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Rejuvenation Instructions Power Cables Visual Inspection & Measurement

Version 20111223

Visual Inspection & Measurement

All cables must be de-energized, tested dead, and grounded before any of these Inspection procedures may be executed. All switching operations must cease. 100% of the personnel on the site must verbally concur that it is safe to handle the cable. The ground must be connected to the termination to be handled, or in the case of a spiking operation at a cable midpoint (e.g. a splice or fault), the ground must be immediately adjacent (i.e. the connection can be confirmed by an unobstructed view of the cable between the spike and the work area) to the portion of the cable to be worked. The individual who executes these Inspection instructions must be present when the ground is put in place and must witness and concur with the temporary removal of any ground connections. The ground connections should be left in place until their removal is required and put back in place as soon as possible. All test instruments and equipment and accessories must be of the appropriate type and rating for the application for which they will be used; proper functionality must be verified before and after an absence of voltage test, per the individual equipment instructions.

Caution: Working around energized high-voltage systems may cause serious injury or death. The procedures in these instructions should be performed by personnel familiar with good safety practice in handling high-voltage electrical equipment. De-energize and ground all electrical systems before proceeding.

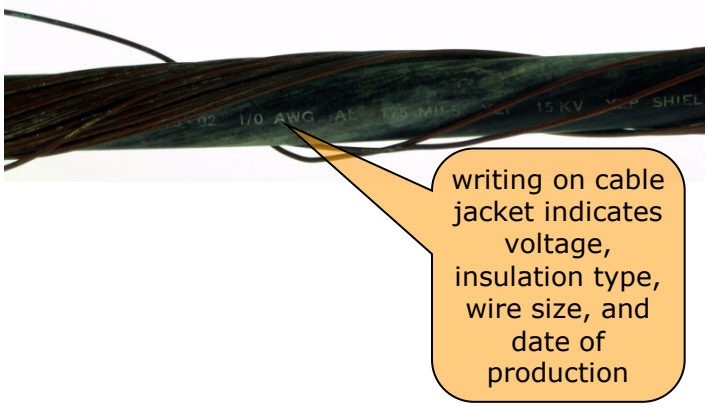
1. Check the cable jacket for writing which may indicate cable size, insulation type, production year, or any other pertinent information. Record all writing on the cable jacket in NITS.

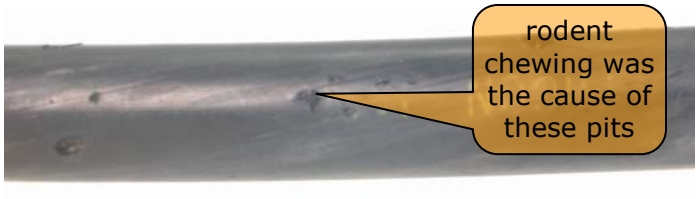
2. Remove the cable termination to allow inspection of the cable.

3. Visually examine the cable end for defects. Any defects found must be corrected using methods which conform to IEEE® P1816™ cable preparation standards prior to injection. Record all identified defects and corrective actions in NITS. If the defects cannot be economically removed the cable must be identified for replacement. Defects include:

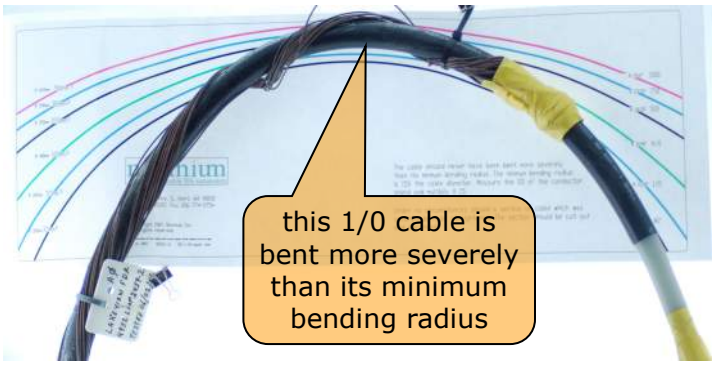
   a. Insulation shield semi-con which is separated from the insulation.

   b. Discharge marks, or mechanical damage to the insulation shield.



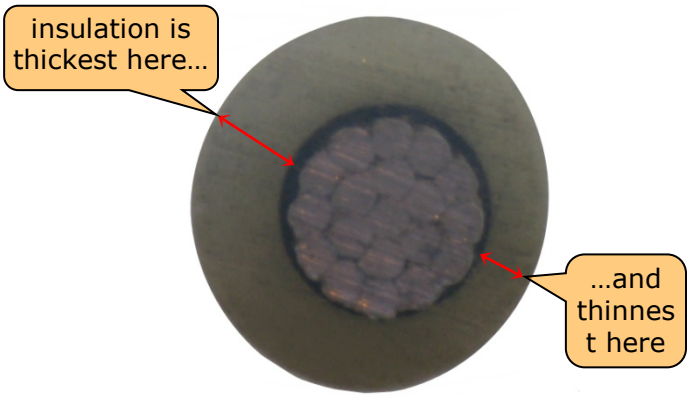


c. Cables bent more severely than the Novinium approved minimum radius of 15X the cable diameter. Measure the OD of the insulation shield and multiply by 15 or use the bending radius template, NRI 11. **Under no circumstances should a section of cable which was excessively bent be straightened. The excessively bent portion of cable must be cut out and discarded.**

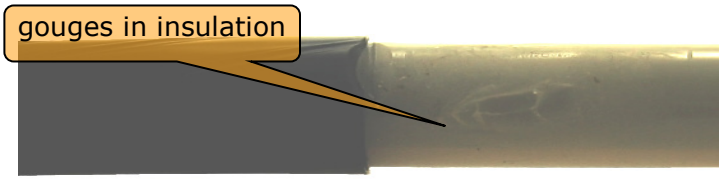


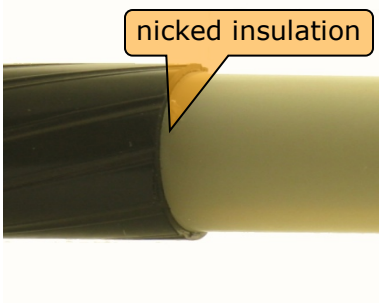
d. Evidence of Electrical discharges, surface tracking, corona or other carbonization of insulation.

e. Hourglass, oval-shaped, or otherwise non-concentric insulation (the insulation is not equal thickness all the way around the conductor).

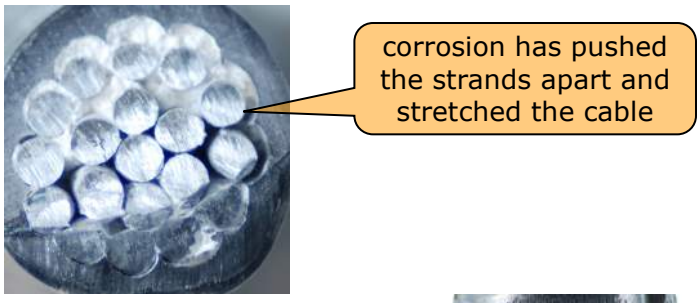


f. Nicks, gouges, scratches or cuts in the insulation.

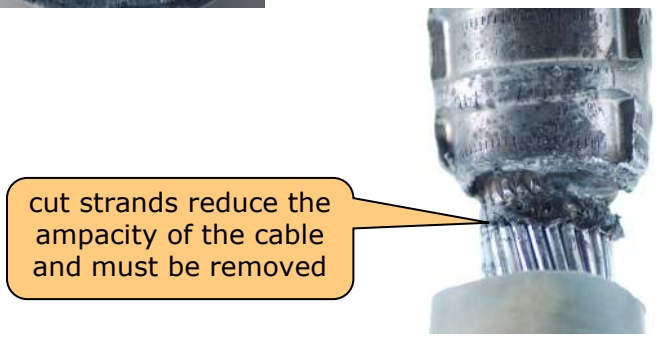




g. Excessive strand corrosion, which may cause deformation of the cable, poor electrical connection and or flow restriction.



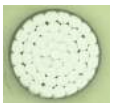
h. Nicked or cut conductor strands



4. Determine and record cable design information in the NITS "Cable Information" tab. For cables which will be injected, follow steps a-h below. If new cable is being used to correct defects by adding extra cable length, record all writing on the cable, as well as the conductor and insulation types, cable vintage, and the outside diameter of the insulation. New cable spliced on as a corrective action must be treated as a separate sub-segment.

a. If the conductor is copper check the "Copper" box in NITS. If the conductor is aluminum, leave the box unchecked.


copper


Aluminum

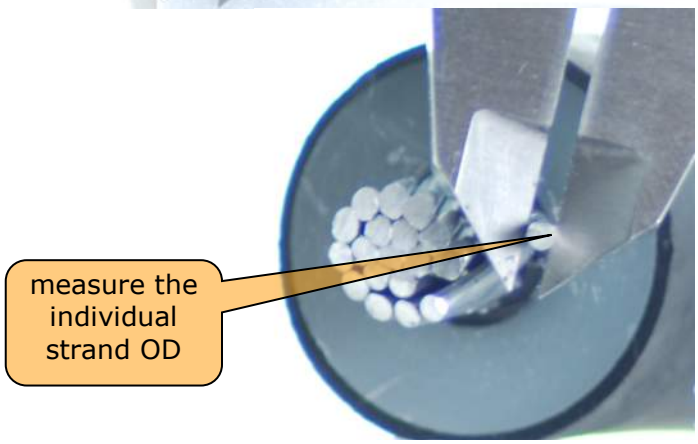
b. Indicate in NITS whether the conductor shield is extruded or taped. Taped conductor shields are not common. If a taped conductor shield is encountered the fluid usage will be significantly higher than indicated by the Cable Table (NRI 21). Contact Novinium engineering.

taped

Extruded

c. Measure the outside diameter of the conductor strand bundle (Strand Bundle OD) with calipers. Record the value in NITS.

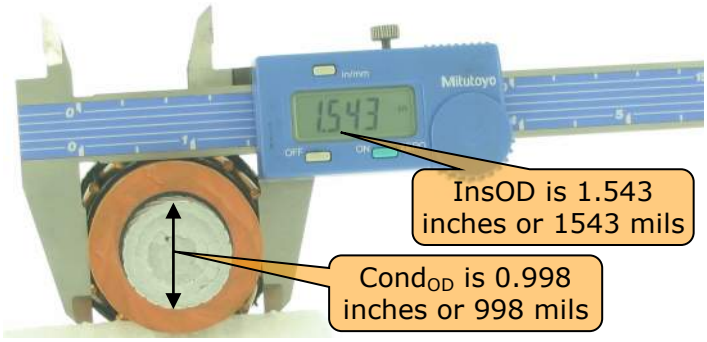
d. Measure and record the outside diameter of an individual strand conductor (Strand OD). If the strand is not round, measure the greatest diameter and the smallest diameter; then average those two values to estimate the equivalent diameter of a round conductor. Enter the Strand OD in NITS in the OD Units specified.



e. Measure and record the nominal Insulation OD and insulation thickness. Measure the outside diameter of the insulation (Ins_{OD}) and calculate the insulation thickness:

$$Ins_{thick}=[(Ins_{OD} - Cond_{OD})\div 2]-(2\bullet CS_{thick})$$

Where CS_{thick} is the conductor shield thickness, typically 25 mils.



$$Ins_{thick}=[(1543 - 998)\div 2]-(2\bullet 25) = 222 \text{ mils}$$

f. Use the calculated insulation thickness in NITS to choose the correct Cable and Design Voltage.

Example NITS Cable pull down
15kV 100% (180): 1/0, C-3 (Concentric)

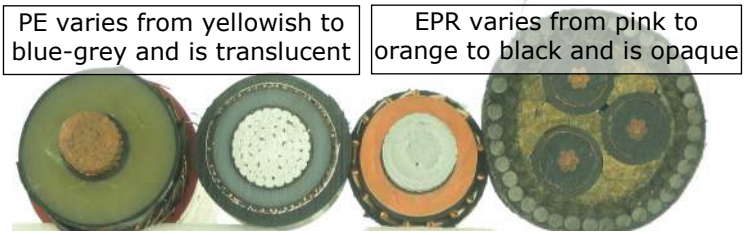
design voltage

nominal insulation thickness

g. Insulation type: If the insulation type is not available from step 1, look at the insulation to determine if it is PE (XLPE, HMWPE, or TRXLPE), EPR or butyl rubber (grey).

PE varies from yellowish to blue-grey and is translucent

EPR varies from pink to orange to black and is opaque



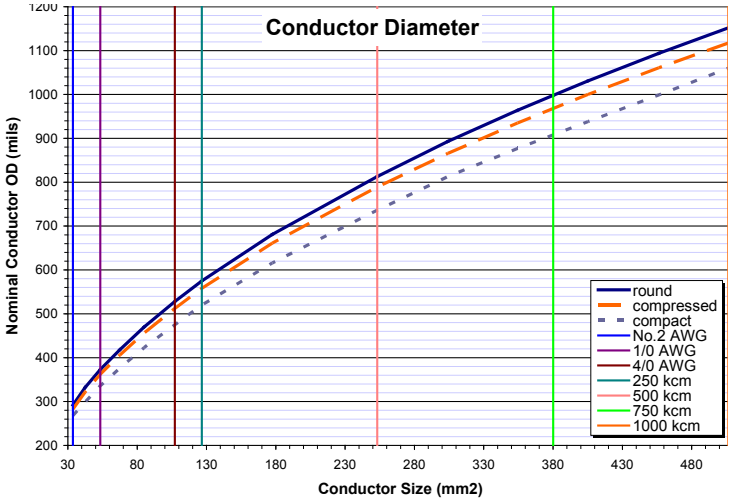
h. Jacket: If a jacket is not present, record the Jacket as "Unjacketed" in NITS. If a jacket is present, record its basic design (encapsulating or non-encapsulating) and the material of construction if known.


encapsulating PE jacket


non-encapsulating PE jacket

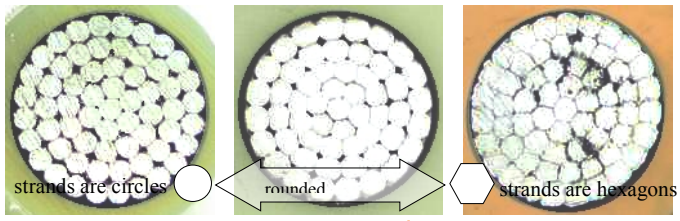

non-encapsulating PVC jacket

5. Determine the conductor sizing and compression, as well as the insulation class of the cable to be injected by selecting the appropriate entry in NRI 21: cable Table. If an entry for the cable to be injected does not exist, contact Novinium Engineering.



Concentric stranded cables will have individual strands which are round; compressed strands will be rounded hexagons; compact strands will be hexagonally shaped.

Conductor	Strands	Nominal Conductor OD (mils) Round	com-pressed	compact
No.2 AWG	7	292	283	268
No.1 AWG	19	332	322	299
1/0 AWG	19	373	362	336
4/0 AWG	19	528	512	475
250 kcm	37	575	558	520
500 kcm	37	813	789	736
750 kcm	61	998	968	908
1000 kcm	61	1152	1117	1060



Concentric Compressed Compact

Select the Cable entry in NITS that most closely matches the insulation thickness, voltage class, conductor size and strand compression for the cable to be injected.