

STANDARD OPERATING PROCEDURE

Working with Liquid Nitrogen

Document Number: 960C-SOP-302

Original Approval Date: Jan 18, 2021

Revision Number: 3

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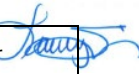
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WORKING WITH LIQUID NITROGEN

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|------------|---------------|------------------|---------------------------|--------------------|--------------------|---|
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The following is a step-by-step procedure on how to complete a specific task or meet a facility specific requirement. Standard Operating Procedures (SOPs) are written for all identified critical tasks. By virtue of the hazard or complexity associated with critical tasks it is paramount that the SOP be followed as written. SOPs contain a listing of high-level hazards associated with the task, for detailed hazard analysis reference the applicable Task Hazard Assessments. SOPs do not replace the requirements contained in the company Standards, Codes, and Processes nor does it replace the need to comply with required legislation. Section 8.0 references documentation that the worker shall understand before work commences.

1.0 PURPOSE

- To establish a company standard to safely and effectively carry out work as it applies to working with liquid nitrogen.

2.0 SCOPE AND APPLICATION

- This document applies to all company Heavy Construction and Mining operations. Ensure all site-specific requirements are being met or exceeded before performing the task.

3.0 HAZARDS AND CONTROLS

- Unknown chemical or compressed gas hazards when working with liquid nitrogen.
 - Review the product's SDS before using.
 - Keep work area clear of personnel not associated in the task.
 - All workers working with liquid nitrogen must update their hazard assessments for working with the product.
- Injury caused by exposure to extreme cold temperatures. Liquid nitrogen boils rapidly when it is poured into another container which can cause splashing. Liquid nitrogen is approximately -196 degrees Celsius.
 - Specialized and task specific PPE and tooling is required to work with liquid nitrogen. This includes but is not limited to:
 - Full coveralls without a cuff in the pant leg. Sleeves must be rolled down so no bare skin exposed.
 - Goggles
 - Face shield
 - Cryogenic gloves – must be loose fitting in the event some liquid nitrogen is splashed inside them
 - Long handled tongs/grips
 - Do not touch frozen parts with bare hands or skin.
- Improper storage of liquid nitrogen.
 - Only approved insulated containers that are specially designed to hold liquid nitrogen are permitted for use.
 - Do not store nitrogen containers in confined spaces.

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- All containers approved to store liquid nitrogen should be clearly labelled “approved for liquid nitrogen”.
- Example of approved nitrogen containers:



- Uncontrolled release of liquid nitrogen when transporting and using.
 - Maintain a clear, smooth path when transporting liquid nitrogen. Ensure ground conditions are level and unobstructed.
 - When transferring liquid nitrogen from its cylinder into an approved container, do so at a slow, controlled pour to reduce internal stresses on the container. Initially, liquid nitrogen will expand causing outward pressure. As it stabilizes, the extreme cold will drop the pressure in the container and could cause it to collapse if the container is not approved liquid nitrogen storage container.
 - Ensure the lid of the liquid nitrogen storage container is properly vented to prevent pressure build-up.
 - Inspect insulated container, hose and fittings prior to use. Do not use the insulated container, hose or fittings if damage or holes are observed during inspection.
 - Ensure the hose is secured tightly to the side of the container to prevent the hose from moving when the liquid nitrogen is being delivered into the container.
 - Use only an approved liquid nitrogen hose with brass diffuser tip.
 - Only open the valve enough to ensure a steady flow of nitrogen and not to cause any splashing.
 - Do not use the bulk tank outside in wet weather as the delivery valve will freeze open.
- Asphyxiation due to loss of oxygen caused by liquid nitrogen being used in confined spaces.
 - Do not use, store or release liquid nitrogen in an enclosed or confined space.
 - Proper ventilation is required during the dispensing process. Note – 1 litre of liquid nitrogen vaporizes into approximately 1 cubic metre of gas.

4.0 CHECKLIST

- Attend all preparatory meetings (IE: daily PSI; job scope; review of JSA's and SOP's for the job).
- Complete FLRA cards before starting the work.

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- Ensure all personnel involved in the task are aware of the hazards and the controls to be used, as identified in the SOP's; JSA's; and FLRA's
- Conduct a pre-job inspection of all equipment to be worked on and tools to be used.
- Standard of Training required for working on this job: On-the job training.**

5.0 DEFINITIONS

5.1 Company

Means North American Construction Group Ltd. (NACG) and all directly or indirectly owned subsidiary companies, including joint ventures.

5.2 Company Personnel

Includes the Company's employees, officers, directors, agents, associates, consultants/contractors, temporary employees and third-party processors.

5.3 HSE

Refers to the Health, Safety & Environment department

5.4 Cryogenic Liquid

Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures. The word "cryogenic" means "producing, or related to, low temperatures," and all cryogenic liquids are extremely cold. All cryogenic liquids are gases at normal temperatures and pressures. The vapours and gases released from cryogenic liquids also remain very cold. They often condense the moisture in air, creating a highly visible fog. In poorly insulated containers, some cryogenic liquids condense the surrounding air, forming a liquid air mixture.

Liquid nitrogen is an inert cryogenic fluid with a temperature of **- 196 °C [- 320 °F]**.

6.0 PROCEDURE

- 1) Complete a hazard assessment on the task.
- 2) Inspect travel path when transporting liquid nitrogen to the work area. Ensure path is smooth, level and free from hazards.
- 3) Set up work area in a well-ventilated area.
- 4) Don task specific PPE and the have proper tools available for the task.
- 5) Bring the specialized container to the work area by either using the overhead crane or the forklift. It may also have wheels for transport.
- 6) Inspect containers, hoses and fittings to ensure no damage or holes. Do not use if damaged or holes are present.
- 7) Remove and inspect the top of insulated container and place the items to be frozen on the bottom using the tongs.
- 8) Insert the hose from the nitrogen tank to the bottom of the insulated container and secure it tightly to the side of the container to prevent the hose from moving during the delivery process. Slowly open the delivery valve.
- 9) Only open the valve enough to ensure a steady flow of nitrogen and not to cause any splashing.
- 10) Fill the container to completely cover the components and also allow for evaporation depending on freezing time and component size. When filled, turn off the valve and allow the hose to drain completely before putting the hose away. Return the cap to the bulk bottle.

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- 11) Keep work area clear of personnel not involved with the task. Inspect the valve and hoses of the tank.
- 12) When removing components use tongs or long handled grips.
- 13) Use components immediately to avoid expansion.
- 14) When finished with the nitrogen, move the container to a safe area outside of the shop and leave it to evaporate.
- 15) Remove the gauges and hose from the nitrogen bottle and replace the cap. Store the specialty gauges, hose and diffuser in their proper place.

7.0 NOTES

If this task is to be done by a method different than described in this SOP, the work must **STOP** and the alternate method must be **DOCUMENTED** with an adequate hazard assessment tool such as a JSA. The document must be **APPROVED** by a supervisor before such procedures are implemented.

8.0 REFERENCES

- 950C-C-007 Compressed Gas Cylinder Code

9.0 APPENDICES

- No appendices.