



DEPARTMENT OF THE NAVY  
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LEMOORE, CALIFORNIA 93246-5004

IN REPLY REFER TO:

6260  
Ser 00/087  
6 Feb 15

From: Commanding Officer, Naval Hospital Lemoore  
To: Chief of Staff, Naval Postgraduate School,  
1 University Circle, Monterey CA 93943

Subj: NOISE MEASUREMENTS, NAVAL POSTGRADUATE SCHOOL,  
SPACE SYSTEMS ACADEMIC GROUP AND PHYSICS DEPARTMENT,  
OUTDOOR AND INDOOR LIQUID NITROGEN FILLING, HALLIGAN  
AND BULLARD HALLS, BLDGS 233 AND 234

Encl: (1) Industrial Hygiene Noise Survey Report

1. As requested by the Space Systems Lab Manager, noise measurements of two liquid nitrogen processes were conducted on 22 January 2015 by the Naval Hospital Lemoore, Monterey area Industrial Hygienist: the first involved liquid nitrogen transfer from a large bulk outdoor tank into a smaller portable tank, and the second involved filling a small flask from a low-pressure portable tank located inside Bullard Hall (Bldg 233).
2. Results and recommendations are discussed in enclosure (1).
3. If further consultation on this report is needed, please contact Mr. S. Eric Thurston, Industrial Hygienist at (831)656-1074 or by e-mail at sethurst@nps.edu.

A handwritten signature in black ink, appearing to read "K. R. Dagher", is positioned above the typed name.

K. R. DAGHER  
By direction

Copy to:  
NPS OSHE Dir  
NPS Dir Fac Mgt  
SP Chairman

## INDUSTRIAL HYGIENE SURVEY DATA

Command: Naval Postgraduate School                      DATE: 22 January 2015

Depts: Space Systems, Physics                              POC: David Rigmaiden

Location: Outside Bldg 234, West side; Bldg 233, Room 106

DESCRIPTION: Noise levels during the dispensing of liquid nitrogen from one of two high-pressure (250 psi) 500-gallon capacity tanks into a portable 230-liter tank and from a low-pressure (22 psi) 180-liter tank into a small flask were measured on 22 January 2015. Members of the Space Systems, Electrical and Computer Engineering (ECE), Physics, and the Mechanical and Aerospace Engineering Departments (MAE) are expected to/are performing at least one of these two processes as well.

Performance of both of these processes has changed since the August 2014 noise survey as follows:

(1) Rather than having an open port in the portable tank to vent any displaced, previously accumulated nitrogen gas during its filling with liquid nitrogen, the Space Systems Lab Manager devised, had constructed, and put in place a 2-inch diameter PVC pipe of considerable length and a 90 degree bend to which the tank is now connected via a piece of flexible metal tubing. The PVC pipe serves as a sound-dampening resonator tube to reduce the noise created during this process.

(2) Since August 2014, the Space Systems Lab Manager independently researched the filling of small flasks with liquid nitrogen, and identified that the current industry standard dictates filling from a low-pressure rather than a high-pressure source to avoid both creation of high noise levels and splashing of the liquid, which not only can create a serious skin/eye contact hazard, but also lead to waste of the expensive product. The process now involves/will involve filling of the small flasks from portable low-pressure (22 psi) tanks belonging to the above GSEAS departments rather than outside from the high pressure (250 psi) outside bulk storage tanks.

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RESULTS:

**Location:** Outside, Halligan Hall West Wall

<u>Process Description</u>	<u>Tank Status</u>	<u>Reading, dBA</u>	<u>Noise Hazard Radius</u>
Portable 230-liter tank	Empty	89	12 ft
Filling	Hall full	90	15 ft
	Nearly full	88	10 ft

**Location:** Bullard Hall, Room 106

<u>Process Description</u>	<u>Reading, dBA</u>	<u>Noise Hazard Radius</u>
Dispensing into 2-liter flask	72	N/A

DISCUSSION:

Comparing measurements from the August 2014 survey:

- the noise levels generated during portable tank filling process have been reduced considerably (from a range of 103 to 118 dBA to a much quieter 88 to 90 dBA range). These results indicate the attachment of the resonator tube is a very effective engineering control for noise reduction during this process. Although the noise levels of this process are still hazardous and require the use of hearing protection, the degree of the hazard has been greatly reduced.
- the process of dispensing liquid nitrogen into the flask has been reduced from 87 dBA to 72 dBA. These results indicates that filling from a much lower pressure tank rather than a high pressure tank has eliminated the noise hazard.

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### DISCUSSION (continued):

As outlined in reference (a), enclosure (1), paragraphs 5 and 6c, noise levels generated during the filling of the portable tanks exceed the Navy criterion level of 85 dBA for single hearing protection (rather than the criterion for double hearing protection as was the case prior to introduction of the resonator tube use into process). The calculated 8-hour average noise exposures of personnel performing this process no longer exceed the NOEL outlined in reference (a), enclosure (1), paragraph 1.

The noise levels of the flask filling process now are far below the Navy noise criterion level (and no longer exceed it as was the case when it involved filling from a high pressure rather a low pressure tank).

### RECOMMENDATIONS:

#### **DISPENSING INTO PORTABLE TANKS:**

As required by reference (a), enclosure (1), paragraphs 5 and 6c, personnel present during filling of portable tanks (as well as those remaining within 15 feet of the tank during this process) need to:

- wear single hearing protection (ear plugs or muffs)
- complete both initial PPE (one-time) and annual PPE-job specific training (currently accomplished through ESAMS training modules 1398 and 239) as required by reference (b), Chapter 20, Section 2013.
- Because their 8-hour average noise exposures are now insignificant, completion of formal hearing conservation training, and enrollment in the Noise medical surveillance for those performing this process for two or more days per month, are no longer necessary.

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RECOMMENDATIONS (continued):

**DISPENSING INTO PORTABLE TANKS** (continued):

The noise hazard radius of this process is now no greater than 15 feet (distance varies dependent on the amount of liquid nitrogen inside the tank during the filling process). Those involved in the process can administratively control access to unprotected personnel within 15 feet of the bulk storage tanks. The following actions are no longer necessary:

- restricting access to the entire courtyard/service area between Halligan and Watkins Halls, including entering/exiting through the nearby Halligan Hall large rollup door's integrated swing-out door, without wearing of hearing protection
- posting of noise hazard signs at the courtyard's perimeters or on or nearby the interior of the above-described door.

**DISPENSING INTO SMALL FLASKS:** Since noise levels are now below the Navy noise criterion level, hearing protection and PPE training are not required as was the case when the flasks were filled from the high pressure bulk tanks.

Other process recommendations include the following:

(1) Either labeling of the outside bulk liquid nitrogen tanks with large NAVMED noise hazard signs (as required by reference (a), enclosure (1), Section 6) has not occurred or they have become detached due to weathering. This labeling was previously discussed in references (c) and (d), the August and September 2014 noise survey reports involving the liquid nitrogen filling/dispensing processes. Because the tanks are located outside, the signs can be subject to premature aging/tattering, fading due to sun exposure, and adhesive degradation due to weathering. Therefore, the signs should be placed inside closeable plastic sleeves which can be directly affixed to the tanks rather than the signs.

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RECOMMENDATIONS (continued):

The signs need to denote that:

- double hearing protection (DHP) is needed during tank venting, with a DHP noise hazard radius of 12 feet and single hearing protection (SHP) noise hazard radius of 50 feet
- single hearing protection is needed during bulk tank filling from the truck, with a SHP hazard radius of 12 feet
- single hearing protection is needed during filling of the portable tanks, with a SHP noise hazard radius of 15 feet.

These signs can be obtained by contacting the NPS OSHE Office Hearing Conservation Manager, currently ETC Cassaundra Baleros.

(2) The Space Systems Lab Manager is spearheading the development of SOP's for this process. As discussed in reference (e), the SOP's should be forwarded for review and input by the Industrial Hygienist to include not only noise exposure control, but also use of appropriate personal protective equipment (PPE) to protect against extreme cold exposure resulting in potentially serious skin/eye damage from direct contact, prior to finalization. The PPE worn during the process (thermal gloves and chemical safety goggles) appears to be adequate to protect against these hazards, but the NPS OSHE Office also needs to be included in this SOPs for possible additional input during the review/approval process.

- REFERENCES:
- (a) BUMEDNOTE 6260 of 24 Apr 14
  - (b) OPNAVINST 5100.23G
  - (c) NAVHOSP Lemoore ltr 6260 00/626 of 9 Sep 14
  - (d) NAVHOSP Lemoore ltr 6260 00/724 of 21 Oct 14
  - (e) Federal OSHA VPP Section II: Worksite Analysis B1/B2

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### ACKNOWLEDGEMENT:

The Space Systems Lab Manager, Mr. David Rigmaiden, is to be commended for his self-initiative in generating ideas to reduce not only his own noise exposure, but also the exposures of others involved in/present during the processes and indirectly also the occupants of nearby courtyard offices in Halligan and Watkins Halls.

- Mr. Rigmaiden's self-initiated idea to reduce noise levels by use of a resonator tube has effectively reduced noise levels to where only those present during the portable tank filling need to wear hearing protection (and only ear muffs or plugs rather than both as was the case prior to implementation of the resonator tube) and has eliminated the need for them to complete annual formal hearing conservation training. He plans to extend the resonator tube with additions to determine if the need for hearing protection by those present during the filling process can be eliminated. The Industrial Hygienist will continue to support this effort as with this and previous noise surveys involving liquid nitrogen filling/dispensing processes.
- Mr. Rigmaiden's self-initiated research identified the standard industry practice of filling flasks from a low pressure rather than high pressure source, and implementation has eliminated the need for hearing protection, as well as reducing waste of expensive liquid nitrogen due to splashing.