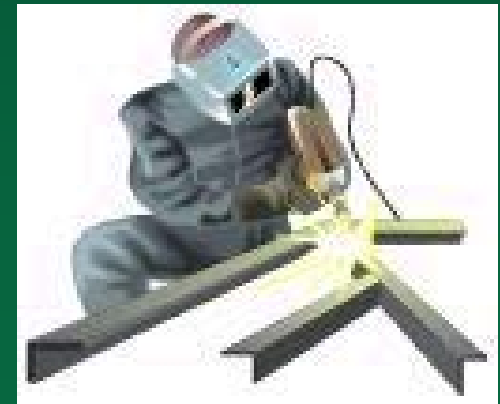


## Lesson Topic 3.2

---

# GAS FREE PROCEDURES FOR HOT WORK



# INTRODUCTION

---

*As Gas Free Engineering Personnel you will be required to know the guide lines, procedures and safety precautions for gas free related hot work.*

## ENABLING OBJECTIVES

---

- Describe the corrective actions and safety precautions to be taken in preparation for Hot work on/in fuel tanks, welding on the exterior of oil tanks, hot work near ammunition/explosive areas, hot work in machinery rooms, and pump rooms and hot work when preservative coating exists in accordance with NSTM Chapter 074 Vol. 3, Gas Free Engineering, NSTM Chapter 074 Vol. 1, Welding and Allied Processes, NAVSEA OP-4, Ammunition Afloat and OPNAVINST 5100.19, series.

## **ENABLING OBJECTIVES**

---

- Describe the purpose, procedures and safety precautions for Inerting, Pressing up, and Steam Blanketing for Hot Work in accordance with NSTM Chapter 074 Vol. 3, Gas Free Engineering and OPNAVINST 5100.19, series.



# REFERENCES FOR HOT WORK

**NSTM 074-VOL 1 SECTION 10**

**•NSTM 074-VOL 3 SECTION 22 & Appendix C**

**•OPNAV 510019.D**

**\*OPNAVINST 8023.21**

**•NAVSEA OP 4**

# Preliminary Procedures/Precautions For Hot Work

# HOT WORK DEFINED:

1. Flame Heating, Welding, Torch Cutting, Brazing or Carbon Arc Gouging.



2. Any Operation Producing Temperatures of  $204^{\circ}\text{C}$  \  $400^{\circ}\text{F}$ .

# HOT WORK DEFINED:

3. Any Operation Occurring in the Presence of Flammables Which Requires the Use or the Presence of an Ignition Source.



## Examples:

Spark-Producing Tools

Arc-Producing Equipment

Grinders > 3" diameter

Open Flames or Embers



# **Cleaning and ventilation for hot work**

---

- Before hot work can begin in a confined space, the space shall be tested, inspected and emptied of flammable cargo then cleaned and ventilated and certified safe for hot work.

# Hot work fire prevention

---

- A fire watch will be present when hot work is performed.
- The fire watch will be properly trained
- Communications will be established to permit the fire watch to report hazardous conditions.

# Fire Watch Requirements



Basic DC  
PQS  
Qualified

All 6 Sides  
Watched

Watch &  
Welder  
Comms

PPE: Visor,  
Flash Gear,  
Gloves



Portable  
Extinguisher  
or Fire Hose

30 minutes  
after Work  
Complete



# GAS FREE RELATED HOT WORK

## PQS QUALIFIED FIRE WATCHES ASSIGNED

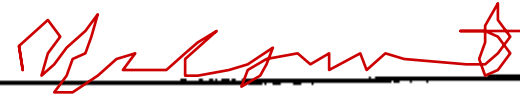
LOCATIONS	PRINT NAME/RATE	SIGNATURE* (UPON COMPLETION)
01-224-3-L	HT2 ALLEN	
1-224-0-C	FN NGUYEN	

TIME SECURED 1530

\*FINAL CHECKUP: WORK AREA AND ALL ADJACENT AREAS TO WHICH SPARKS AND HEAT MIGHT SPREAD WERE INSPECTED 30 MINUTES AFTER THE WORK WAS COMPLETED AND WERE FOUND TO BE FIRE SAFE. THE EQUIPMENT AND STRUCTURES WORKED ON WERE COOL TO THE TOUCH.

I CERTIFY THAT I AM FAMILIAR WITH AND WILL COMPLY WITH ALL SAFETY PRECAUTIONS PERTINENT TO THIS TYPE OF WORK.

HOT WORK OPERATOR SIGNATURE  HT1 (SW) Bowen

HOT WORK SUPERVISOR  DCC(SW) Lacount

FIRE MARSHAL  DC1(SW) Bruderer

SERIAL # \_\_\_\_\_ NAVY GAS FREE CERTIFICATION AND TEST LOG

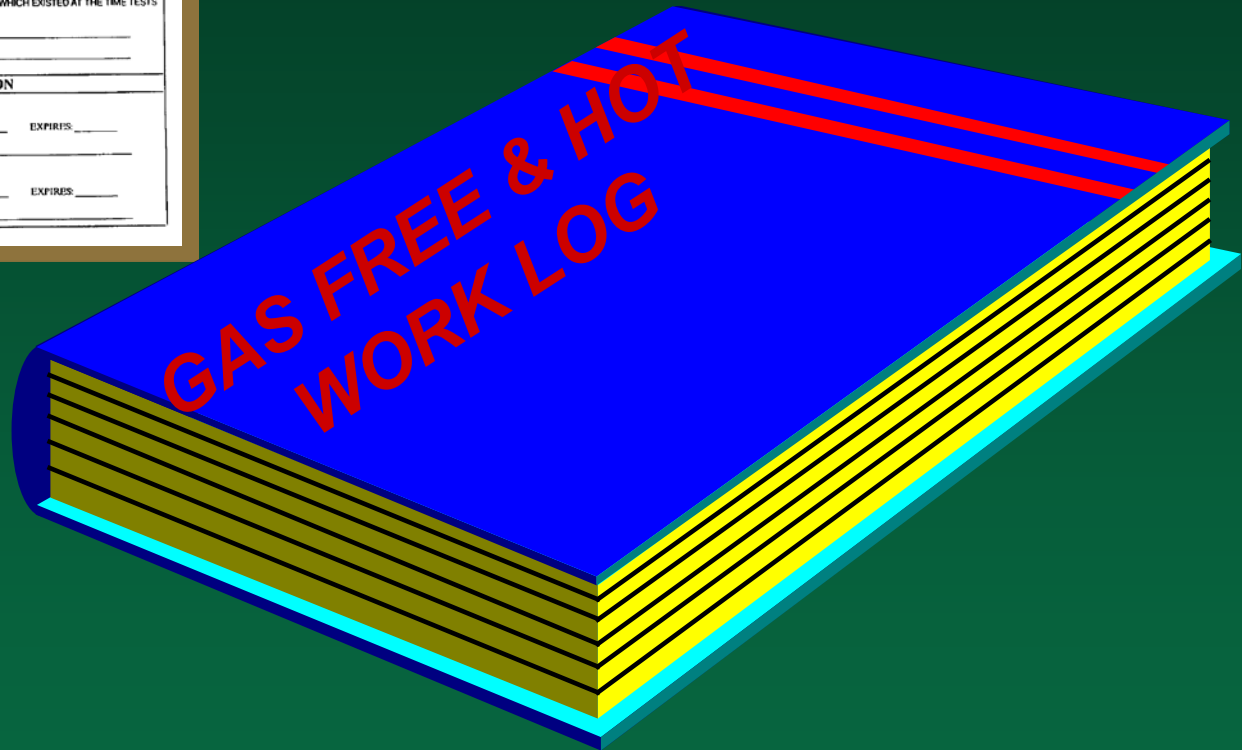
INITIAL CERTIFICATION		TEST RESULTS			
SHIP/UNIT/ACTIVITY: _____		TESTS CONDUCTED AS REQUIRED	INITIAL TEST	1ST RETEST	2ND RETEST
ITEM/COMPARTMENT/SPACE: _____		OXYGEN			
TYPE OF OPERATION TO BE CONDUCTED: _____		COMBUSTIBLE GAS			
INITIAL DATE OF TEST: _____ HOUR: _____ DATE: _____		TOXIC TYPE			
INITIAL TESTER: _____		EXHAUSTING CONDITIONS			
VERIFICATION: _____		NOT SAFE FOR PERSONNEL/ NOT SAFE FOR HOT WORK			
TYPE: _____		NOT SAFE FOR PERSONNEL/ WITHOUT PROTECTION/ NOT SAFE FOR HOT WORK			
INERTED GAS _____ (gpm)		SAFE FOR PERSONNEL/ NOT SAFE FOR HOT WORK			
OR _____ (liquid)		SAFE FOR PERSONNEL/ SAFE FOR HOT WORK			
FRESHENED UP WITH: _____		NOT SAFE FOR PERSONNEL INSIDE/SAFE FOR HOT WORK OUTSIDE			
REQUIREMENTS/CONCLUSIONS/PRESCRIBED PRECAUTIONS/INSTRUCTIONS: _____					
<b>GAS FREE RELATED HOT WORK</b>		NOTE: THIS INSPECTION INDICATES THE CONDITIONS WHICH EXISTED AT THE TIME TESTS WERE CONDUCTED.			
PQS QUALIFIED FIRE WATCHES ASSIGNED		GFE PERSONNEL SIGNATURE: _____			
LOCATIONS	PRINT NAME/RATE	SIGNATURE	CO SIGNATURE, if required _____		
TIME SECURED: _____		<b>RECERTIFICATION</b>			
1ST RETEST/UPDATE		TIME: _____	DATE: _____	EXPIRES: _____	
GFE PERSONNEL SIGNATURE					
2ND RETEST/UPDATE		TIME: _____	DATE: _____	EXPIRES: _____	
GFE PERSONNEL SIGNATURE					

FINAL CHECKUP: WORK AREA AND ALL ADJACENT AREAS TO WHICH SPARKS AND HEAT MIGHT SPREAD WERE INSPECTED 30 MINUTES AFTER THE WORK WAS COMPLETED AND WERE FOUND TO BE FIRE SAFE. THE EQUIPMENT AND STRUCTURES WORKED ON WERE COOL TO THE TOUCH.  
I CERTIFY THAT I AM FAMILIAR WITH AND WILL COMPLY WITH ALL SAFETY PRECAUTIONS PERTINENT TO THIS TYPE OF WORK.

HOT WORK OPERATOR SIGNATURE: \_\_\_\_\_  
HOT WORK SUPERVISOR: \_\_\_\_\_  
FIRE MARSHAL: \_\_\_\_\_

GPNV 510216 (3-91) SN 0107 LF 011-140

**FILE IN YOUR HOT WORK LOG**

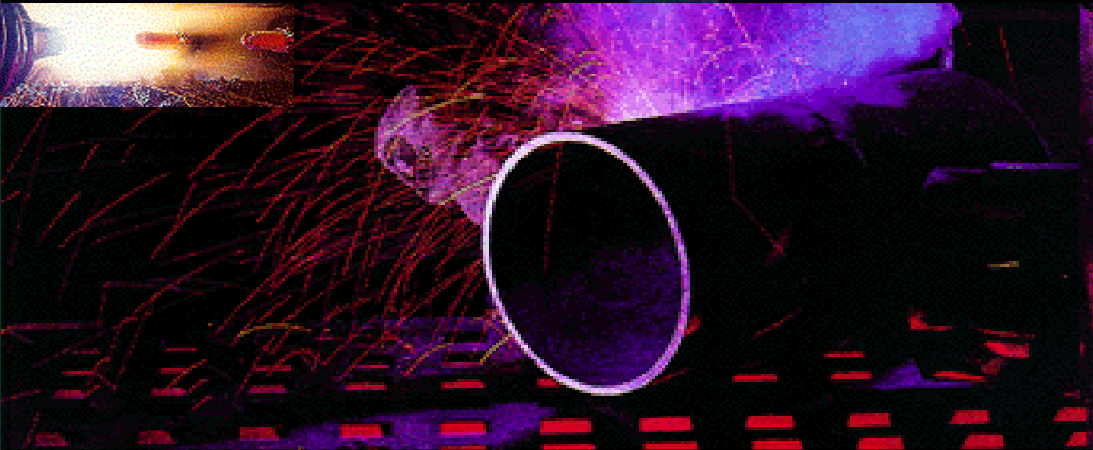
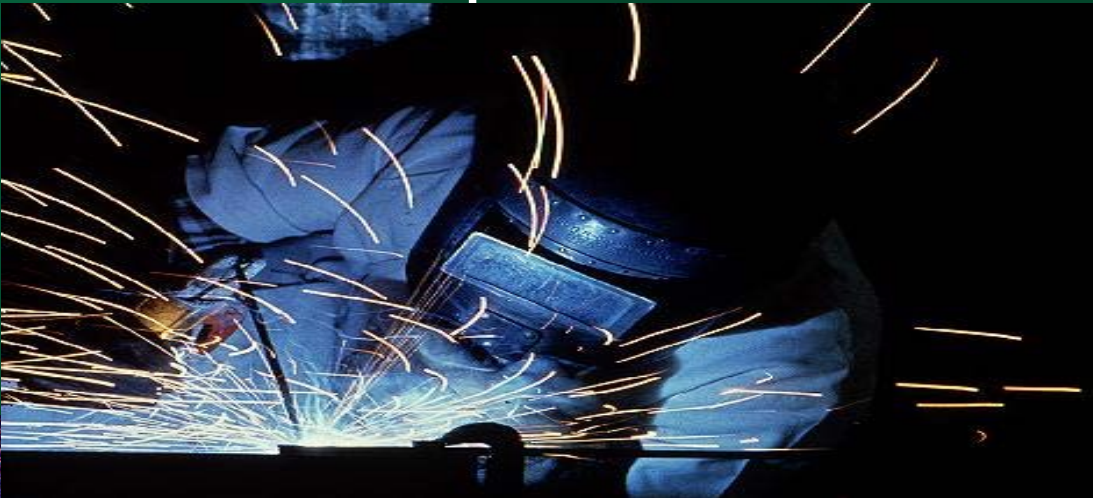


Where only **Class Alpha** Materials are Exposed,

Hot Work is Divided into Two Classes:

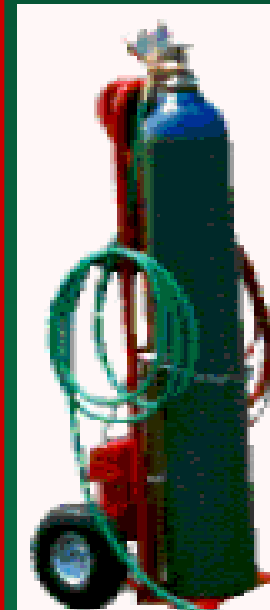
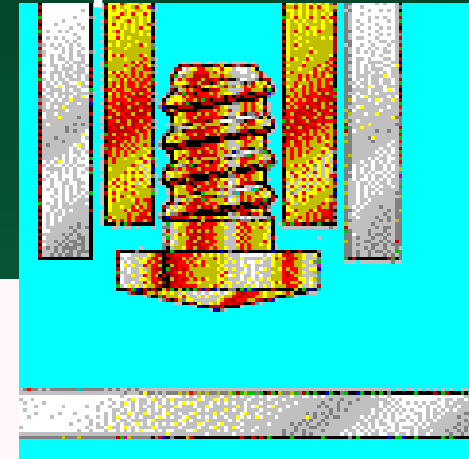
**CLASS I**

High Energy, Scattered Sparks



**CLASS II**

Minimal Energy, Localized Sparks





# \* CLASS I\* : High Energy, Scattered Sparks

Processes that produce high energy sparks or slag that can be thrown or dropped at the work site or produce heat that can be transferred through the deck, overhead, bulkhead, or structure to a location not visible to the hot work operator. --NSTM 074 VOL 1 sec 10.8.1.2

Flame Cutting  
Welding  
Plasma Cutting  
Electric Arc Welding



- Arcing and Gouging
- Thermal Spraying
- Other Hot Sparks/Flames

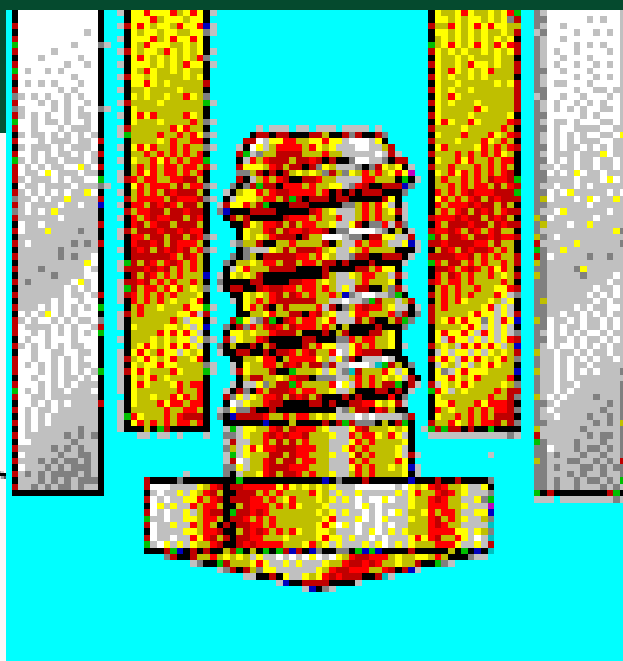
**\*Requires Fire Watch---ALWAYS**

# **\*CLASS II\*: Minimal Energy, Localized Sparks**

Processes that produce flames or minimal energy sparks or slag which are generally localized to the immediate work area.

- Stud Welding with an Electric Stud Gun
- Gas-Tungsten-Arc (GTA) welding

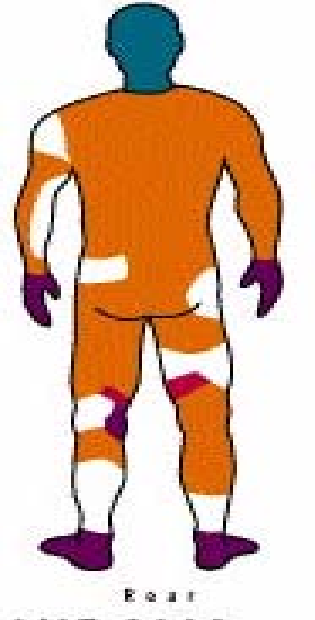
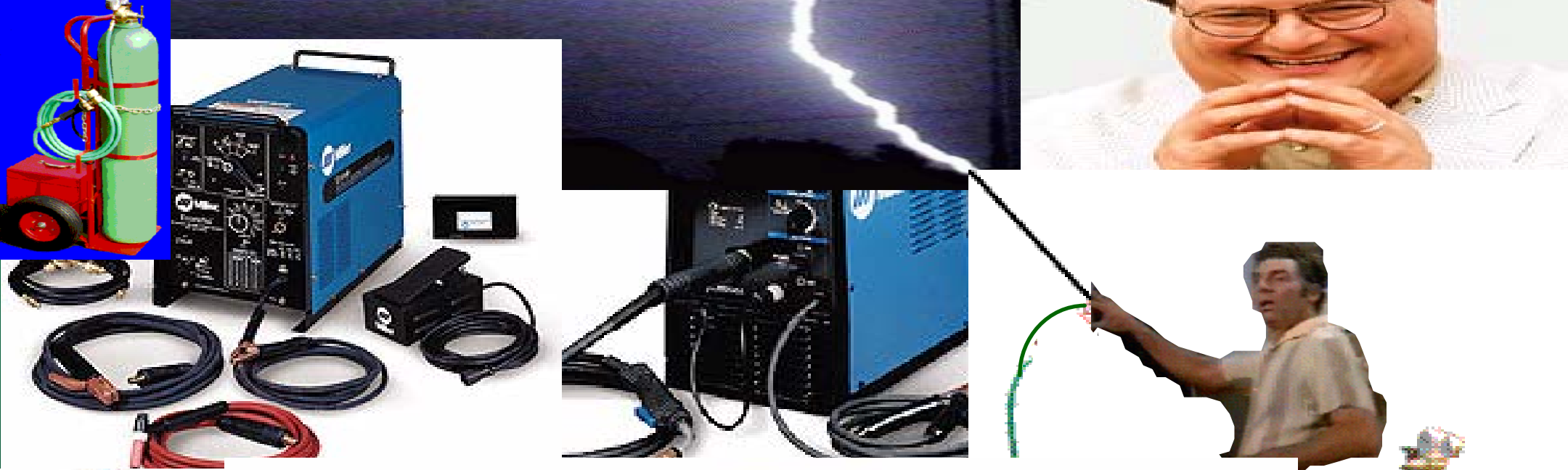
- Torch Brazing
- Ferrous Metal Grinding with Abrasive Disks



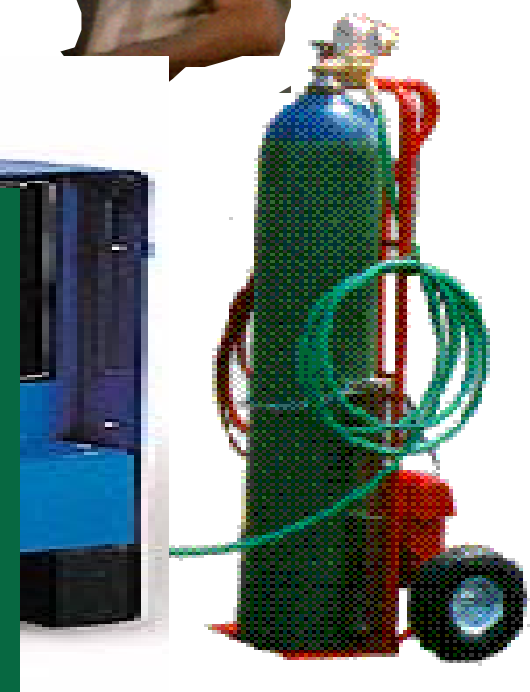
**DCA or Fire Marshall determines the need for a Fire Watch**

**If no Fire Watch, Worker stays for 30 min Cool Down**





- Ground All Electrical Welding Equipment !
- Use Only Non-Shatter Cylinders
- De-Energize Equip Before Walking Away
- Keep Welding Material Clean & Dry
- Wear Protective Gear
- Remove cigarette lighters



# CREW SAFETY

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- Minor skin burns and eye irritation are common injuries for people not involved in hot work.
- When class one hot work is conducted in open areas, flash screens should be used.
- Control spread of smoke and fumes by using local exhaust.

INITIAL CERTIFICATION	TEST RESULTS			
SHIP/UNIT/ACTIVITY: _____	TESTS CONDUCTED AS REQUIRED	INITIAL TEST	1ST RETEST	2ND RETEST
ITEM/COMPARTMENT/SPACE: _____				

**Prior to Issuing a Hot Work Chit, the GFE or Fire Marshall Must Assess Space for Hazards**

EXISTING CONDITIONS	INITIAL TEST	1ST RETEST	2ND RETEST
NOT SAFE FOR PERSONNEL/			

**Any flammables in the space must be re-located a minimum of 35 feet from the work site when possible.**

SAFE FOR HOT WORK			
-------------------	--	--	--

**No Hot Work within 40 feet of Painting or Chemical Cleaning (IAW p. C-16)**

TIME SECURED _____	<b>RECERTIFICATION</b>		
*FINAL CHECKUP: WORK AREA AND ALL ADJACENT AREAS TO WHICH SPARKS AND HEAT MIGHT SPREAD WERE INSPECTED 30 MINUTES AFTER THE WORK WAS COMPLETED AND WERE FOUND TO BE FIRE SAFE. THE EQUIPMENT AND STRUCTURES WORKED ON WERE COOL TO THE TOUCH.	1ST RETEST/UPDATE		
I CERTIFY THAT I AM FAMILIAR WITH AND WILL COMPLY WITH ALL SAFETY PRECAUTIONS PERTINENT TO THIS TYPE OF WORK.	TIME: _____	DATE: _____	EXPIRES: _____
HOT WORK OPERATOR SIGNATURE _____	GFE PERSONNEL SIGNATURE _____		
HOT WORK SUPERVISOR _____	2ND RETEST/UPDATE		
FIRE MARSHAL _____	TIME: _____	DATE: _____	EXPIRES: _____
	GFE PERSONNEL SIGNATURE _____		

# PIPES, TUBES, COILS:

---

*Must be certified safe prior to any hot work.*

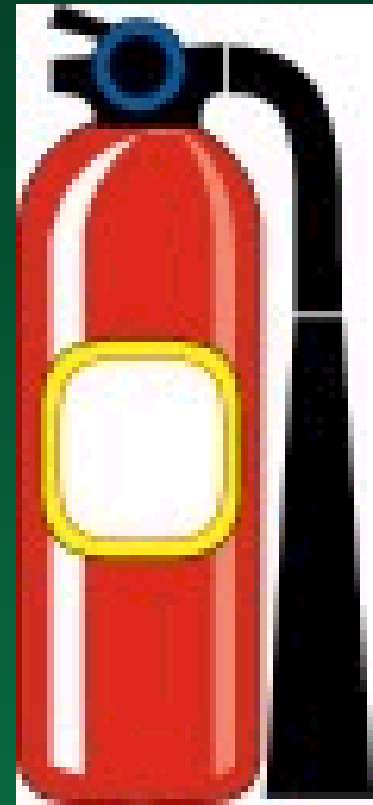
*Valves to pipes, tubes, coils must be closed and pipes blanked off.*

*Do not perform any hot work on Temp Reg Valve (TRV) probe assemblies -- capillary tubing contains highly volatile liquid..*

# Fire extinguishing equipment

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- Provide suitable fire extinguishing equipment depending on the nature and amount of flammables or combustibles present.



# Hot work locations

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## ■ Boundary spaces

- When hot work is performed on fuel tanks, associated vent spaces, or other spaces containing flammables, the adjacent spaces above, below, and on all sides shall first be inspected, tested, cleaned and ventilated or inerted, as appropriate, and certified safe.

# CLOSED CONTAINERS OR STRUCTURES:



- **Hollow Structures, Bilge Keels, Support Stanchions, Bits, Bollards**



- **Must be Flushed, Purged, Inerted, Filled with Water, or otherwise Made Safe**



- **VENTILATE AS REQUIRED**

## Hot Work Near Flammable Coatings

- Determine flammability of coatings before starting hot work.
  - Remove combustible coatings
  - Strip the area at least 4 inches on all sides of the outer edge of the hot work
  - Keep a portable fire bottle or 1½ inch fire hose with vari-nozzle in the immediate vicinity, charged and ready for use.





## Hot Work Near Flammable Coatings

- Test continuously during hot work.
- Where significant outgassing is detected stop hot work and further strip the coating.



## Hot Work Near Flammable Coatings

- Never use flame or uncontrolled heat for stripping flammable coatings.



# Hot Work Near Preservative Coatings

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- Toxic coatings
  - Strip any coatings that are toxic when heated, prior to any hot work.
  - Equip personnel with proper NIOSH approved air line respirators.
  - Establish proper ventilation (local exhaust)

# DAMAGED SURFACES

- *Tank Wall Coatings may Contain Toxicants*
- **Clean Away Blisters, Scales and Similar Formations**
- **Ascertain Previous Tank Contents**
- **Clean / Wet Down Minimum 4' on All Sides of Work Area**
- **Assess Possibility of a Surface Flash Which Would Involve the Whole Space**

# PRESSURIZED SYSTEMS

- Depressurize Nearby Systems such as Hydraulics or Freon
- Protect Piping, Fittings, & Valves From Hot Slag
- Clean Space and Remove Contaminants Before Hot Work

**TAG OUT !!**

## Hot work near insulation

---

- Conduct hot work carefully near combustible insulation.
- Some insulation may be ignited by welding slag
- Foam insulation materials are particularly likely to ignite and to generate toxic combustible products.




# INSULATION

- Remove Insulation 12 inches from the hot work Area
- Wet Down Non-Removable Insulation and Cover with Fire Retardant Cloth
- Station Fire Watch with a Charged 1 1/2" Hose



# **Hot work in/near ammunition and explosive areas**

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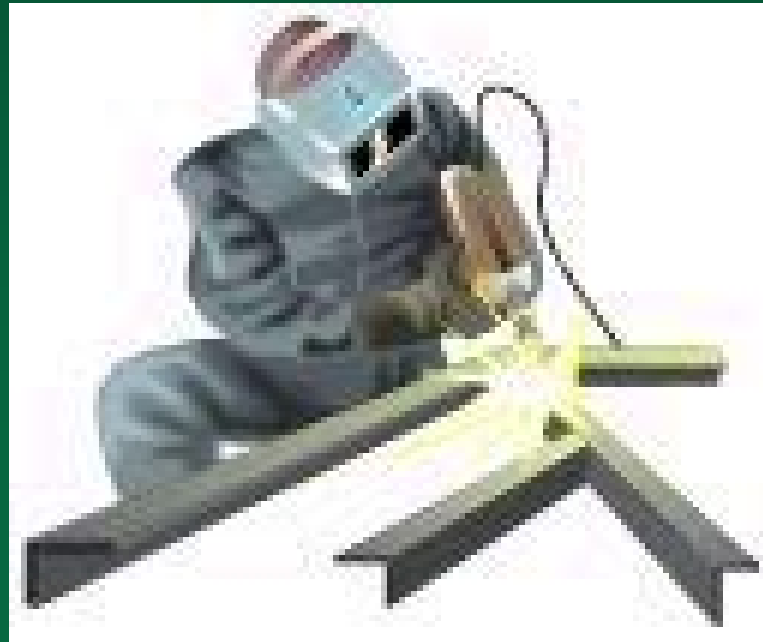
**No flame, heat, or spark  
producing devices shall be  
permitted where explosives  
or flammable materials, batteries,  
or battery charging lockers  
are located.**



# Hot work in/near ammunition and explosive areas

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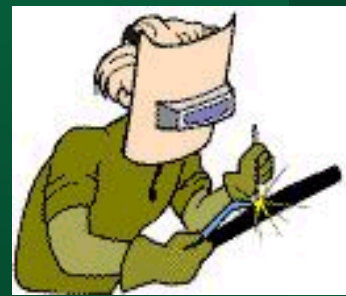
- Hot work in/near ammunition and explosive areas
  - Restrictions for hot work in spaces adjacent to explosive areas.



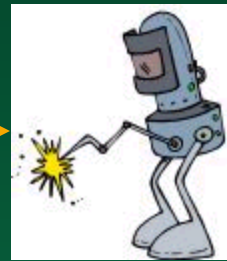
# AMMUNITION AND EXPLOSIVES

- Remove Ammunition Prior to Availability or Overhaul
- No Hot Work in Any Space Containing Ammunition
- CO Must Approve in Writing any Hot Work in Adjacent Spaces
- Apply 5 ft. Rule for Adjacent Spaces

Lesson Topic 3.2, Gas Free Procedures For Hot Work



5 feet



5 feet



5 feet

## NAVSEA OP 4 SIXTH REVISION

**2-22.5. HOT WORK.** The following hot work precautions shall be observed aboard ship:

a. a. Within the ship, no hot work of any type will be performed in any space containing ammunition and explosives. Further, no hot work shall be performed in or on any space adjacent to, directly above, or directly below a space containing ammunition and explosives, except as follows:

(1) After the Weapons/Ordnance Handling Officer and Officer of the Deck (OOD) have been notified.

(2) If the work area is adjacent to, i.e., on the same level as and sharing a bulkhead with, another explosives area, hot work may be performed on the bulkhead furthest removed from the bulkhead shared with the space containing ammunition, or on the overhead, deck and bulkheads at locations **no less than 5 feet** from the shared structural or nonstructural bulkhead.

- (3) In spaces directly below the explosive area, hot work may be performed on the deck and bulkheads at locations **no less than 5 feet** from the overhead. No hot work is permitted in the spaces directly above an explosives area.
- b. Hot work may be performed in other spaces in the vicinity of the explosives area, unless the above considerations prevent doing so. If hot work is required and these criteria cannot be met prior to entering the shipyard, the explosives and other hazardous **materials must be offloaded or moved to another magazine**, if compatible stowage is available. For hot work on external parts of the ship, these requirements may be waived by the ship yard commander, provided safety precautions are taken and the work is not performed on a magazine boundary.
- c. **Welding in the area of loaded submarine vertical launch missile or torpedo tubes shall conform to the following safety requirements:**
- (1) **A firewatch shall be posted at the welding site throughout all phases of the operation.**

**(1) Prior to commencement of hot work, the submarine's weapons officer shall verify the safety of the intended operations and shall ensure that a person from the submarine's weapons department who is knowledgeable of these requirements is present to monitor these operations.**

**(2) Welding shall be in accordance with MIL-STD-1688A(SH) for HY80/HY100 or With NSTM S9086-CH-STM-010/CH-074.**

**During normal ship upkeep periods outside the shipyard, the restrictions on hot work specified in the previous paragraphs shall also apply, except that authorized hot work on the exterior of the ship, not involving magazine boundaries, shall be coordinated between the ship and the naval shore activity commanders.**

**e. If the performance of hot work is necessary which will violate the preceding restrictions, or which will involve a magazine boundary, it may be authorized by the Fleet Commander-in-Chief (FLTCINC) on a one-time case basis. Such violations must be required by urgent operational necessity, as certified by the Operational Commander. Requests for waivers of hot work restrictions requirements will be submitted via the Operational Commander, citing the location and nature of the work, the distance to the nearest compartment containing ammunition or explosives, and the special safety precautions proposed for the performance of hot work. The Operational Commander will certify operational necessity for the hot work to be conducted in a message to FLTCINC, who will then act upon the request. These waivers are considered to be canceled when the short-term evolution for which they were issued is completed.**

**f. Additional safety precautions included in NSTM S9086-CH-STM-010, -020, and -030/CH-074 shall be observed for any hot work in a ship.**

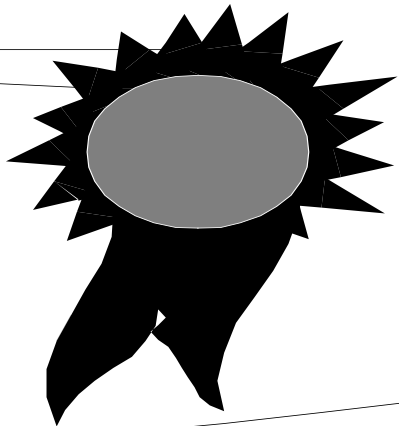
# MISCELLANEOUS HAZARD SPACES

- 
- **Battery Lockers**
  - **Flammable Liquid Storerooms**
  - **Paint Mix and Issue Rooms**
  - **Flammable Gas Cylinder Storerooms**



# **Appendix C Enclosure 6**

## **Alternative Hot Work Permit**



# **SPACES EXEMPT FROM HOT WORK PERMIT** **REQUIREMENTS**

(Due to Design, Work Stands, Curtains & Vent Hoods)

**NSTM 074 vol 3 Appendix C Encl. 13**

**Upper & Lower Nuclear Weld Shop**

**Shipfitter Shop**

**Machine Shop**

**Aviation Engine Shop**

**Aviation Structure Shop**

**R-Div Pipe Shop**

**A-Div Steam Heat Shop**

**Arresting Gear Terminal Socket Pouring Room**

# HAZARDOUS EVOLUTIONS:

- **Hot Work Shall Not be Performed During Fueling or Ammunition Transfer**

**AS TYPE SHIPS ARE EXEMPT**



# Compressed gas cylinders

---

- Keep compressed gas cylinders, or gas manifolds used in welding and cutting operations, out of confined or enclosed spaces.



# **Welding and cutting equipment**

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- Remove electrode holders, torches and hoses from the space at crew change or at night.
- Remove open hoses immediately after connecting torches or other devices from the hose.

# HOT WORK MISHAPS

---

- USS Brisco- 1730 07 May 2001
- NORSHIPCO Norfolk, VA
- While installing condensate return piping, pipe hangers were installed on FWD bulkhead of MER 2. Fire watch on far side of is in AMR 2.
- Heat from welding ignites class “A” materials in GSK storeroom one deck above.
- Main cause- unfamiliar with the ship

# **Inerting, Pressing-up, and Steam Blanketing for Hot Work**

# INERTING, PRESSING-UP AND STEAM BLANKETING

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- NSTM 074 SECTION 24

- CONTAINS DETAILED PROCEDURES AND REQUIREMENTS FOR CONDUCTING EACH EVOLUTION.



# INERTING, PRESSING-UP AND STEAM BLANKETING

---

- MAY BE USED WHEN HOT WORK IS REQUIRED AND NORMAL CLEANING AND GAS FREEING IS IMPOSSIBLE "EMERGENCY USE ONLY"
- NOT FOR USE WITH GASOLINE TANKS
- TOTALLY ISOLATE TANK FROM SURROUNDING SPACES INCLUDING COMMON VENTS AND INTERCONNECTING PIPING

# Inerting

---

- A process whereby flammable vapor-air mixture can be prevented from burning or exploding by mixing in a quantity of inert or nonflammable gas, such as:
  - Carbon Dioxide
  - Dry Nitrogen (Preferred medium)
  - Helium
  - Argon

# Inerting

---

- Permissible only under emergency conditions, or when normal cleaning and gas freeing of confined spaces is impossible.
- Hot work may be permitted on the exterior boundary of a space that has been inerted only under the following restrictions:

# Inerting

---

- Inerting is prohibited on spaces containing highly volatile materials including gasoline, JP-4 fuel, or similar materials with flashpoints of 100 degrees F or less.

# Inerting precautions

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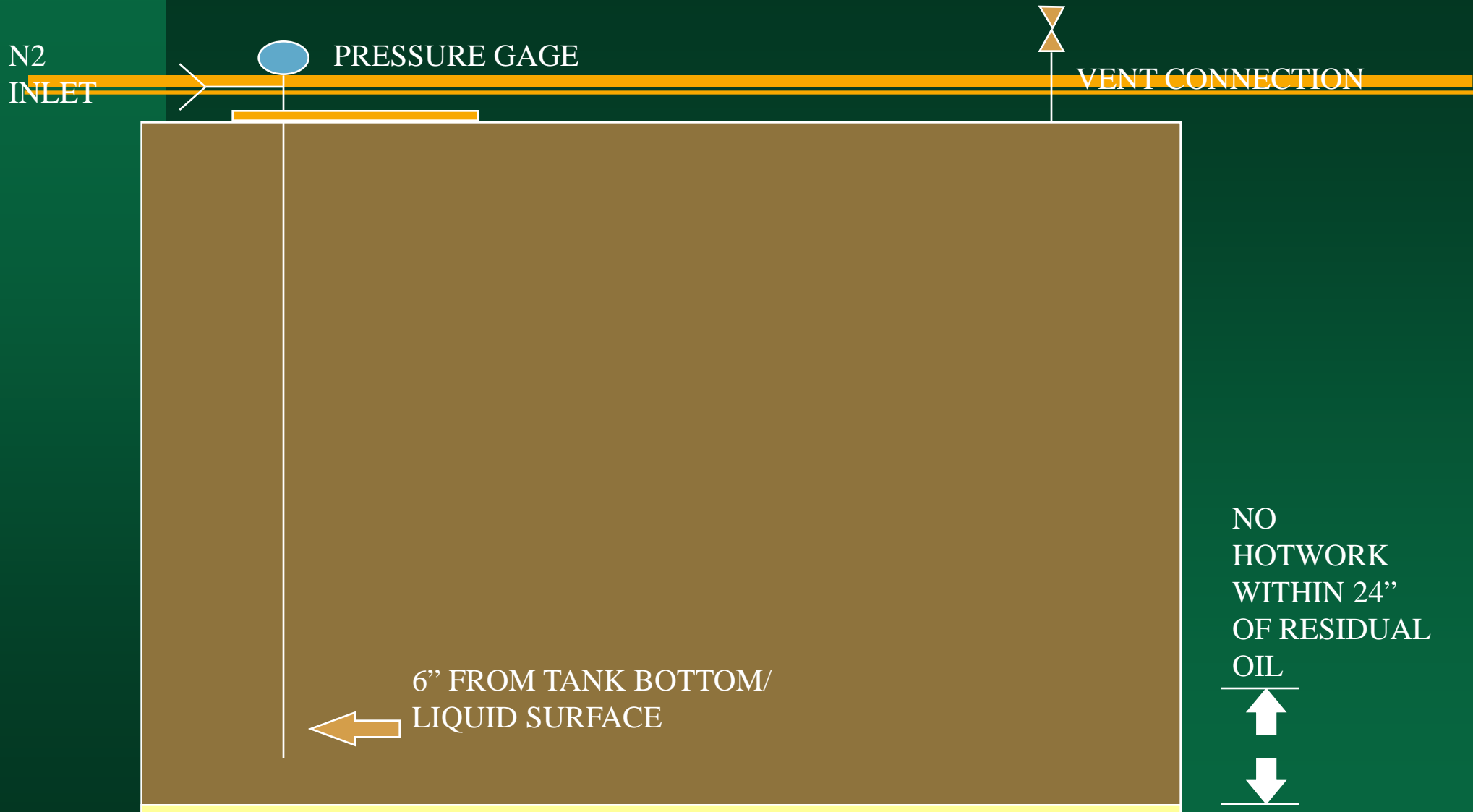
- The oxygen level less than 1%.
  - Conduct test oxygen content at the vent.
  - Dry nitrogen gas is the preferred medium for inerting.
  - All gases from a space must be vented to the outside
  - Ensure vented gases do not drift into other spaces

# Inerting precautions

---

- Eliminate all air pockets
- Pressure for inerting should not exceed 1 psi.

# INERTING WITH N2



# Pressing-up

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- Pressing up is a means of displacing flammable vapor/air mixtures from a space by completely filling space with water.

**WARNING: PRESSING UP IS A LAST RESORT  
BECAUSE IT MAY BE HAZARDOUS EVEN UNDER  
THE BEST CONDITIONS**



# Pressing-up

---

- Pressing up is limited to emergency conditions, when spaces cannot be cleaned and made gas free or gas inerted in accordance with normal procedures.

# Pressing-up

---

## ■ Restrictions

- All restrictions for inerting procedures are applicable during pressing up operations.
- Pump as much flammable or combustible liquid as possible from the tank or space to be pressed up.

# Pressing-up

---

## ■ Restrictions (Cont'd)

- Press up tank or space WITH WATER ONLY.
- Restrict hot work to an area at least 12 inches below the water level.
- Eliminate all air pockets
- Ensure that the strength of the tank walls are not exceeded.

# Steam blanketing

---

- A method for making the outer boundaries of a space safe for hot work by using steam to displace and carry off flammable vapor/air mixtures within the space.

# Steam blanketing

---

**WARNING: TEST AT THE OUTLETS TO ENSURE THAT NO FLAMMABLE VAPOR/AIR MIXTURES ARE PRESENT BEFORE COMMENCING HOT WORK.**

# Steam blanketing

---

- Steam blanketing is NOT practical as an alternative either to cleaning and gas freeing the space or to gas inerting.
- Steam blanketing can be effectively used for closed items such as rudders or skegs, which may contain flammable rust inhibitors or coatings.

# Steam blanketing

---

- Restrictions/requirements:
  - All restrictions for inerting and pressing up are applicable during steam blanketing operations.
  - Steam must be turned on 3 hours prior to hot work and remain on during entire operation.

# Steam blanketing

---

- Restrictions/requirements: (Cont'd)
  - Steam must be visible at the exhaust.
  - Check pressure gauge frequently for build-up of pressure within the tank.
    - ☐ Not to exceed 1 PSI
  - Monitor temperatures of the space wall and boundaries.
    - ☐ No more than 230 degrees F.



# REVIEW AND SUMMARY

## **REVIEW AND SUMMARY**

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- Preliminary Procedures/Precautions for Hot Work.
- Inerting, Pressing-up, and Steam Blanketing for Hot Work.

---

ANY QUESTIONS?