Rejuvenation Instructions

#563 – 600A Live-Front Terminations – SPR

This NRI covers the following:

- How to prepare a cable for SPR injection without using a template.
- How to use Injection Adapters (IAs) and the Injection Tool (IT) for SPR injection.
- How to install new termination kits with an IA that requires adjusting the cutbacks in the manufacturer's instructions.

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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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Introduction

- This NRI describes how to install new 600A live-front termination kits used for the Sustained Pressure Rejuvenation (SPR) process. Using the IA requires modifying the cutback dimensions.
- All feeder-sized injections must be performed using the SPR method and IAs.
- There are typically not as many templates created for live-front terminations as there are combinations of components and accessories.

Creating a Physical Template

Templates are typically not created for Live-Front Terminations. Call Engineering to see if templates are available for the job.

In any case, it is good practice to create a physical template out of extra cable for the following reasons:

- It serves as a practice run.
- It can uncover potential problems.
- It can be used as a quality checking tool.

Use this NRI as the means for creating the template.

Selecting Feeder Swage Dies

The radial swage (SWAY-juh), delivered by the dies, compresses the connector and IA to a consistent diameter.

Each swage die has a four digit name referring to its compressed inner diameter of the die in mils (1 mil = 0.001”).

- For example, a 0742 die has a compressed inner diameter of 0.742”.

Each die size is associated with two colors.

- For example, the 0842 die is the white/gold die.
- **NRI 442** has all of the common swage dies and their color codes.

Figure 1: The White/Gold 0842 die.

- Feeder heads require spacers to hold swage dies smaller than the 1682.
- Feeder heads also require 3-hole endplates to hold in place the spacers and swage dies smaller than the 1682.
- Make sure that the end plates and spacers are used.

Figure 2: Feeder swage head with spacers and 3-hole end plate.

1. Select swage dies for connectors.

SPR installations **must** use additional swages on connectors with crimping regions extending beyond the injection adapter (IA).

Similar to crimping for iUPR, fit as many swages onto the connector as possible.

Figure 3: Additional length above the IA.

The additional swages will improve the conductor compression and reduce resistance between the connector and conductor.

a. Measure the outside diameter of the connector with a digital caliper.
   - Manufacturers have a sizing pattern to their connectors.

b. Refer to **NRI 442** for swage dies based on connectors with a given outside diameter.

2. Select swage dies for IAs.

The connector and insulation ends of the IA typically require different die sizes.

Figure 4: What the IA looks like after swaging.

a. Look at either **NRI 432, The IA Reference Table**, the IA label (if there is one), or the IA bag label (if there is one).

b. Feeder swage dies require using the larger feeder head for the swage press.

3. Lubricate swage dies.

a. Place matching swage die halves into the die head.

b. Lubricate the swage dies and all contact surfaces of the head at least once a day.

- Use either Corbin Swage Lube or Break Free CLP for lubrication.

c. Protect and keep the swage dies in a clean location throughout cable preparation.

- Examine dies frequently for debris between the teeth of the die.

Figure 5: Add lubricant to the dies.

- Swaging rocks and debris can damage the swage dies, which can lead to IA damage during the swaging process.

d. As an option, swage spare IAs and connectors onto a cable piece as a test. If the dies do not appear to swage the IAs and connector correctly, contact Engineering for assistance.

Preparing the Cable

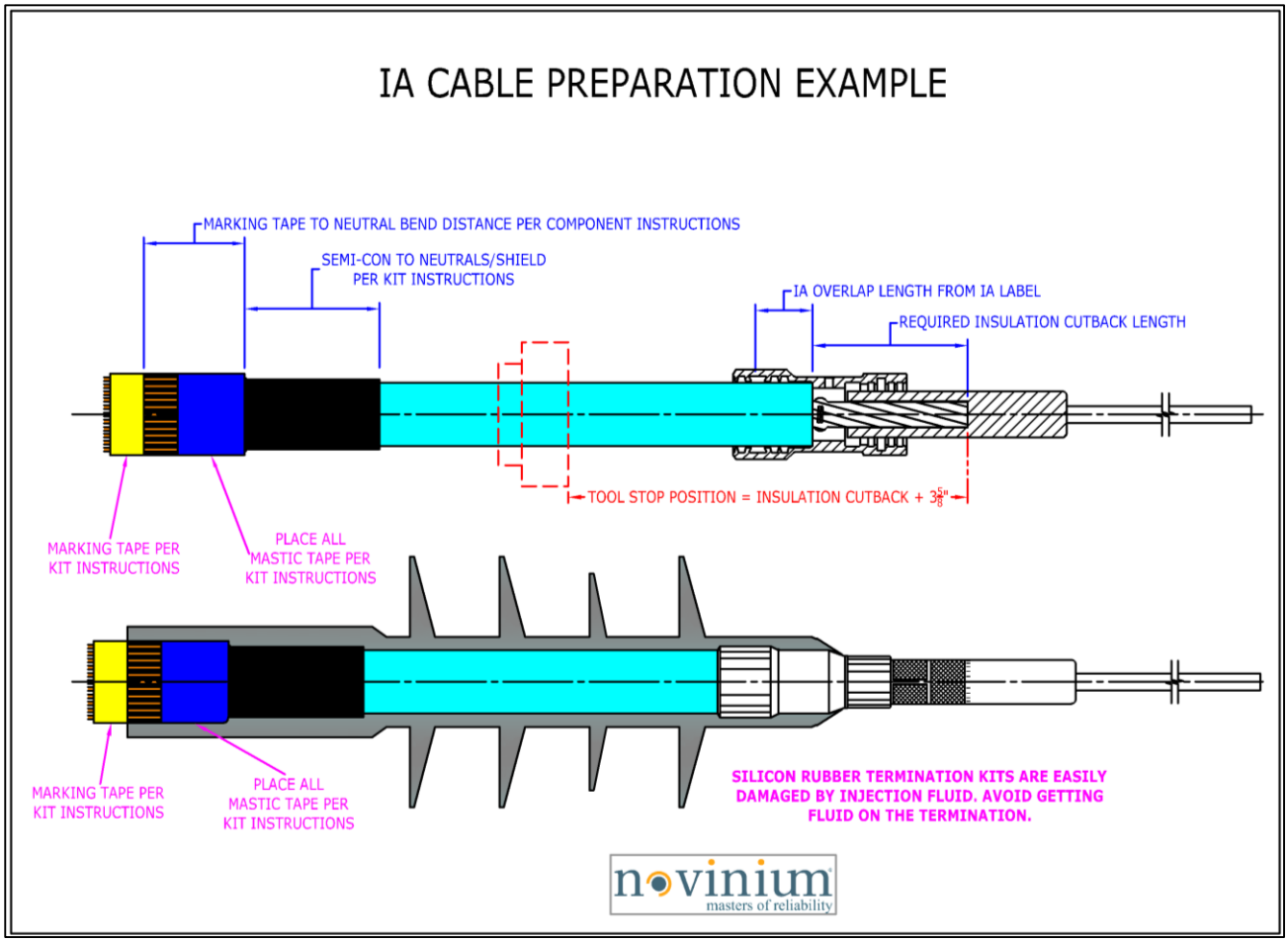

Figure 6: Example of an SPR live-front termination.

1. Insulation cutback.

a. Using a caliper, measure the connector's barrel depth near the edge (the center can be domed).

Figure 7: Measure the connector barrel depth with a digital caliper.

b. Find the injection adapter's (IA) gap length. It can be found on the IA's label, IA bag's label, or in **NRI 330 – IA Reference Table.**

Figure 8: Gap dimension on old IA label.

Figure 9: Gap dimension on new IA bag label.

c. The required insulation cutback length is the connector depth and IA gap length plus an extra 1/16" of play.

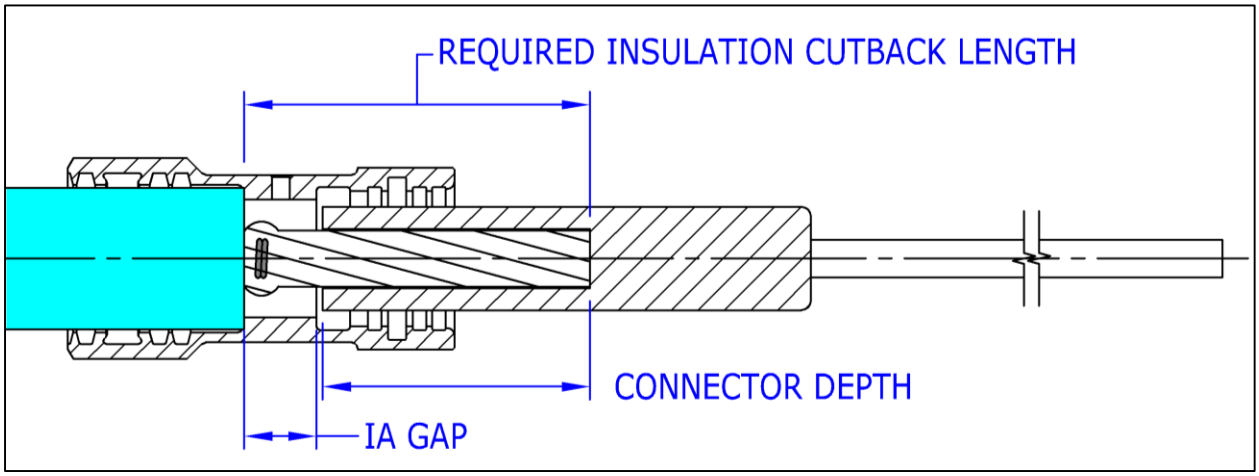

Figure 10: Calculate the insulation cutback length from the connector depth, IA gap, and some extra play.

d. Mark this spot on the cable's insulation.

e. Place the tool stop $3\frac{5}{8}$" from the mark and remove the insulation.

2. Semi-con cutback.

a. Treat the IA as an extension of the connector. The exposed insulation below the IA **must** match the bare insulation length in the kit instructions.

b. Locate the IA overlap length on the IA's label, IA bag's label, or in **NRI 432 The IA Reference Table**.

Figure 11: Overlap dimension on old IA label.

Figure 12: Overlap dimension on new IA bag label.

c. Increase the semi-con cutback length in the manufacturer's instructions by the IA overlap length.

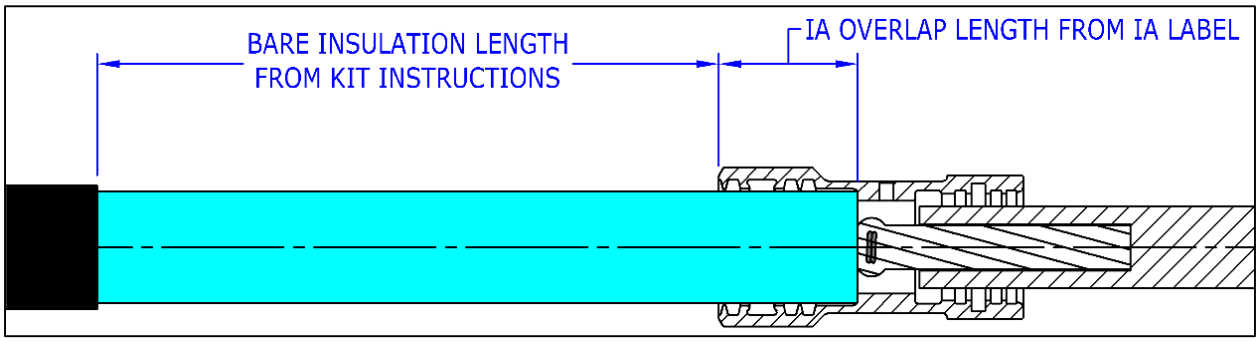

Figure 13: Extend the manufacturer's bare insulation length by the IA overlap length.

d. Measure, mark, and remove the semi-con to this length.

3. Adjust the jacket cutback and neutral wire bend location.

Follow the steps below, depending on the type of cable construction.

Jacketed Concentric Neutral Cable:

a. Use the kit instructions to find and mark the jacket cutback location from the semi-con cutback.

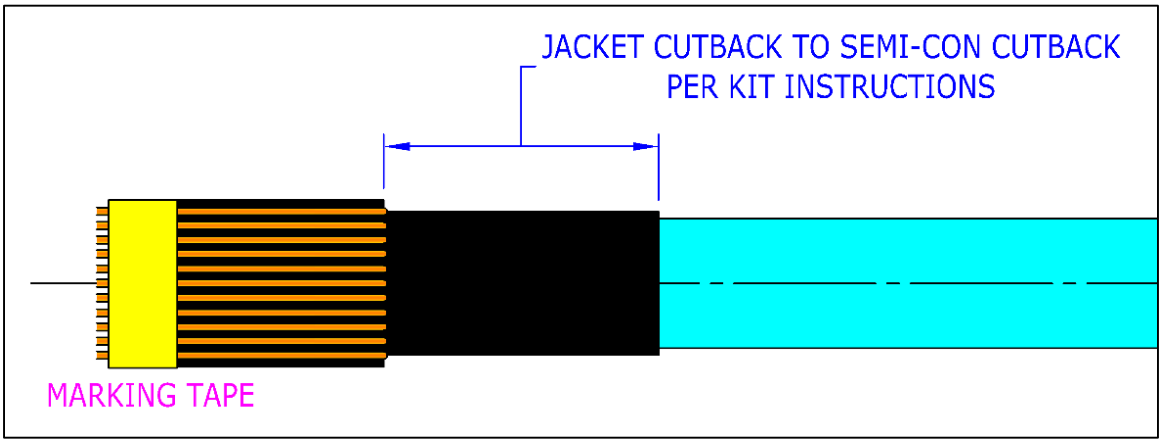

Figure 14: Adjust the jacket cutback and neutral wire bend location after removing the semi-con.

b. Remove the jacket to that point.

Unjacketed Concentric Neutral Cable:

a. Use the kit instructions to find where to bend the neutral wires back from the semi-con cutback.

b. Secure the neutral wires at this point and bend them back.

Jacketed Tape Shielded Cable:

a. Use the kit instructions to find and mark the jacket cutback location from the semi-con cutback.

b. Remove the jacket to that point.

c. Find the exposed tape shield length required in the kit instructions.

d. Remove the tape shield to that length.

4. Place the marking tape.

Use the kit instructions to find and place the marking tape from the semi-con cutback.

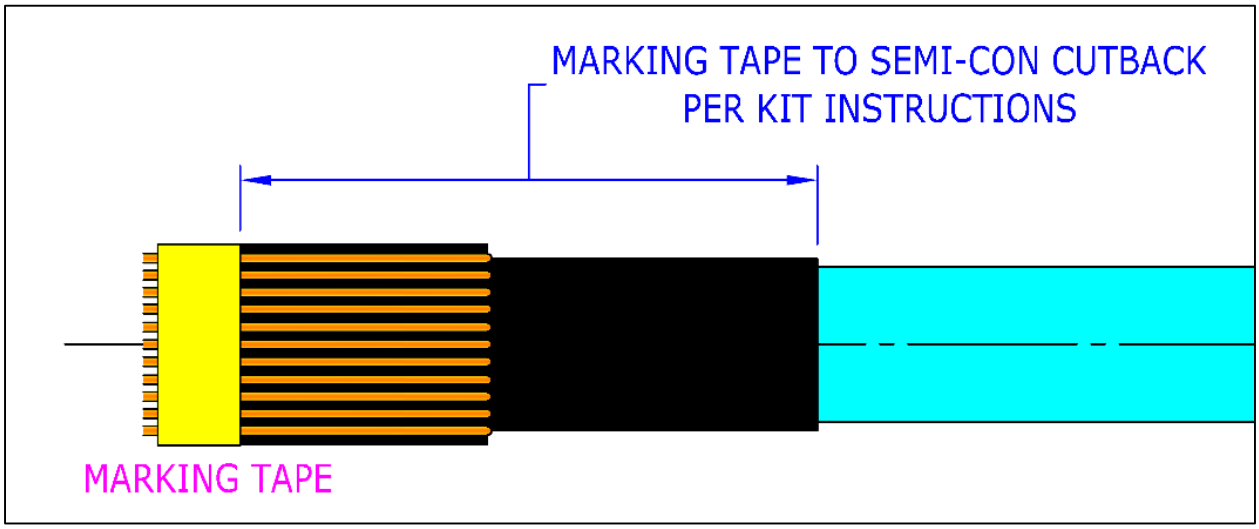

Figure 15: Place the marking tape by using the semi-con cutback position as given in the manufacturer's instructions.

Positioning the IA

1. Molded items.

Slide any molded items, such as insulation adapters, onto the cable.

- It may be difficult to slide over the installed IAs.

- Follow any directions related to cleaning surfaces when sliding components on.

Figure 16: Molded accessory.

2. IA quality check marks.

a. Put the connector in the IA.

b. Draw a line on the connector above the IA to use for full connector insertion into the IA on the cable.

Figure 17: Use marks on the connector to show full insertion.

c. Place the IA on the cable.

d. Rest the IA's internal shoulder on the insulation.

- If it is difficult to put the IA on the cable, the insulation may be too large or out of round.
- Use the next larger sized IA for the insulation.
- Increase the first number in the IA's name by 1 (e.g., you have a 2-2 but need a 3-2.)

e. Draw a line on the insulation underneath the IA to check for correct IA seating.

- Using a different color for this line can help match the IA insulation end with the insulation.

Figure 18: Use marks on the insulation to show full insertion into the IA.

3. Space the IA for the connector side swage.

a. Slide the appropriate alignment pin bushing onto the alignment pin.

- Use the standard alignment pin bushing for all except for the 7-2 IA.

Figure 19: Alignment pins and bushings.

Figure 20: Standard bushing on alignment pin.

b. Insert the alignment pin into the injection port hole of the IA.

c. Turn the tool stop so that the rounded shoulder is facing downwards.

- Large diameter cables usually use IAs needing swage dies larger than the 1262.
- Swage head end plates will be damaged by the tool stop's rounded shoulder during swaging.

Figure 21: The rounded shoulder is down for large diameter cables.

d. Place the IA inside the tool stop.

e. For ease of injecting later, point the IA's port hole facing away from the tightening nuts.

Figure 22: IA and pin resting in the tool stop.

f. Position the IA in the tool stop so that the alignment pin bushing sits flush with the tool stop.
   - There should not be a gap between the bushing and the tool stop.

Figure 23: Bushing resting flush against tool stop.

g. Tighten the tool stop to hand tight; then with a wrench, tighten the nuts a quarter to a half turn more.
   - Do not overtighten since the IA can become warped and not fit over the insulation.

h. Remove the alignment pin and pushing from the IA.

i. Check for proper alignment with the swage die.
   - Take half of the swage head and place it against the tool stop.
   - Look to see where the edge of the die's teeth will line up with the IA.
   - The IAs have defined swaging regions.
   - Make sure that the swage die will not compress on the middle section of the IA. This will cause damage as well as make injection difficult or impossible.

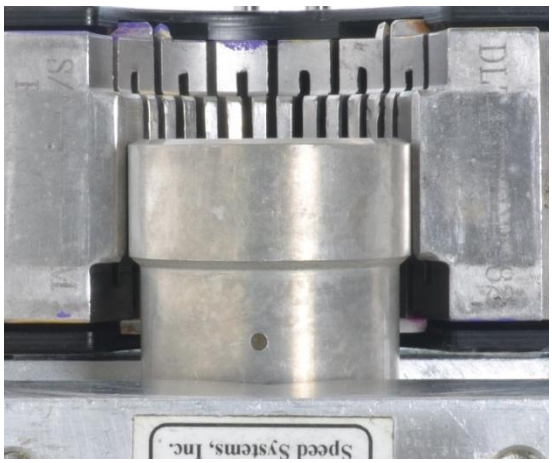

Figure 24: Swaging region of IA lines up with the die.

j. If the swage die does not look like it is aligned correctly, manually adjust the IA's position in the tool stop so it swages in the correct location.
   - Contact Engineering in this case and send pictures showing this issue.

4. Assemble the connector and IA.

a. Place the IA with tool stop onto the cable and slide the connector onto the conductor.

b. Double-check that all parts of the accessory kit that need to be on the cable are in place, otherwise the cable will need to be cut and prepared again to put them in place.

c. The IA must be free to rotate and should not be held tight by the connector and insulation.
   - Wiggle the IA to make sure that there is space between the connector and insulation.
   - This helps confirm that the bare conductor is fully inserted into the connector.

d. Double-check that the IA is correctly placed on the cable.

e. Look at the two quality check marks on the connector and insulation.

- If the IA does not match closely with the lines, reposition the connector and conductor until it does.

Figure 25: Quality check marks line up correctly.

Swaging and Crimping

1. SPR connector barrel crimps/swages.

a. Crimp the connect barrel as many times as possible in the connector's crimping region.

b. Follow IEEE® 1816™ guidelines on how to install the connector.

c. If installing IAs, do not swage or damage the IAs at this time.

d. Make sure the conductor is fully inserted into the connection and the IA is sitting against the insulation.

e. Begin crimping/swaging the connector at the "no crimp" line.

f. Crimp/swage the connector as many times as possible, moving towards the cable each time.

Figure 26: Crimp the connector as many times as possible.

2. IA's connector side swage.

a. Fit the swage head with the swage dies for the IA's connector side onto the swage press.

b. Position the swage press so that the die release button is on the opposite side of the tool stop.

Figure 27: The release button is on the opposite side from the tool stop.

c. Position the swage press around the IA and hold it snug against the tool stop.

- It is important to keep the head square against the tool stop to swage the IA straight.

Figure 28: The swage head is square on the tool stop.

d. Keep fingers away from the closing portion of the press and begin swaging the IA.

e. Continue swaging until the swage head's shoulders make full contact with each other and the attached in-line hydraulic pump reaches at least 9000psi of pressure.
   - This ensures full swage die compression, helping eliminate the formation of "ears" on the IA.
   - The natural variance between individual swage presses and subjective visual clues are non-factors.

Figure 29: The swage head's shoulders have come completely together, fully compressing the swage die.

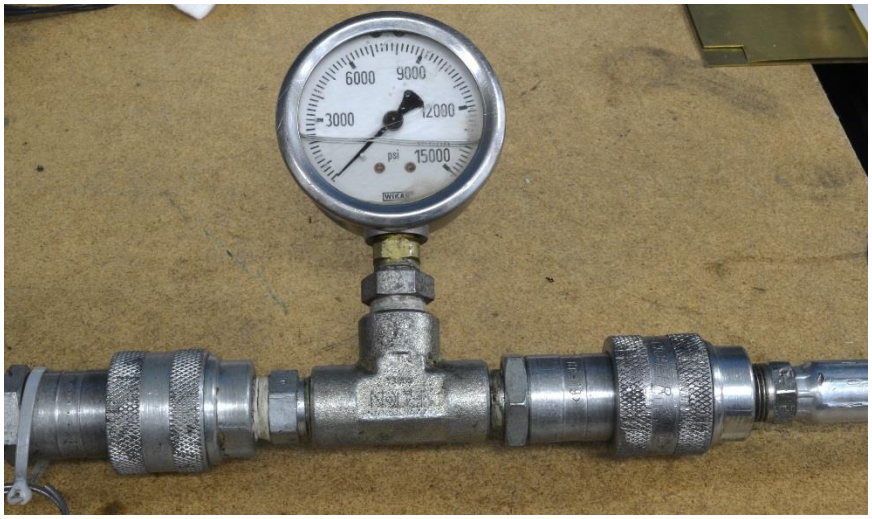

Figure 30: An example in-line hydraulic gauge between the swage press and foot pump. It must read at least 9000psi for a proper swage.

f. Release the swage press now.

3. Space the IA for the insulation side swage.

a. Place the appropriate IA spacer for the IA, given in **NRI 432**, snug against the IA.

b. Place the tool stop snug against the spacer.

c. Tighten the tool stop to hand tight; then with a wrench, tighten a quarter to half-turn more.

d. Do not overtighten as the tool stop can deform the insulation.

e. Remove the IA V-spacer.

f. Check for proper alignment with the swage die, just like on the IA's connector side swage.

g. Adjust the IA's position in the tool stop if the swage die does not look like it is aligned correctly.

Figure 31: Spacing the tool stop with the V-spacer.

4. IA's insulation side swage.

g. Attach the head with dies, determined previously, to swage the IA's insulation side to the swage press.

h. Position the swage press so that the die release button is facing away from the tool stop.

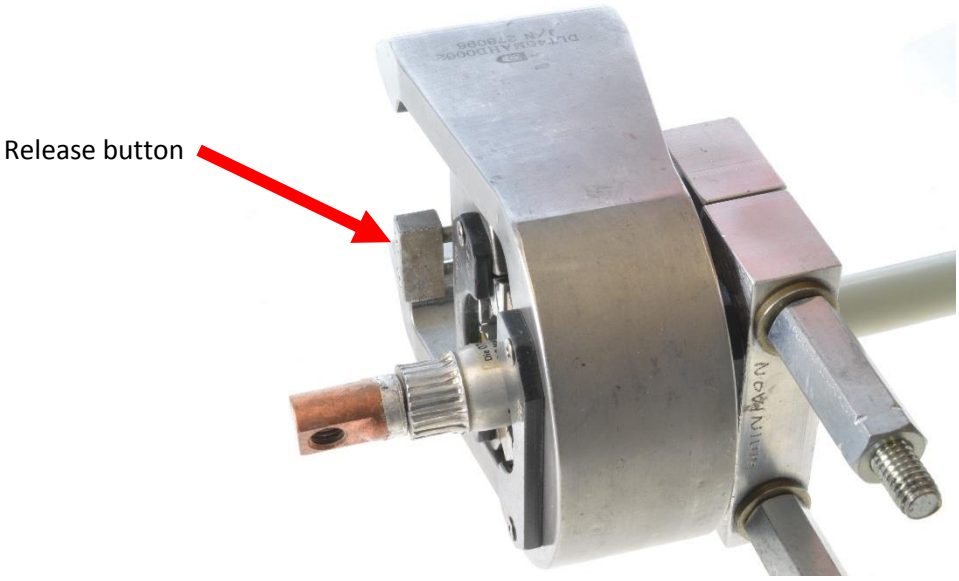

Figure 32: The release button for the swage block is on the opposite side as the tool stop.

i. Hold the swage press around the IA, snug against the tool stop.

j. Keep fingers away from the closing portion of the press and begin swaging the IA.

k. Continue swaging until the swage head's shoulders make full contact with each other and the attached in-line hydraulic pump reaches at least 9000psi of pressure.

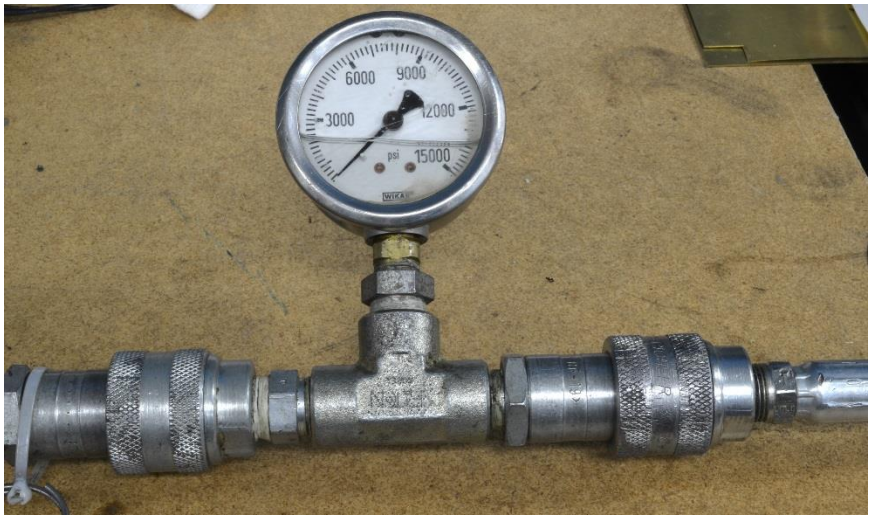

Figure 33: An in-line hydraulic gauge between the swage press and foot pump. It must read at least 9000psi.

Release the swage press.Quality Check

1. Check IA swages.

a. The swaged area will often have rough edges. Smooth these rough edges with a file, a 3M® Scotch-brite™ pad, or 120 grit sandpaper.

- Smoothing these edges helps prevent interior damage to component bodies.

b. Check for improper swages and cracks.

- Correct swages will leave the IA's center unmarked and compress the full IA end length.
- Swaging the IA's center may damage the injection port area, preventing injection and sealing with the injection tool and plug pins.

Figure 34: Improper swage on the IA's mid-section.

2. Compare the cable against the template.

a. Lay the swaged cable length next to the post-swage portion of the template.

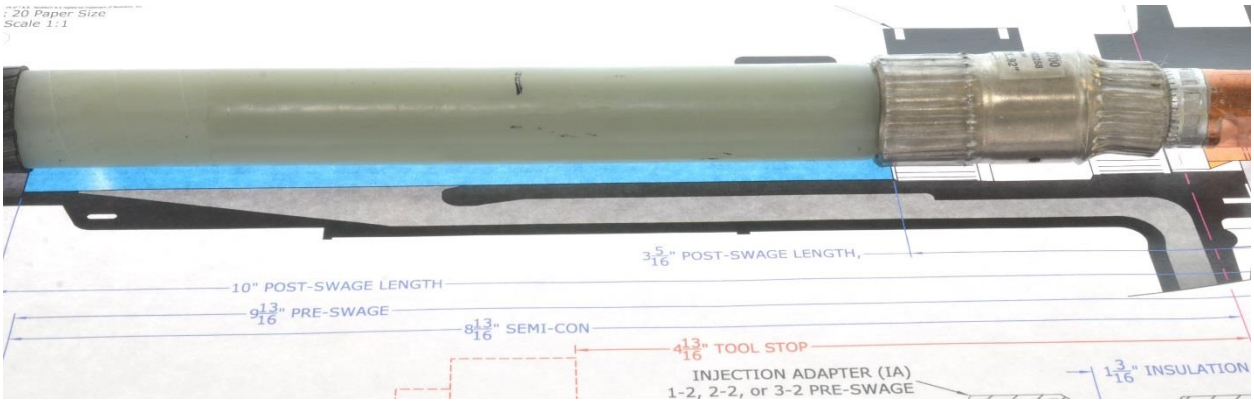

Figure 35: Check the cable against the template.

b. Confirm that all cutbacks and post-swage lengths are within the required ranges. Adjust or redo any if necessary.

c. Check the insulation and semi-con for cracks, gouges, ripples, scratches, dirt, or other defects.

d. Fix any damage found or remove the section of cable and redo the cable preparation.

Injecting and Finishing Terminal Installation

1. Complete injection.

Injection must be completed before the cable can be re-energized.

a. Install the injection tool on the IA per **NRI 452 Injection Tools – iUPR & SPR**.

b. Begin SPR injection according to NRI 612 – Large Diameter Cables (URD) - SPR.

c. After the injection is finished, remove the injection tool from the cable.

d. Perform any other installation steps described in the manufacturer's instructions.

e. Align the bottom of the termination body with the marking tape and install according to the manufacturer's instructions.

f. The end of the termination body should overlap some of the IA body.

2. SPR injection and installation are now complete.