

# SAFETY TRAINING GOUGE #6

## GAS-FREE ENGINEERING

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### About "Safety Training Gouge"

If you're an afloat safety officer or division officer, you have a challenging, important role at your command. This series of pamphlets will help you meet your bi-monthly training requirements. Modify and use them at quarters or muster. You can also check the Naval Safety Center website at <http://www.public.navy.mil/navsafecen/Pages/safety-gouge/SafetyGouge.aspx> for the latest issues. We welcome feedback so we can continue to provide you with topics you need. Email LTJG Melissa Balint at [melissa.balint@navy.mil](mailto:melissa.balint@navy.mil).

*This series is prepared by the Naval Safety and Environmental Training Center and the Naval Safety Center.*

### Why do we have gas-free engineers (GFEs)?

Ships have many confined or enclosed non-occupied spaces that have "limited and restricted openings" and "lack of natural ventilation." These spaces aren't intended to be occupied for long periods of time. They are considered unsafe for entry or work until the space has been gas-free tested by a qualified gas-free engineer (GFE).

Hazards result from flammable or explosive materials or atmospheres, toxic materials or atmospheres or oxygen-depleted or oxygen-enriched atmospheres. Entry into (or work in or on) confined spaces may cause fire, explosions, injury, illness, or death. Because hazards are not always readily apparent, nor can you see or smell them, you must test for these hazardous conditions prior to entering confined or enclosed spaces.

After the GFE has declared the space acceptable for entry (there are safe levels of oxygen and absence of toxic gases or vapors), he or she will issue a gas-free certificate, stating the hazard or special precautions that must be followed by each Sailor.

[Cont. on page 2]



At sea aboard an aircraft carrier, two damage controlmen check for hydrogen sulfide gas using a 4-gas analyzer.

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#### Common Gas-Free Certifications

- **Not safe** for personnel – **Not safe** for hot work
- **Not safe** for personnel without protection – **Not safe** for hot work
- **Safe** for personnel – **Not safe** for hot work
- **Safe** for personnel – **Safe** for hot work
- **Not safe** for personnel **inside** – **Safe** for hot work **outside**



## Why do we have GFEs, cont.

Aboard ship, the gas-free certificate is only approved for a maximum of 24 hours. Retesting must be done every 8 hours within the allotted 24 hours to maintain a gas-free certificate in the active status.

GFEP are defined as the GFE, GFEA (assistant), the GFEOP (petty officer) or a marine chemist.



## When not to enter

**Rule of Thumb: Don't enter a confined or unoccupied, unventilated enclosed space until:**

- **A gas-free certificate has been issued**
- **Rescue personnel are prepared to provide assistance**
- **Adequate ventilation has been established**
- **PPE (gloves to handle toxins; face shields; cotton, fire-retardant or disposable clothing) has been issued as determined by the GFE.**

*Knowing when you must gas-free a space can mean the difference between breathing and not breathing.*

## When do you have to gas-free a space?

- Someone has to enter any confined or enclosed space.
- There are excessive levels of oxygen, which increase the danger of fire or explosions.
- Hazardous materials (hazmat) spills
- People are doing hotwork in (or on) any confined or enclosed space, catapult room, bilges, or closed structure.
- The environment is Immediately Dangerous to Life and Health (IDLH). Maybe there isn't enough oxygen (<19.5% or > 22.0%). Or explosive gases are at ≥ 10% of the lower explosive limit (LEL). Or toxic gases are above NIOSH IDLH limits.
- The space contains flammable or explosive atmospheres or materials.
- Workers are spray painting or spray cleaning with a solvent in a confined or enclosed space.
- Toxic gas is leaking. Or toxic atmospheres or materials are present.

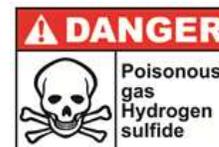
## REFERENCES

1. OPNAVINST 5100.19E chapter B8
2. NSTM Chapter 074V3R5
3. NAVEDTRA 43119-40K Series (Damage Control PQS) Manual

## Two Fatal Mishaps

An HTFA and an FR were removing a flange from a starboard pump when hydrogen sulfide began leaking out. Both Sailors were overcome. The HTFA was extracted from the space and taken by medevac to a hospital, where he died. The FR was hospitalized.

Aboard an underway ship, a pipe ruptured during a test of the fixed aqueous film forming foam (AFFF) system. A Sailor entered the space to isolate the leak but was overcome by hydrogen sulfide within 2-to-5 minutes. The CPOIC pulled him from the space. A second Sailor, unaware of this event, entered the space and collapsed, also overcome by the gas. He inhaled a mixture of salt water and AFFF. Although he began breathing after on-scene emergency medical treatment and advanced life support in the medical ward, he remained in a coma and died of cardiac arrest.



## Shipboard Compartment Hazardous Identification Table

Common Hazard	Compartment Locations
<b>Carbon monoxide (CO)</b>	Diesel generator rooms (also contain carbon dioxide), trapped exhaust gases, and paint lockers. Fresh paint or spaces that were painted and immediately closed. These conditions can cause oxygen deficiency, may indicate a presence of carbon monoxide, and may retain explosive vapors. When spray painting, ventilation must be kept after painting until flammable materials have evaporated and the space is gas free. The space must be re-tested within 10 minutes after the ventilation has been turned off.
<b>Hydrogen sulfide</b>	Fire main piping, strainers, heat exchangers, fuel tanks, sewage piping and holding compartments, AFFF Piping Systems, CHT pump/equipment room and bilges. Standing sea water can deplete oxygen and produce hydrogen sulfide. Hydrogen sulfide is a colorless gas that is a byproduct of degenerating raw organic waste. It is highly toxic, and in high concentrations can cause death from just a few inhalations.
<b>Hydraulic fluids</b>	After-steering compartments
<b>Freon</b>	Air conditioning machinery room, reefer and reefer machinery room.
<b>Oxygen gas cylinders, hydrogen peroxide</b>	Battle dressing stations, DC repair stations (DCRS), medical spaces/ward
<b>Paints, oils and greases</b>	Flammable storage lockers.
<b>Chlorine gas &amp; bleach</b>	Laundry and storerooms
<b>Hydrogen gas</b>	Rust can deplete oxygen and generate hydrogen gas.

Source: Appendix E, NSTM Chapter 074V3R5, Table 074-E-2

## Training and procedures protect shipmates

If you see a Sailor down, stop all work. Evacuate the area and get help immediately. If you see a person unconscious in any space, no one should enter that space without respiratory protection equipment and someone to back you up. Be prepared to give this information: name, specific location and nature of emergency.

**Ensure area is free of hazards:** Notify the chain of command to obtain a GFE services before entering any unventilated, non-occupied space designated to store hazardous or toxic materials, or any sealed space).

**Test the atmosphere:** Verify that such a space was gas free tested and certified safe for entry/or work by the appropriate GFE personnel prior to entry.

**Compliance:** Comply with the requirements of the GFE certificates posted outside the space.

**Notification:** Notify the chain of command before any new space is used to store hazardous or toxic material, or of any spill of hazardous or toxic material. Tell the GFE about any spill of hazmat or any change of storage.

**Use the buddy system:** When working in a confined space, make sure you have an observer who can monitor from outside the space. Maintain communication with personnel outside the space (the type of communication shall be specified by the GFE).

**Training:** Attend required training at indoc and annually thereafter.

Ref: OPNAVINST 5100.19E, para B0802

## Key terms

**Confined Space** -- Any area that isn't designed for people to occupy on a routine basis, or that has limited entry/exit, can contain a dangerous atmosphere. A confined space also may have these characteristics:

- It is large enough for a worker to enter and do work.
- It contains or can contain a hazardous atmosphere, produced by chemicals, sludge or sewage.
- It is laid out so that anyone who enters could be trapped or asphyxiated (walls that converge or a floor that slopes down and tapers to a small cross-section, such as a fuel tank).
- Confined spaces may include: double bottoms, voids, tanks, vats, degreasers, reaction vessels, boiler water and firesides, ventilation and exhaust ducts, pipelines and condensers.

**Enclosed Space** -- A space which by its nature or design is such a shape, depth, other feature that natural ventilation or the natural movement of air is restricted. Examples include engine rooms, pump rooms, machinery rooms, emergency generator rooms and reactor compartments.

**IDLH space** -- IDLH stands for "Immediately Dangerous to Life and Health." Only the CO can approve entry into these spaces. Fuel and sewage/CHT tanks, chemical and AFFF concentrate tanks and piping will always be treated as IDLH. These areas require:

- Using the buddy system. Post attendant personnel immediately outside the access to the space.
- Wear the recommended PPE, a supplied air respirator with a 15-minute back-up air supply, establish rescue control points and communication equipment.
- The self-contained breathing apparatus may be utilized in IDLH spaces as per the criteria outlined in NSTM 074 vol. 3 paragraph 074-19.14.e.



## Are You Inspection Ready? Common INSURV Discrepancies

- No annual review of the GFE Program by the Safety Officer and GFE. GFE notebook was not maintained IAW NSTM Chap. 074, Vol.3.
- Annual emergency rescue training not conducted.
- GFE personnel not recertified by the CO.
- Expired chemical detection tubes.
- The Bio Systems portable gas meter was missing required parts for PMS/ Calibration and calibration gas expended or expired.
- Bellows on the detector tube pump failed leak test.
- Trace gas analyzer was missing required parts for PMS/Calibration.

**For the complete INSURV Checklist for a GFE program, review:**

[http://www.public.navy.mil/fltfor/insurv/Getting\\_Inspected/Pages/Deck\\_Pages/NAVOSH\\_EP.aspx](http://www.public.navy.mil/fltfor/insurv/Getting_Inspected/Pages/Deck_Pages/NAVOSH_EP.aspx)

**Gas Free Engineering Program Assessment Sheet:**

[http://dcfnavymil.org/GFE-FM/gfe-fm/pubs/GFE\\_Tip\\_011.pdf](http://dcfnavymil.org/GFE-FM/gfe-fm/pubs/GFE_Tip_011.pdf)

## Useful Websites

Maritime DC & PPE Information Center, Afloat GFE Engineer Index:

<http://dcfnavymil.org/GFE-FM/gfe-fm/GFE.html>

NAVEDTRA 43119-4 Series (Damage Control PQS):

<http://dcfnavymil.org/GFE-FM/gfe-fm/tips/gfetip011.htm>



A gas-free engineer damage controlman aboard an aircraft carrier responds to a simulated fire.