

## Rejuvenation Instructions

### #352 – Injection Pressure Selection – iUPR & SPR



#### This NRI covers the following:

- How to perform flow and pressure tests.
- How to determine the pneumatic resistance of the cable.
- How to interpret flow readings on an air flow meter.

Trademarks: <http://www.novinium.com/trademarks/>

Patents: <http://www.novinium.com/patents/>



**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.

## Table of Contents

iUPR Injection Pressures .....	2
1. Cables without splices.....	2
2. Cables with splices.....	2
SPR Injection Pressures.....	2
1. Find the tailored injection pressure (TIP). .....	2
2. Find the adjusted flow pressure (AFP).....	3
3. Find the adjusted tailored injection pressure (ATIP). .....	3
4. Adjust the AFP and ATIP.....	3
5. Record the pressures into Knomentous. ....	4

## iUPR Injection Pressures

- iUPR injection is only applicable to conductors of 4/0 size and smaller.
- SPR injection must be used on cables larger than 4/0.

### 1. Cables without splices.

- The iUPR injection pressure for cables without splices is limited to a maximum of 25psi. However, a component’s ability to contain pressure decreases as diameter increases.
- Use good field judgement when determining injection pressures to avoid blowing out a component.
- Recommended iUPR pressures are:
  - 18psi** for conductor sizes **#4 to 2/0**.
  - 13psi** for conductor sizes **3/0 to 4/0**.

### 2. Cables with splices.

- Perform a successful pressure test of the cable as in **NRI 282**.
- The injection pressure is 2psi less than the lowest successful pressure test.
  - This will help prevent over-pressurizing any splices in the cable.

## SPR Injection Pressures

### 1. Find the tailored injection pressure (TIP).

The Tailored Injection Pressure is the base amount of pressure calculated for injection. TIP is determined by the conductor’s geometry and insulation thickness.

- Refer to **NRI 302 The Cable Table**.
- Find the cable to be injected.
- Find the value for the tailored injection pressure column of the cable.

Cable Number	Design voltage & insulation level	Stranding	Actual Insulation Thickness (mils)	Conductor AWG, kcm, or mm <sup>2</sup>	Conductor Size (mm <sup>2</sup> )	Number of Strands	Strand Diameter (mils)	Strand Diameter	Nominal Conductor OD (mils)	Conductor shield OD (mils)	Typical Insulation OD (mils)	Typical Shield OD (mils)	tailored injection pressure (psig)
<b>AEIC Cables</b>													
1	15kV; 100%	Concentric	180	2	33.6	7	97.4	2.47	292	332	692	772	76
2			180	1	42.4	19	66.4	1.69	332	374	734	814	146
3			180	1/0	50.1	26	50.1	1.69	332	374	734	814	219
4			180	2/0	67.4	19	83.7	2.13	418	464	824	904	146
5			180	3/0	85.1	19	94.0	2.39	470	518	878	958	173
6			180	4/0	107.2	19	105.5	2.68	528	578	938	1018	155
7			180	250	126.7	37	82.2	2.09	575	625	985	1065	142
8			180	350	177.5	37	97.3	2.47	681	731	1091	1191	120
9			180	500	253.1	37	116.2	2.95	813	863	1223	1323	101
10			180	600	304.2	61	99.2	2.52	893	943	1303	1403	100
11			180	700	354.5	61	107.1	2.72	964	1016	1376	1476	100
12			180	750	380.1	61	110.9	2.82	998	1052	1412	1512	100
13			180	800	405.2	61	114.5	2.91	1031	1087	1447	1547	100
14			180	900	456.3	61	121.5	3.09	1094	1152	1512	1612	100
15			180	1000	506.4	61	128.0	3.25	1152	1212	1572	1702	100

Figure 1: Flow test valve assembly.

## 2. Find the adjusted flow pressure (AFP).

The Adjusted Flow Pressure is the pressure of the injection before the outlet end of the cable is pinned.

- Use the TIP to calculate the Adjusted Flow Pressure.
- Find the expected temperature of the cable during injection.
- Refer to the table and find the factor associated with that temperature.
- Multiply the TIP by the factor. This will give the AFP, the pressure for pushing the injection.
- As an alternative, as long as the cable is below 40°C, the TIP can always be used instead of the AFP.

Temperature Range of the Cable	Factor
Below 0°C (32°F)	1.5
0-9°C (32 -49°F)	1.35
10°-19°C (50-67°F)	1.25
20-29°C (68-85°F)	1.15
30-39°C (86-103°F)	1.10
40-50°C (104-122°F)	1.0
Above 50°C (122°F)	.75

**Figure 2:** AFP temperature factors.

## 3. Find the adjusted tailored injection pressure (ATIP).

The Adjusted Tailored Injection Pressure is the pressure used to pressurize the cable and left in the cable after the inlet end of the cable is pinned.

- Use the TIP to calculate the Adjusted Tailored Injection Pressure.
- Determine the maximum temperature the cable will reach within 30 days of the injection.
- Refer to the table and find the pressure de-rating factor associated with that temperature.
- Multiply the TIP by the factor. This will give the ATIP to pressurize the cable.
- Cables that will stay below 40°C will maintain the original TIP for pressurization.

Temperature Range of Cable Within 30 Days	Factor
40-49°C (104-121°F)	.75
50-59°C (122-139°F)	.60
60-69°C (140-157°F)	.45
70-79°C (158-175°F)	.30
80-89°C (176-193°F)	.15
90-100°C (194-212°F)	.05

**Figure 3:** ATIP temperature factors.

## 4. Adjust the AFP and ATIP.

In the event of rubber insulation or a large elevation change between the two ends of the sub-segment, the AFP and ATIP must be adjusted.

- a. Reduce the AFP and ATIP for rubber insulation.
  - Take the AFP and ATIP, found above, and divide the value by 4.
  - Rubber insulation is not able to take the same pressures as XLPE.
- b. Reduce the ATIP for large elevation changes.
  - If the elevation between the two terminations or ends of the sub-segment is greater than 33ft (10 meters), the ATIP must be reduced. For extreme elevation changes, call Engineering.
  - Reduce the ATIP by 2psi for every 5ft of elevation change.
  - For those working in meters, reduce the ATIP by 7psi for every 5 meters of change.

## **5. Record the pressures into Knomentous.**

- a. Record the pressures used in the “Pressure Start” and “Pressure End” fields in Knomentous.
- b. The “Pressure Start” value should be the AFP calculated before, and the “Pressure End” should be the lower calculated ATIP.