strands.

c. Measure and record the outside diameter of the conductor strand bundle.

Figure 16: Conductor bundle outer diameter.

d. Measure and record the outside diameter of a single conductor strand.

- If the strand is not round, take the average of the greatest and smallest diameter measured.

Figure 17: Single conductor strand outer diameter.

e. Determine the conductor compression of the cable.

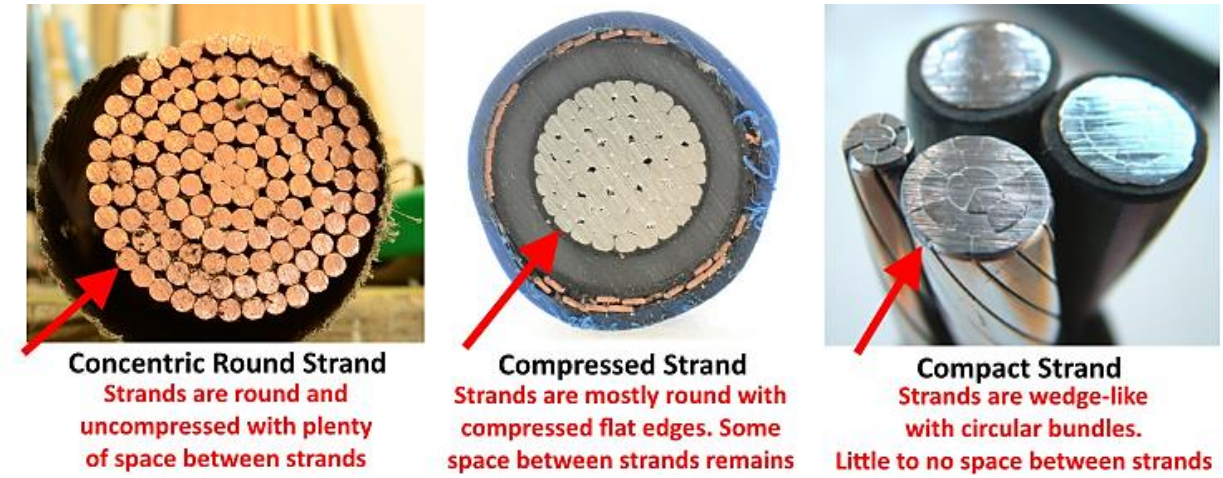

Figure 18: Examples and descriptions of the different strand compressions.

f. Find the cable in **NRI 302 The Cable Table** that has the closest match to the conductor bundle OD, strand OD, and insulation ODs measured.

g. If you are having difficulty measuring, using the cable table, or finding a cable in Knomentous, call Engineering for help.

h. Record all cable dimensions into Knomentous. This will allow you to select the cable in the "Cable" drop down box in Knomentous.