

Lesson Learned/Best Practice Briefing

No.: LL/BP23-0011

Title: Beware of Unauthorized Equipment Modifications: Always Inspect Equipment Before Use (BNL)

Event: Other Facility Event

Event Date: 02/02/2023

Category: ESH-Compressed Gases - Compressed Gases-General, Pressure Systems (any)

Discussion:

Lessons Learned Statement

When using equipment, ensure that a pre-use inspection is completed prior to beginning your task. Inspections need to include whether unauthorized modifications may have been made to the equipment from the original specifications. If any noted changes have been made, do not use the equipment without a proper safety inspection to prevent possible injury.

Discussion of Activities

A staff member replaced the pressure regulator on a nitrogen cylinder. As the delivery pressure was adjusted, the housing cap was being inadvertently unthreaded to the point that when the system was pressurized, the cap shot off the body and struck the worker in the chest. This caused injuries that required evaluation and treatment at a local hospital. The regulator has a maximum output pressure of 40 psig, and the cap could have been released with approximately 300 lbs. of force.

Analysis

Regulators are designed to safely reduce high cylinder gas pressure to safe operating pressure. The regulator that failed does this in two (2) stages. The first stage reduces the input pressure (typically in the 2,000 psig range) to an intermediate pressure set by the manufacturer for each specific regulator model. An adjustment screw on the front of the regulator is used to reduce the final output pressure as needed. The screw is inserted into a threaded bushing, that is press-fitted into the low-pressure housing cap.

The adjustment screw was found to become bound in the bushing and did not rotate freely as designed. This could allow the operator to unknowingly unscrew that cap when trying to lower the regulator pressure, so when the compressed gas cylinder valve was open, the

low-pressure housing cap dislodged from the regulator body and struck the worker in the chest.

To prevent a catastrophic pressure failure of the regulator, a pressure relief device is installed on the intermediate pressure stage that will open if the high-pressure components fail. However, in this regulator, the pressure relief device had been removed and replaced with a plug, which was an unauthorized modification.

Actions to Prevent Recurrence:

Recommended Action(s)

Upon discovery of the failure, a Laboratory-wide notification was released requesting that all users verify all regulators in service, ensuring that the adjustment screws were not bound (i.e. could be freely removed from the bushing) and that the valve body was wrench tight. Those regulators with issues were taken out of service.

The following requirements have been identified for incorporation into Laboratory training and usage:

Prior to use:

- Verify that both high- and low-pressure caps are tight (manufacturer's torquing requirement is 40-50 ft.-lbs.).
- Verify that regulator input has the correct CGA fitting for the gas being used.
 - No sealants or pipe tape can be used on this connection.
- Verify output range of regulator is consistent with the distribution system and downstream components:
 - Pressure gauges read with the correct scale.
 - Install pressure relief devices to protect lower pressure rated components if needed.
- Verify regulator is compatible with the gas use (i.e., Oxygen, flammable, corrosive).

When pressurizing the system:

- Never stand in front of the regulator when opening the pressure source.
- Use safety glasses.
- Verify that the regulator is unloaded (adjusted fully counterclockwise).
- Verify gauges are free to move and give reading that are expected.
- Slowly load the regulator until the designed output pressure is achieved.
- Check for leaks.
 - Reduce pressure if repairs/adjustments are required.

Originating Organization: Brookhaven National Laboratory (BNL)

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Lessons Learned are part of the ISM Core Function 5, Feedback and Improvement. Applicable Lessons Learned are to be considered during working planning activities and incorporated in work processes, prior to performing work.

Please contact the following subject matter experts if you have any questions regarding this briefing.

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Uploaded documents/attachments:

[Beware of Unauthorized Equipment Modifications_BNL 020223.pdf](#)

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