Rejuvenation Instructions

#402 – Air Systems – iUPR & SPR

This NRI covers the following:

How to refill Compact CO_2 kits.

How to transport, secure and connect the regulator to large CO_2 cylinders.

Understand the types of Flow Test Equipment that will be used to test cables for flow prior to injection

How to properly maintain air driven equipment

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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CO_2 Containers

1. Large CO_2 cylinders.

CO_2 gas has many purposes within the iUPR and SPR processes:

- Flow and pressure tests of the cable and components.
- The driving force behind injection.
- Drives the swaging and lug-splitting equipment.
- Purges air from an opened pail for resealing.

Figure 1: CO_2 cylinders.

Some CO_2 cylinders have dip tubes or siphons which pull CO_2 from the bottom while some do not. To check if your cylinder has a dip tube:

a. Secure the tank upright

b. Open the valve slightly

c. Watch the discharge. If it looks like snow, the cylinder has a siphon or dip tube.

2. Compact CO_2 kit – iUPR.

The compact CO_2 kit is used in conjunction with the UP1.5L tank during iUPR injection.

The kit supplies up to 12 oz. of CO_2 during the injection. This amount of CO_2 is enough for the majority of injections.

The CO_2 comes with a regulator to set the output pressure. Novinium-made dual stage regulators also have a gauge showing the remaining pressure in the bottle.

If the CO_2 bottle ever runs out, it can be refilled using the CO_2 refill kit.

Figure 2: Compact CO_2 kit (left) and refill kit (right).

3. 200psi Compact CO_2 kit - SPR

A compact CO_2 kit capable of higher injection pressures is also available for SPR injections when space for a Large CO_2 cylinder is not available. One of these situations is when an Insulated 2L Tank is for an unattended injection.

The 200psi Compact CO_2 kit can be identified by it's outlet, which is on the left side, whereas the outlet of the iUPR Compact CO_2 is on the right side.

Depending on the length and conductor size of the segment to be injected, a 20oz CO_2 bottle may be necessary to maintain injection pressure.

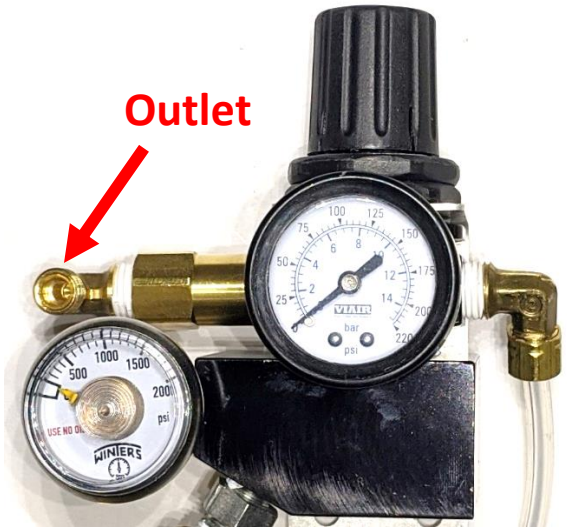

Figure 3: 200psi Compact CO_2 regulator.

4. Refilling the compact CO_2 kit.

a. Insert the CO_2 washer into the Ninja Tool.

b. Attach the Ninja Tool to the source tank and CO_2 bottle

c. The bleed valve should be open and will vent any remaining CO_2 in the bottle.

d. After the bottle is vented screw out the Ninja Tool's bleed valve to close it.

e. Determine if the fill tank has a dip tube (see previous page)

   i. If there is no dip tube, invert the tank slightly with a wrench to feed liquid into the bottle

   ii. If there is a dip tube, leave the tank upright

   Prevent the tank from rolling with another wrench.

f. Screw in the knob on the bottle to open the Ninja Tool.

Figure 4: Left, insert the CO_2 washer.

Figure 5: Close the bleed valve

Figure 6: Lay the source tank on its side and invert slightly if the feed tank has no diptube

Note: The fill tank should always be upright except when refilling without a dip tube.

Figure 7: Open the Ninja Tool.

g. Screw out the knob on the source tank to open

h. Place the CO_2 bottle below the source tank.

i. Let the bottle fill for three minutes, letting the pressure equalize.

Figure 8: CO_2 bottle needs to be lower than the source tank.

j. Screw in the source tank's knob to close.

k. Close all valves including the Ninja Tool's knob (screw out) to close.

l. Screw out the bleed valve to vent trapped gas in the line.

Figure 9: Open the bleed valve.

m. When finished, remove the Ninja Tool from the source tank. Be sure to remove and keep the CO_2 washer.

There are video guides available on LMS for maintenance tips and refill tips

5. Transporting large compressed gas and CO_2 tanks.

Refer to the Compressed Gas Cylinder Safety section in Chapter 4 of the FOSH.

When storing or transporting containers that are under pressure, always secure them using nylon, metal straps, or chains in an upright position.

During transport, remove the regulators and put safety caps in place, if it has provisions for a cap.

Figure 10: 20 pound cylinders secured for transportation with metal bands and nylon straps

Figure 11: Cylinder with protective safety cap installed.

6. Securing compressed gas and CO_2 tanks during injection.

An unsecured CO_2 cylinder is a potential hazard, as it can tip over and rupture if bumped into or pulled. Observe all local requirements when securing compressed gas cylinders.

Below are examples of properly secured cylinders:

Secure the cylinders in the vehicle and run an air hose to the injection equipment.

Figure 12: Secured tank with coil for easy storage and management of hose length.

Figure 13: Secured in bay with hose on regulator.

Figure 14: Clamps secure the tank for injection.

Construct a wheeled cart that holds the injection tanks and CO_2 cylinder.

Figure 15: Tank secured to back of injection cart.

Leash the CO_2 cylinder to a solid fixture, like the transformer box or utility pole, with nylon straps.

7. Connecting a CO_2 regulator.

a. Insert the CO_2 washer into the regulator's fitting.

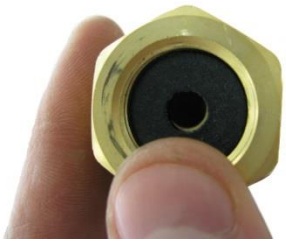

Figure 16: Insert CO_2 washer into regulator's fitting.

b. Thread the regulator's fitting, along with the CO_2 washer, onto the threading of the CO_2 cylinder.

Figure 17: Thread the fitting onto the cylinder.

c. Tighten the regulator to the CO_2 tank with a wrench.

Be careful not to over-tighten the fitting.

Flow Test Equipment

1. Air flow meters.

- Air flow meter must be kept upright when taking readings.
- The air flow meter is used during flow and pressure tests, typically with the cable test adapter (CTA).
- The meter's needle valve enables setting of specific flow rates. This is useful for flow tests.
- Setting the push flow meter at a maximum of 50 cc/min allows easy calculation of the cable's pneumatic resistance by reading the outlet flow.

Figure 18: Air flow meter.

- Do not use injection fluid with the flow meter. Injection fluid will degrade the meter's seals.
- The glass tube is rated for pressures up to 200psi, which exceeds typical operation ranges.

If the ball becomes stuck in the tube, run CO_2 through both directions at 20psi for 15 seconds to blow out any moisture present.

2. Cable test adapters (CTAs).

Cable test adapters (CTAs) are commonly used with the air flow meters to determine if a cable is unblocked. They are also used to test whether splices in the cable can withstand the pressures of injection.

The most common CTA sizes are shown below:

Cable OD	Typical Cable
0.625"	175mil #2
0.750"	175mil #2-1/0
0.875"	220mil #2-1/0
1.125"	260mil 1/0

Use the tightest fitting CTA when doing a flow and pressure test of cable, components, and accessories.

Secure the CTA to the cable being tested to prevent the CTA from blowing off

a. Attach an air flow meter to the CTA by using zip ties.

   There are two CTA assemblies: The push assembly and the catch assembly.

Figure 19: Generic CTA assembly.

b. Build the CTA push assembly by connecting:

   The flow meter's outlet to the CTA.

   The flow meter's inlet to the inline gauge/CO_2 tank.

Figure 20: Left, the push CTA assembly.

c. Build the CTA catch assembly by connecting:

   The flow meter's inlet to the CTA.

   The flow meter's outlet is open to the air.

d. Connect an inline gauge and a 1/4" by 1/8" tubing ball valve together.

Figure 21: The catch CTA assembly.

Figure 22: Inline gauge to verify pressure output from CO_2 tank.

Using an inline gauge helps verify the output pressure from the connected CO_2 tank.

e. Connect the inline gauge to the push CTA assembly's inlet.

f. The CTA assemblies are now ready for use.

3. Valved Flowmeters

The valved flowmeter provides a faster way to air and pressure test cables. By switching the two-way valve, air will be sent to or received from the other end of the cable.

The valved flowmeter has male 1/8 NPT fittings to connect directly to a standalone CTA and air source. The fittings may be changed to accommodate other testing equipment. All guidelines on page 8 for using a flowmeter apply to the valved flowmeter.

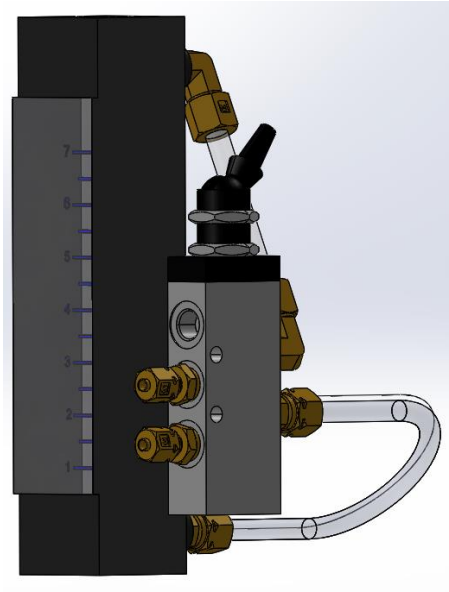

Figure 23: Valved flowmeter

To use the valved flowmeter:

a. Connect the valve to the cable and air source as shown in Figure 23.
b. Set the air source to the correct pressure
c. When the valve is in the **exhaust position**, the air supply is closed and the flow coming from the cable will be measured by the flowmeter.
d. When the valve is in the **pressurize position**, the air supply will be allowed to flow into the cable. The rate of flow will be measured by the flowmeter.
e. Pressure tests can be done by setting both valves at each end to pressurize.

The valved flowmeter can also be used to differentiate a blocked splice on a segment withmultiple splices. Contact Engineering for more information.

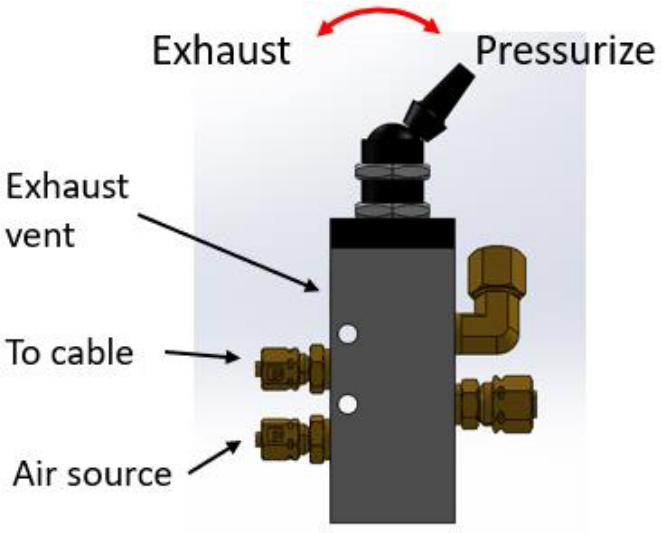

Figure 24: Two-way valve on the valved flowmeter

Air Driven Equipment

1. Pneumatic-to-hydraulic Pumps

The Enerpac and Power Team Pumps are used in the swaging operation for SPR craftwork. These pumps are equivalent in operation and maintenance. They are pneumatic-to-hydraulic pumps driven by CO_2 to power the swage press for installing IAs and swaging connectors to create a good electrical connection and a fluid-tight seal.

The inlet CO_2 pressure should be set to 60-100 psi. Do not set inlet pressure over 100 psi since over-pressurizing the pump will cause damage to the internal diaphragm.

Figure 25: The Enerpac pump on the left and Power Team pump on the right.

2. Maintenance

To maximize the lifetime of the pump:

a. Clean and dry frequently, especially near the inlet and release valve

b. Clean air inlet filter periodically

c. Clean coupling surfaces

   i. If the couplings are not tight, air can get in and create pockets

Figure 26: Make sure coupling are clean

Figure 27: Apply air tool often

d. Before each use, or three times a day add three drops of air tool oil into the inlet and cycle afterward. You cannot over-lubricate the pump.

If your pump does not reach 9000psi at 100psi inlet pressure, your pump must be repaired by priming in the field or sending back to supply chain.

3. Priming

To prime the pump.

a. Set the inlet pressure to 30-40psi

b. Move the foot pedal to the release position

c. Manually press the silver actuating valve near the air inlet

d. Run for 1 minute

e. Increase the pressure back up to normal and run for 1 cycle to ensure it reaches 9000psi

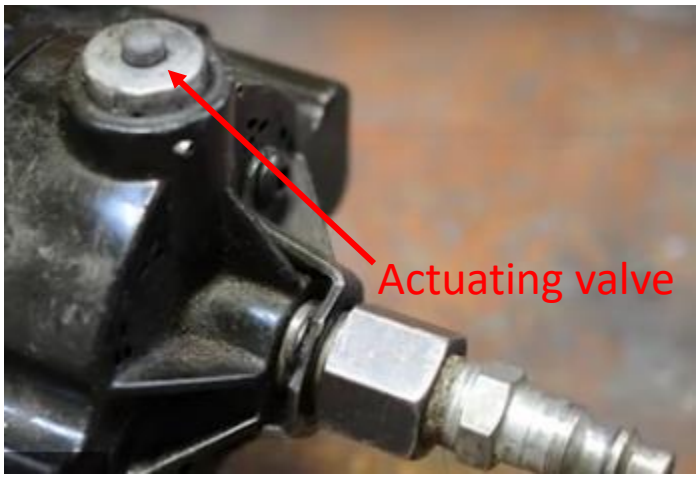

Figure 28: Air inlet and actuating valve

If pump does not reach 9000psi after priming 3 times, send the unit back to supply.

For more information, see the LMS video on pump maintenance

Cold-Weather Use of Compact CO_2 Regulators

1. Handling CO_2 regulators

When handling the CO_2 regulator assembly in cold temperatures, you will get best performance when the internal o-rings are stressed as little as possible.

1. **Fill** CO_2 bottles, but do not install the regulator
2. **Warm** up whole CO_2 kit to near room temp (in the vehicle cab or hotel room)
3. **Install** regulator to the bottle while kit is warm
4. **Install** injection cap, set the pressure, and begin injection
5. **Place** kit upright in transformer carefully

Figure 29: iUPR Regulator assemblies should be treated carefully in cold weather.

Note: Do not have CO_2 containers in an unventilated space with you!

2. Fixing CO_2 regulator leaks

Check for leaks each time you assemble the CO_2 kit and bring it out to the cold. To check for leaks:

1. Pause and listen/feel for leaks
2. If a leak is suspected, use soapy water to find the source
3. Use the necessary corrective action to fix the leak or contact Engineering

To fix the CO_2 manifold vent leak:

a. Replace the bottle O-ring as shown.

b. Wipe down the inside manifold threads with a clean cloth or paper towel.

c. Lubricate these O-rings with Silicone grease and replace these O-rings often since they quickly wear out.

Figure 30: Replace bottle O-rings often to maintain a seal.

Figure 31: The iUPR CO_2 regulator.