

Executive Overview: U.S. Navy's Acquisition Safety Website



OPNAV Safety Liaison Office

For Questions: joy.erdman@navy.mil

<http://www.safetycenter.navy.mil/acquisition>

Summary

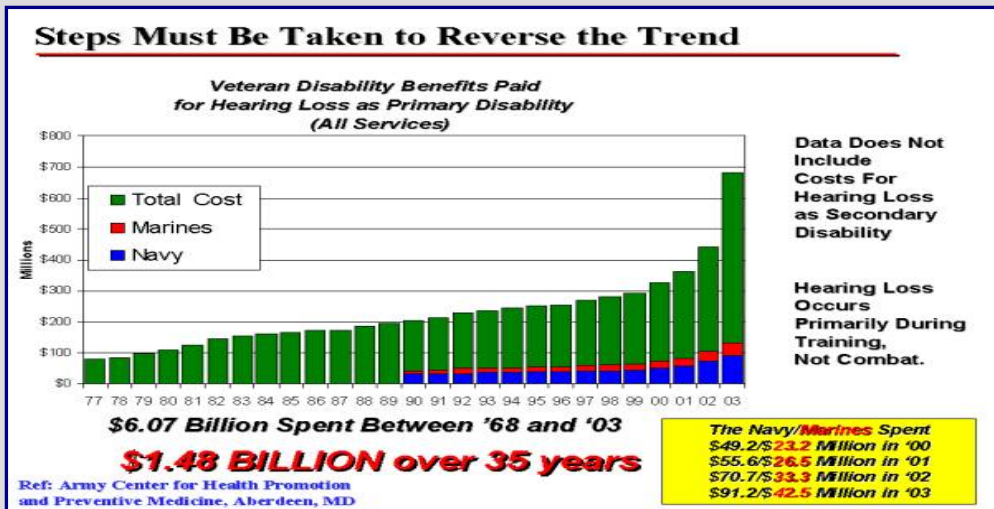
1. Acquisition Safety in Navy
2. Website: <http://www.safetycenter.navy.mil/acquisition>
 - Noise
 - Vibration
 - Ergonomics/Human Factors Engineering
 - Fall Protection
 - Confined Space Entry
 - Ventilation
 - Heat Stress
 - Radar
 - System Safety
 - Nanotechnology – Coming soon
 - Electrical – Coming soon
3. Summary

Acquisition Safety in Navy

- Goal: Save money through better design
 - Primary focus is on Ships
 - Consider construction, use, overhaul, dismantlement
 - Safety during ship use = productivity = readiness
- Tools:
 - Acquisition Safety Policy (OPNAVINST 5100.24 due out soon)
 - Performance Metrics (Disability Costs, Mishap Rates, Military Lost Time)
 - [Website](#)



- Significant safety problems really need solving
 - Describe the risks
 - Provide a compelling reason to change
 - A “Hook” in each section:
 - Noise: Increasing costs of military hearing loss (\$150M/yr +)
 - Vibration: Gangrene fingers from too much vibration
- Safety is focused on the most important!
 - Focus on our Top 10!!!
- Problems are solveable
 - Feasible, Cost Benefit...and compelling need



Work, Play, Live... Safely!
Naval Safety Center

Site Map | Search
 AScA | Shore Aviation | Medical | ODP | Services | Training | Popular

Acquisition Home | Vibration Home | Vibration Resources

Quick Links

- Checklists
- Instructions
- News & Articles
- Presentations
- Safety Awards
- Seasonal Resources
- Success Stories

Focus on Safety

- Mishap Reduction
- Good Samaritan
- Photo of the Week
- Newsletter
- Online Reporting
- SafeTip
- Risk Management

Services

- Online Feedback
- FOIA
- Links
- Plus Ins
- Privacy Policy
- Secure Site (PKI)
- Staff Directory

Acquisition Safety Vibration

- Introduction
- Background
- Relevance of Vibration Control to Acquisition
- Discussion
- Recommendations
- Resources

Introduction

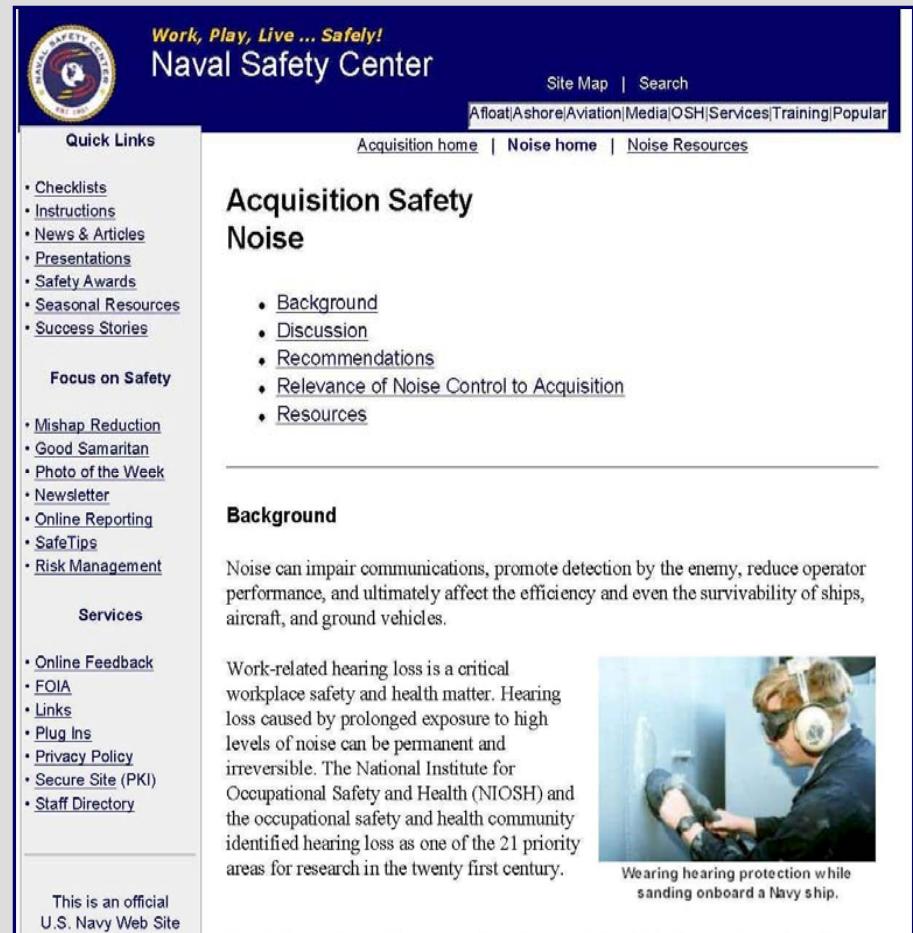
The Navy cares deeply about protecting the safety and health of its greatest resource - its people. In today's workplaces, there exist many potentially serious occupational hazards. Some hazards, like noise-induced hearing loss and heat stress, are well known, heavily reported, and well documented. Much less is known about other workplace perils, which can produce serious, irreversible, and unsuspected diseases. Occupational Vibration, affecting eight to ten million people in the U.S. alone, is one of these less obvious workplace hazards. Because Navy Leadership is concerned about the safety and health of its military and civilian workers, they are working hard to address this under-recognized occupational health problem through acquisition of safe, cost-effective, and performance-improving designs and equipment. This section of the Acquisition Safety website addresses the vibration issue uniquely and in depth. Included are the potential health effects of uncontrolled vibration and ongoing efforts to control this risk to Navy personnel. Also provided are best business practices and technical assistance for acquisition (research, development, design and procurement) of designs and equipment that will maximize productivity and operational effectiveness while protecting operators and maintainers of this equipment.

Hands of vibrating pneumatic hand-tool operator in later stages of irreversible Hand Arm Vibration Syndrome 1

This is an official U.S. Navy Web Site. Contact the Webmaster or Public Affairs Officer.

□ Noise – Why?

- Navy Hearing Loss to Vets is over \$150M/ yr
- Negative impact to health
- Impact to readiness if can't hear important information



The screenshot shows the Naval Safety Center website. The header includes the slogan "Work, Play, Live ... Safely!" and the site name "Naval Safety Center". Navigation links include "Site Map | Search" and a menu with "Afloat/Ashore/Aviation/Media/OSH/Services/Training/Popular". The main content area is titled "Acquisition Safety Noise" and contains a list of links: "Background", "Discussion", "Recommendations", "Relevance of Noise Control to Acquisition", and "Resources". A "Background" section explains that noise can impair communications and affect the efficiency and survivability of ships, aircraft, and ground vehicles. It also states that work-related hearing loss is a critical workplace safety and health matter, citing the National Institute for Occupational Safety and Health (NIOSH). An image shows a person wearing hearing protection while sanding on a ship. The caption reads: "Wearing hearing protection while sanding onboard a Navy ship." The footer of the page states "This is an official U.S. Navy Web Site".

Naval Safety Center
Work, Play, Live ... Safely!
Site Map | Search
Afloat/Ashore/Aviation/Media/OSH/Services/Training/Popular

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Focus on Safety

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Services

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Acquisition Safety Noise

- [Background](#)
- [Discussion](#)
- [Recommendations](#)
- [Relevance of Noise Control to Acquisition](#)
- [Resources](#)

Background

Noise can impair communications, promote detection by the enemy, reduce operator performance, and ultimately affect the efficiency and even the survivability of ships, aircraft, and ground vehicles.

Work-related hearing loss is a critical workplace safety and health matter. Hearing loss caused by prolonged exposure to high levels of noise can be permanent and irreversible. The National Institute for Occupational Safety and Health (NIOSH) and the occupational safety and health community identified hearing loss as one of the 21 priority areas for research in the twenty first century.



Wearing hearing protection while sanding onboard a Navy ship.

This is an official U.S. Navy Web Site

□ Noise

Recommendations

- Minimize noise sources
- Select optimal sound absorbing material
- Keep people from noisiest areas
- Use acoustical engineer to maximize noise control throughout the acquisition



Noise

Example Web-Linked References:

- Noise Control Handbook – Excellent (good/bad designs)
- NIOSH Best Practices in Hearing Loss Prevention
- Military Handbook 2036, "Preparation of Electronic Equipment Specifications"

□ Vibration – Why?

- Hand Arm Vibration
 - Causes Hand Arm Vibration Syndrome
- Whole Body Vibration
 - Concentrates in lower back

Work, Play, Live ... Safely!
Naval Safety Center

Site Map | Search
Afloat/Ashore/Aviation/Media/OSH/Services/Training/Popular


Acquisition home | Vibration home | Vibration Resources

Acquisition Safety Vibration

- Introduction
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Introduction

The Navy cares deeply about protecting the safety and health of its greatest resource - its people. In today's workplaces, there exist many potentially serious occupational hazards. Some hazards, like noise-induced hearing loss and heat stress, are well known, heavily reported, and well documented. Much less is known about other workplace perils, which can produce serious, irreversible, and unsuspected diseases. *Occupational Vibration*, affecting eight to ten million people in the U.S. alone, is one of these less obvious workplace hazards. Because Navy Leadership is concerned about the safety and health of its military and civilian workers, they are working hard to address this under-recognized occupational health problem through acquisition of safe, cost-effective, and performance-improving designs and equipment. This section of the Acquisition Safety website addresses the vibration issue uniquely and in depth. Included are the potential health effects of uncontrolled vibration and ongoing efforts to control this risk to Navy personnel. Also provided are best business practices and technical assistance for acquisition (research, development, design and procurement) of designs and equipment that will maximize productivity and operational effectiveness while protecting operators and maintainers of this equipment.



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□ Vibration

- Hand Arm Vibration
 - Hand Tools



Rare case gangrene hands vibrating pneumatic hand-tool operator, terminal stage irreversible Hand Arm Vibration Syndrome. Copyright 1990, D.E. Wasserman, Inc.; Photo (not U.S. Navy worker) used with permission.



Full finger protected AntiVibration gloves meet ANSI/ISO standards

- Whole Body Vibration
 - Trucks
 - Forklifts
 - Hovercraft
 - Aircraft
 - Ships



Whole Body Vibration can cause operator to lose control of a vehicle.



Whole Body Vibration occurs in workers who regularly operate or ride in helicopters.

□ Vibration

Recommendations

- Vehicles with isolating/floating cabs
- “Air Ride Seats” in vehicles
- “Air Ride Seats” in fixed workstation with floor vibration
- Isolators under machinery
- Low vibration tools



Regular exposure to WBV from heavy equipment can lead to lower back pain in equipment operators

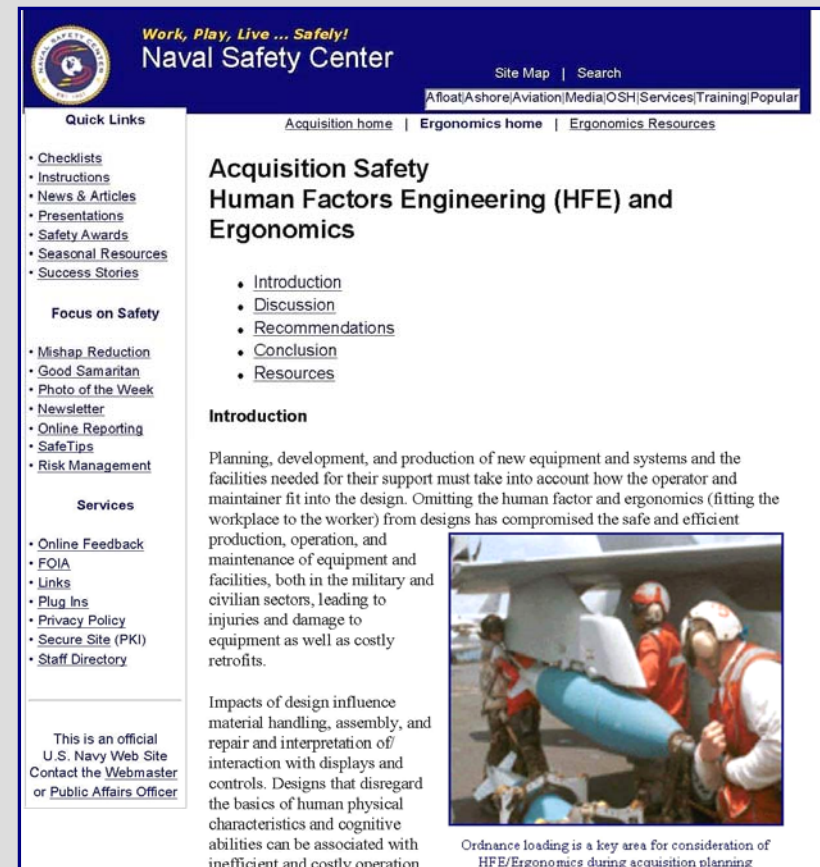
□ Vibration

Example Web-linked References:

- NIOSH 97-141 “Musculoskeletal Disorders...”
- NIOSH #38 “Vibration Syndrome”
- NIOSH Report: “Puget Sound Shipyard’s Vibration Evaluation & Control Program”
- Standards:
 - ACGIH HAV TLV
 - ANSI S3.4o (Glove)
 - ANSI S3.34 (HAV)
 - ANSI S3.18 WBV

□ Ergonomics/Human Factors Engineering (HFE) – Why?

- Ergonomics injuries are #1 most prevalent workplace injury in U.S. and U.S Navy
- All work processes have potential ergonomic issues:
 - Lifting
 - Carrying heavy items
 - Standing for long periods on hard surfaces
 - Working in cramped spaces
 - Using awkward postures (overreaching to work on valves, controls, etc.)
 - Overusing body because of repetitive motions
 - Poor lighting (displays & control panels)
- Ergonomically high risk operations
 - Ship construction
 - Ship operations (watch standing, maintenance ops)
 - Ship overhaul
 - Ship Dismantlement



The screenshot shows the Naval Safety Center website. The header includes the slogan "Work, Play, Live ... Safely!" and the site name "Naval Safety Center". Navigation links include "Site Map", "Search", and a menu for "Afloat/Ashore/Aviation/Media/OSH/Services/Training/Popular". The main content area is titled "Acquisition Safety Human Factors Engineering (HFE) and Ergonomics" and contains a list of links: Introduction, Discussion, Recommendations, Conclusion, and Resources. An "Introduction" section discusses the importance of considering human factors and ergonomics in equipment design to prevent injuries and damage. A photograph shows two personnel in orange safety gear working on a large blue cylindrical object, likely an ordnance component. A caption below the photo states: "Ordnance loading is a key area for consideration of HFE/Ergonomics during acquisition planning."

□ Ergonomics/HFE - Recommendations

- Design with the worker and operations in mind!
- Select correct height for range of workers:
 - Work tables
 - Counters
 - Equipment
- Avoid sharp contact points
- Provide correct lighting for tasks
 - Lower level for computers
 - Higher level for precision work
- Make controls, displays, warning signals user-friendly:
 - Automate & link to central control area
- For work areas that require extensive standing:
 - Use surfaces with anti-fatigue properties
 - Design in foot rails
 - Consider readily available sit-stand stools



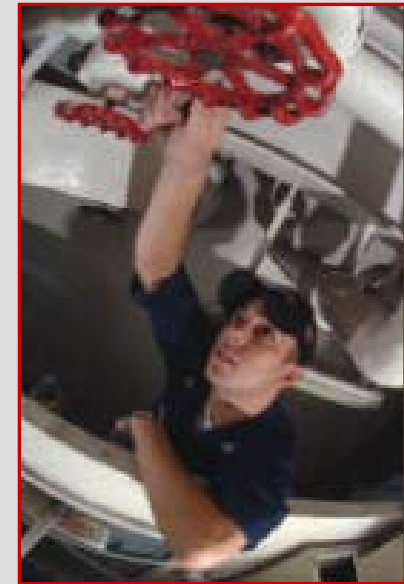
Weapons department personnel push a target overboard



Flight deck crew pushes back F/A-18 *Hornet*

□ Ergonomics/HFE - Recommendations Continued...

- Design with the worker and operations in mind!
- Position valves & controls for easy access.
- If can't position valves, design remote access
- Design to minimize lifting & carrying:
 - Optimize configuration to reduce movement
 - Provide padeyes or lifting points above ladders to allow use of pulleys.
- Replicate Cable Pulling Initiative
 - Mechanically assisted cable pulling installed
 - Reduced time and costs by 50% with 0 injuries.



Extended reaches, strain, and awkward postures can lead to WMSDs.

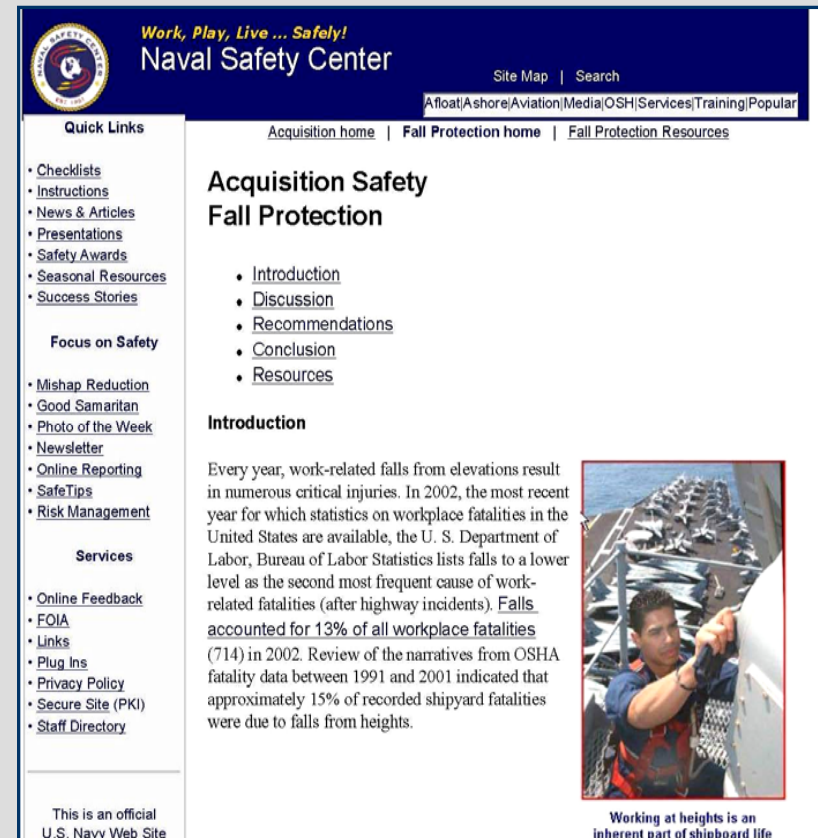
Ergonomics

Example References:

- American Bureau of Shipping (ABS) Guidance Notes for the Application of Ergonomics to Marine Systems.
- ASTM Standard F1166 Practice for Human Engineering Design for Marine Systems , Eqt & Facilities
- DoD Handbook for Human Engineering Design Guidelines Mil-HDBK 759C
- NIOSH Reports Ergonomic Solutions in Shipyards
- OSHA e-Tools:
 - Ergonomics
 - Shipyard Employment: Ship Repair
 - Construction
 - Baggage Handling
 - Beverage Delivery
 - Valves & Controls for Easy Access

□ Fall Protection – Why?

- Risk of falling is prevalent with ships & aircraft:
 - Scaffolds
 - Platforms
 - Auxiliary eqt.
 - Confined spaces
- Working at heights takes more time and can impair quality or frequency of the work
- Falls from heights result in:
 - Down time
 - Medical costs
 - Negative publicity
 - Costly retrofits
 - Decreased morale
 - Reduced readiness
- Cost of fall fatality estimated as \$.8M – \$2.4M

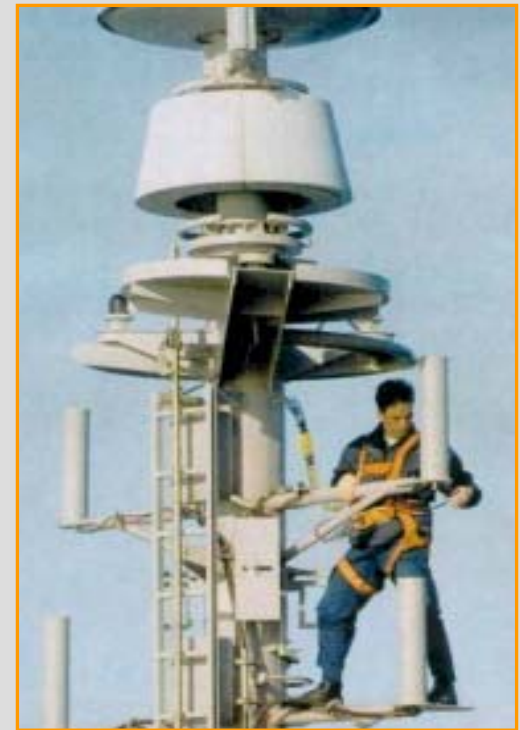


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❑ Fall Protection

High Risk Areas:

- Ship working over the Side
- Ship working aloft (climbing masts)
- Confined Spaces, Tanks, and Voids
- Ladders
- Scaffolding
- Aircraft (maintenance)



Shipboard maintenance often means climbing masts or kingposts

❑ Fall Protection Recommendations

- Ladders: Add secure handrails at tops of ladders
 - Control Panels & Displays: Put at ground level
 - Design to minimize the need to climb
 - Hatch guards with circular openings
 - Use man lifts instead of ladders, scaffolds where possible
 - Design in deck and edge protection
 - Design good traction on working surfaces & ladders (high coefficient of friction)



Note the steep incline of ships' ladders

❑ Fall Protection Recommendations

Continued...

- Design in safe means to raise tools & eqt to elevated work platforms (conveyors, etc.)
- Design to minimize maintenance (long life paint, etc.)
- Design in readily accessible anchorages for scaffolding and fall arrest systems
- Design for remote inspection (robots in fuel tanks, etc.)

❑ Fall Protection

Summary:

- Eliminate need to work at height
- If must work at height, make it safer and more efficient



“Thin skinned” aircraft don’t accommodate anchorages for fall arrest gear.

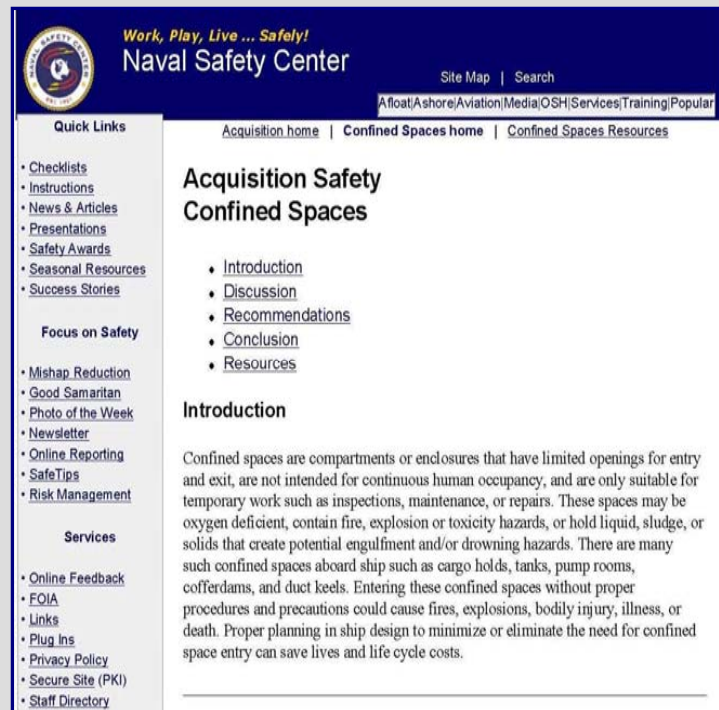
❑ Fall Protection

Example References:

- Navy Fall Protection Guide for Ashore Facilities (useful reference even though not focused on maritime)
- OSHA Maritime standards: 29 CFR 1915
- OSHA Longshoring standards 29 CFR 1918
- ANSI Z359 series Fall Protection

❑ Confined Space Entry – Why?

- Ships and submarines are loaded with confined spaces (150 or more per vessel!)
- Confined spaces are potential death traps during construction, use, repair & overhaul, and ship salvage & dismantlement.



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Acquisition home | **Confined Spaces home** | Confined Spaces Resources

Acquisition Safety Confined Spaces

- [Introduction](#)
- [Discussion](#)
- [Recommendations](#)
- [Conclusion](#)
- [Resources](#)

Introduction

Confined spaces are compartments or enclosures that have limited openings for entry and exit, are not intended for continuous human occupancy, and are only suitable for temporary work such as inspections, maintenance, or repairs. These spaces may be oxygen deficient, contain fire, explosion or toxicity hazards, or hold liquid, sludge, or solids that create potential engulfment and/or drowning hazards. There are many such confined spaces aboard ship such as cargo holds, tanks, pump rooms, cofferdams, and duct keels. Entering these confined spaces without proper procedures and precautions could cause fires, explosions, bodily injury, illness, or death. Proper planning in ship design to minimize or eliminate the need for confined space entry can save lives and life cycle costs.

Quick Links

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Focus on Safety

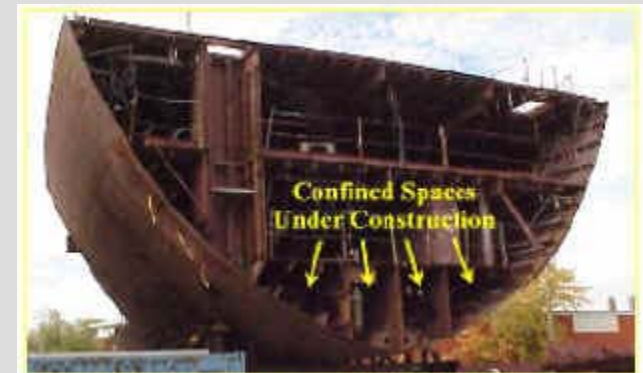
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❑ Confined Space Entry – Why? (Continued)

- Confined spaces can:
 - Be hard to enter & exit
 - Contain hazardous air contaminants
 - Oxygen deficient
 - Toxic
 - Flammable
 - Explosive
 - Include communication problems
 - Have fall hazards
 - And the List Goes On.....
 - Be a one way trip (fatal)
- Confined spaces in tanks have additional problems monitoring fluid levels



❑ Confined Space Entry Recommendations

- Use remote monitoring to eliminate need to enter confined space
 - Non-intrusive radar tank level indicators, mounted on outside of tank (accurate within 1” of fluid in tank).
 - Tank monitoring systems that measure tank corrosion by monitoring changes in electric potential.
 - Can do condition-based maintenance rather than time-based maintenance.
- Use automated cleaning systems to eliminate need to enter confined space
 - Use filters and external pumps to mix water in tanks and automated self-cleaning to prevent sludge build-up.
 - Use of self-propelled video inspection units, telescopic video inspection units, or telescopic valve stems to eliminate need to drain, purge, or enter since inspection is remote.



Naval Research Lab's new Tank Monitoring System Sensor



Example of a robot inspection unit (*courtesy of Inuktun ServicesLtd*)

❑ Confined Space Entry Recommendations Continued...

- When confined space entry is necessary:
 - Provide ventilation, isolation of supply and drain lines, control of hazardous energy, ladders, anchorage, and walkways. [Anticipate the need of the worker]
 - New IMO SOLAS (Safety of Life at Sea) requirement for “permanent means of access (PMA)” to cargo and fuel storage areas. Design in safe, permanent means of access.

❑ Confined Space Entry Recommendations

Continued...

- Use Materials that Reduce Maintenance
 - Coating systems that reduce maintenance & increase service life:
 - Sea Water Tanks increase service life from 5 to 20 yr
 - CHT Tanks from 2 to 8 yr
 - Fuel Tanks from 5 to 20 yr
 - Potable Water Tanks from 5 to 20 yr
 - Use mechanical seals for pump applications that last longer and are easier to install & maintain.



Corrosion is a common problem in shipboard tanks

❑ Confined Space Entry Recommendations

Continued...

- Improve ventilation design in and around confined spaces:
 - Locate supply air away from flammable and toxic air
 - Locate exhaust fan outlets to avoid re-circulation
 - Design ventilation to effectively and efficiently replace the contaminated air
 - Prevent diesel exhaust emissions from re-circulating into confined spaces
 - For fuel oil separators, prevent overpressure which prevents oil vapors from discharging into confined spaces

❑ Confined Space Entry Recommendations

Continued...

- Design safe entry and exit:
 - Two hatches for worker entry plus “butterworth hole” for ventilation.
- Fall Hazard Prevention
 - Fixed ladders, platforms, guardrails, and anchor points for personal fall arrest systems.
 - NSY Puget designed device for bulkheads to accommodate a safety boot for climbing and attach anchorage point.
- Emergency Rescue
 - Big enough holds to remove the injured on a stretcher
 - Handle various stretcher types
 - Anchor points needed for high angle rescue
 - Hoisting points needed for movement of materials & equipment.



Anchor Point Assembly in
training mock-up

❑ Confined Space Entry

Summary:

- Priority #1: Design with goal of eliminating need to enter confined space
 - Remote monitor, long service life, automated cleaning, etc.
- Priority #2: When must enter confined space, design for safe, efficient entry
 - Prevent contaminant incursion
 - Provide adequate ventilation, fall protection, lighting, rescue, communication, and ergonomics.
- Bottom Line: Save lives, increase productivity, save time, and reduce life cycle \$.

□ Ventilation – WHY?

- Clean, breathable air is a necessity to human life
- Clean air on ships/subs is not always optimal:
 - Construction
Grinding, painting, sanding, welding, etc.
 - Ship Use
Laundries, galleys, hazardous material storerooms, ventilation maintenance
 - Ship Dismantlement
Cutting, sawing, grinding, etc.

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Ventilation


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Introduction

Shipboard ventilation systems supply and remove air to/from spaces throughout the ship. In doing so, these systems control quality of breathing air and protect personnel and sensitive equipment from potentially hazardous airborne contaminants, fires, explosions, and excessive heat. The ability of ventilation systems to protect personnel from these hazards is particularly important aboard Navy ships, which are like floating cities fitted into a very limited space. Well designed and easily maintained ventilation systems are critical to a safe and comfortable shipboard work environment.

Ventilation systems include a supply, or makeup air system and an exhaust system. Supply systems replace contaminated air exhausted from a workspace with uncontaminated outside air. Supply ventilations systems also provide replenishment air to air conditioning recirculation systems. Exhaust systems remove odors, heated air, and airborne contaminants from the workspace. Both supply and exhaust airflow quantities must be balanced.

All components of ventilation systems such as fans, motors, ducts, dampers, air intakes and outlets, filters, and access panels, must work properly in order for the systems to operate safely and efficiently. Therefore, ventilation system design must be considered as an essential part of planning, development, and production of new



Buildup of dirt obstructs airflow through ventilation system

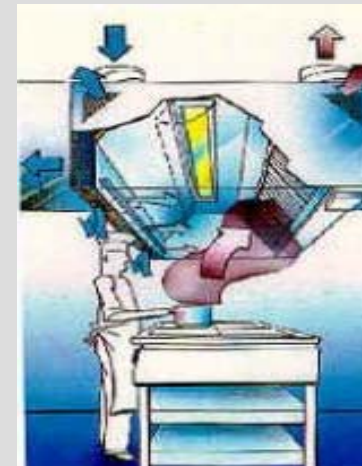
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Contact the Webmaster or Public Affairs Officer

□ Ventilation Recommendations

- Design in local exhaust ventilation for hazardous processes like welding & paint mixing.
- Food Service Areas:
 - Use new technology for food service to simplify & improve ventilation for heat & moisture control.
 - Use high efficiency grease interceptor hoods to eliminate heat, grease, dust, lint, and odors, which are both a fire hazard and maintenance problem. Front supply types offer cooling to the cook. UV technology can be added to break down the grease.
- Reduce ventilation corrosion problems that cost time and money by designing in moisture separators, corrosion resistant materials, and advanced coatings at the ventilation system's air intakes.



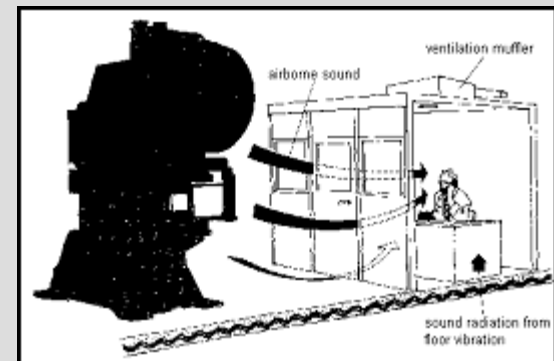
Simple ventilation systems can result from reduced amount of equipment galleys



Innovative commercial cruise ship kitchen ventilation design with grease interceptor and air hoods (*Graphic created by Halton*)

□ Ventilation Recommendations Continued...

- Design control booths for high heat areas where workers need to be cooled, but it's unnecessary to cool the entire space (propulsion spaces).]
- Another option for high heat areas (such as watch standing ops) is spot cooling ventilation (a 'cone of air'), preferably from below, which is more comfortable.



Control booths built into shipboard spaces can provide a temperature and noise controlled environment

□ Ventilation

Recommendations

Continued...

- Disposable filters are generally preferred over filters that require cleaning. They save time, make maintenance easier and are higher quality.
- Use new textile ductwork (made of NOMEX fire retardant material) to provide more even air distribution. The entire length of the duct disperses air evenly into the space, eliminating “hot” spots and “noisier” areas. Ducting can be removed and washed in a washing machine. It’s also lighter than metal.
- Above false ceilings, perforated ductwork provides even distribution to air conditioned spaces.

□ Ventilation

Recommendations

Continued...

- Eliminate ventilation problems by proper ventilation system design. How?
 - Plan and design early in acquisition process
 - Use qualified Industrial Ventilation Engineers
 - Mandate use of Industrial Ventilation Manual

□ Ventilation

Example References:

- ACGIH Industrial Ventilation Manual
- ASHRAE Standard 26-1996
- Product Technical Information

Weblinks provided for Best Technology

- <http://www.navsea.navy.mil/maintenance/Sea04M/CILabor/TextileDucting.asp>
- <http://www.navsea.navy.mil/maintenance/Sea04m/CILabor/MachinerySpaceVentilation.asp>
- <http://www.navsea.navy.mil/maintenance/Sea04m/CILabor/Ventilation.asp>

□ Heat Stress – Why?

- Because heat stress is prevalent:
 - Laundries - Galleys
 - Sculleries - Weather Decks
 - Engineering Spaces
- Result is:
 - Lower performance
 - Lower morale
 - Lower mental alertness
 - Heat stroke, heat exhaustion, heat cramps, heat rash

=====

 - Increases risk of accident
 - Decreased readiness
 - Increases shipboard manning requirements



The screenshot shows the Naval Safety Center website. The header includes the slogan "Work, Play, Live ... Safely!" and the site name "Naval Safety Center". Navigation links include "Acquisition home", "Heat Stress home", and "Heat Stress Resources". The main content area is titled "Acquisition Safety Heat Stress" and lists several topics: Introduction, Discussion, Common Shipboard Heat Stress Challenges, Recommendations, Conclusion, and Resources. Below this is an "Introduction" section featuring a photograph of flight deck personnel on the USS Harry S. Truman, with a caption explaining that newer carriers will use electromagnetic launch systems to eliminate the use of steam.

Work, Play, Live ... Safely!
Naval Safety Center

Site Map | Search

Afloat|Ashore|Aviation|Media|OSH|Services|Training|Popular

Acquisition home | Heat Stress home | Heat Stress Resources

Quick Links

- Checklists
- Instructions
- News & Articles
- Presentations
- Safety Awards
- Seasonal Resources
- Success Stories

Focus on Safety

- Mishap Reduction
- Good Samaritan
- Photo of the Week
- Newsletter
- Online Reporting
- SafeTips
- Risk Management

Services

- Online Feedback
- FOIA
- Links
- Plug Ins
- Privacy Policy
- Secure Site (PKI)
- Staff Directory

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Acquisition Safety Heat Stress

- [Introduction](#)
- [Discussion](#)
- [Common Shipboard Heat Stress Challenges](#)
- [Recommendations](#)
- [Conclusion](#)
- [Resources](#)

Introduction



Flight deck personnel surrounded by steam from the steam-powered catapult on the flight deck of aircraft carrier USS Harry S. Truman. Newer carriers will have an electromagnetic launch system that will eliminate the use of steam in this operation.

□ Heat Stress

- Designers can reduce crew size by reducing heat stress conditions:
 - Prevent steam and water leaks
 - Ensure high quality insulation on steam piping, valves and machinery. Where can't insulate, paint with low emissivity paint
 - Improve ventilation design to reduce heat loss
 - Design to lower temperature & humidity as much as possible (80 degrees not 100 degrees)
 - 90 degrees & 100 % humidity – 4 hr work max
 - 80 degrees & 100% humidity – 8 hr allowed
 - Flight decks, allowable time can be less than 30 min!!
 - Provide remote monitoring outside overheated areas (Automated Heat Stress System (AHSS))
 - Plan for use storage, use of ice vests.



The Automated Heat Stress System (AHSS) measures dry bulb temperature, globe temperature and relative humidity, calculates the WBGT and displays PHEL stay times.



Fireman performs a heat index survey in the auxiliary machinery room aboard mine countermeasure ship USS Dextrous (MCM-13).

□ Heat Stress

- Designers can reduce crew size by reducing heat stress conditions:
 - Laundries, Galleys and Sculleries:
 - Improve ventilation design (supply and exhaust & entire system)
 - Fire-rooms, Engine Rooms, & Steam Catapult Rooms:
 - Usually not feasible to fully control temperature in the whole space
 - Prevent steam and water leaks
 - Use control booths
 - Use remote monitoring
 - Use spot cooling
 - Process to supply fresh water and boiler-feed water:
 - Instead of Flash Type Distilling Units, use Reverse Osmosis Units, which don't generate the heat
 - Weather decks and shipyards:
 - Provide protective cover from sunlight



Controlling heat and humidity in shipboard galleys presents a design challenge.

□ Heat Stress

Successes in the Making:

- New Littoral Combat Ships and new destroyers are being designed for interior air conditioned temperatures of 78 degrees (dry bulb), 65 degrees (wet bulb) and 50% relative humidity.
 - This change will result in big payoff in terms of increased worker comfort and productivity and improved work quality.
 - Computer aided design has been added to assist ship insulation designers (Finite Element Analysis)

□ Heat Stress

Summary:

- **Priority #1** Eliminate heat generation like the Reverse Osmosis Water system
- **Priority #2** Control heat generation like better ventilation and insulation
- **Priority #3** Keep workers out of heat like control rooms, remote monitoring
- **Priority #4** Give workers heat reducing tools like spot cooling, ice vests.

□ Radio Frequency Radiation (RFR) – Why?

High-intensity Radio Frequency Radiation (RFR) exposure can create:

Adverse Effects to People:

- Involuntary muscle contractions
- Electrical shocks/burns
- Excessive heating of tissue

Explosive Risks to Ordnance and Fuel:

- Premature activation of Electro-Explosive Devices
- Electrical arcs that may ignite fuel vapor

The screenshot shows the Naval Safety Center website. The header includes the logo and the slogan "Work, Play, Live ... Safety!". Navigation links include "Afloat", "Ashore", "Aviation", "Media", "OSH", "Services", "Training", and "Popular". The main content area is titled "Acquisition Safety Radio Frequency Radiation (RFR) Hazards" and includes a "Quick Links" sidebar, a "Focus on Safety" section, and a "Services" section. The main text discusses the hazards of RFR, including involuntary muscle contractions, electrical shocks/burns, and excessive heating of tissue. It also mentions the risk of premature activation of Electro-Explosive Devices (EEDs) and electrical arcs that may ignite flammable materials. A warning sign is displayed on the right side of the page, which reads "WARNING RADIO FREQUENCY HAZARD PERSONNEL HAZARD EXISTS IN THIS AREA KEEP MOVING".

Work, Play, Live ... Safety!
Naval Safety Center

Site Map | Search

Afloat | Ashore | Aviation | Media | OSH | Services | Training | Popular


Acquisition home | Radio Frequency Radiation home | RFR Resources

Acquisition Safety Radio Frequency Radiation (RFR) Hazards

- [Introduction](#)
- [Background](#)
- [Recommendations](#)
- [Conclusion](#)

Introduction

Excessive levels of exposure to RFR can result in adverse acute (immediate) effects on people such as involuntary muscle contractions (electrostimulation), electrical shocks/burns (from touching metal objects in RFR fields), and excessive heating of tissue (thermal damage). High-level electromagnetic energy produced by RFR can also induce electrical currents or voltages that may cause premature activation of Electro-Explosive Devices (EEDs) and electrical arcs that may ignite flammable materials. Modern communication and radar transmitters aboard Navy ships can produce high-intensity Radio Frequency Radiation (RFR) environments that are potentially hazardous to 1) operating and maintenance personnel, 2) ordnance and fuels and, 3) associated equipment. The type of biological effect on humans from RFR depends on the frequency of the electromagnetic wave (see Background section for more information). The severity of the biological effect depends on the intensity (strength) of the RFR.



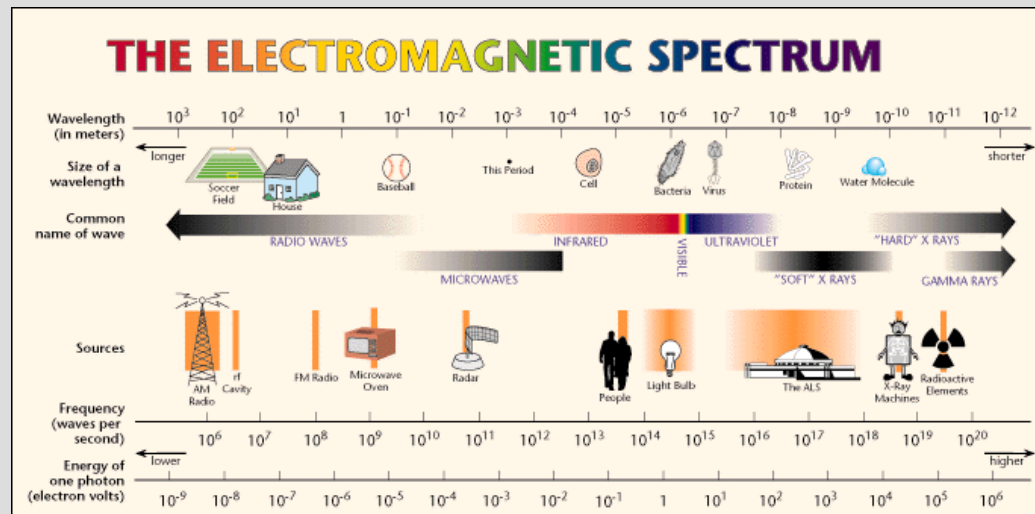
Planning to eliminate or minimize RFR hazards aboard ship should be inherent in the design phases of ship system acquisition. RFR protection and prevention measures must be considered during all phases of ship design, construction, use, maintenance, operation, and final disposal.

This section of the Acquisition Safety website outlines safety and operational concerns regarding RFR and discusses approaches to limit acquisition costs and risks in the ship design

This is an official U.S. Navy Web Site
Contact the [Webmaster](#)
or [Public Affairs Officer](#)

□ Common RFR Sources

- Communication Devices
- Radar transmitters



"Radiofrequency" radiation (RFR) includes Radio waves and microwaves emitted by transmitting antennas.

□ RFR Recommendations:

1. Protection Methods for Navy Personnel

- **RFR Engineering Controls**
 - Use shielding material
 - Design equipment for remote operation
 - Use nonmetallic materials
 - Provide grounding and/or insulating metallic structures
 - Install safety disconnect switches
- **RFR Administrative Controls**
 - Establish controlled procedures
 - Identify Access Restriction/Controlled Areas

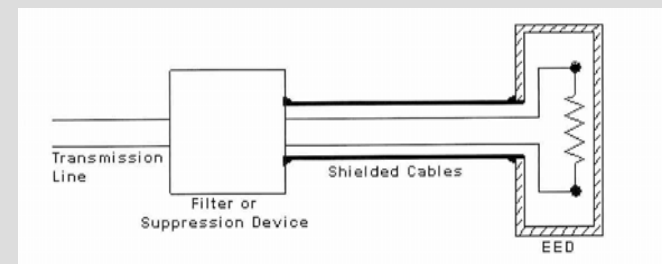


Radar and Communication Systems Aboard
Navy Aircraft Carrier

□ RFR Recommendations:

2. Protection Methods for Ordnance

- Enclose all electrically initiated devices within a continuous electromagnetic interference shield.
- Compartmentalize the ordnance system into shielded subsystems to exclude RF energy.
- Use EMI filter to exclude electromagnetic energy from a shielded enclosure.
- Provide RF Arcing Protection.



Shielded Enclosure with an EMI Filter

□ RFR Recommendations:

3. Protection Methods for Fuel

- Use less volatile fuels such as JP-5.
- Introduce pressurized fueling systems on aircraft.
- Locate transmitting antennas away from fueling stations and vents.



A Marine Corps MV-22B Osprey prepares to refuel while another Osprey approaches the flight deck of the amphibious assault ship USS *Wasp* (LHD 1) for landing.

□ RFR:

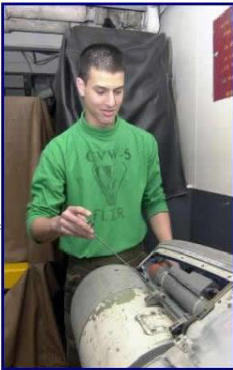
Example References:

- NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010/Volume I, Electromagnetic Radiation Hazards (U)(Hazards To Personnel, Fuel And Other Flammable Material) (U).
- NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010/Volume II, Electromagnetic Radiation Hazards (U) (Hazards to Ordnance) (U).
- NAVSEA OD 30393, Design Principles And Practices For Controlling Hazards Of Electromagnetic Radiation To Ordnance (Hero Design Guide)
- MIL-STD-1310, Standard Practice For Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
- Naval Shore Electronics Criteria Handbook, NSWSG 0101, 106, Electromagnetic Radiation Hazards for guidance on Hazards of Electromagnetic Radiation to Personnel (HERP), Ordnance (HERO), or Fuel (HERF) shielding.

□ Laser Radiation – Why?

- Laser exposure can cause:
 - Severe eye injuries
 - Skin damage
 - Harm to other organs
- The Navy Laser Radiation Safety Program resulted in 0 laser mishaps or injuries during the Gulf War conflict, when tens of thousands of sophisticated laser systems were used.
- The successful Laser Safety Program must be maintained throughout the acquisition process.

<ul style="list-style-type: none">• Checklists• Instructions• News & Articles• Presentations• Safety Awards• Seasonal Resources• Success Stories <p>Focus on Safety</p> <ul style="list-style-type: none">• Navy ESP• Mishap Reduction• Best Practices• Photo of the Week• Newsletter• Online Reporting• SafeTips• Risk Management <p>Services</p> <ul style="list-style-type: none">• Online Feedback• NSC FOIA Request• Navy FOIA• Links• Plug Ins• Privacy Policy• Secure Site (PKI)• Staff Directory <p>This is an official U.S. Navy Web Site. Contact the Webmaster or Public Affairs Officer.</p>	<h2>Acquisition Safety Lasers</h2> <ul style="list-style-type: none">• Introduction• Background• Challenges• Recommendations• Conclusion <h3>Introduction</h3> <p>Exposure to lasers can be hazardous, resulting in permanent and disabling eye injuries, skin damage, and harmful effects to other biological systems. Since May 1996, the Navy's Laser Safety Review Board (LSRB) has provided authoritative safety reviews and assistance for acquisition, development, and deployment of over 100 laser systems, exercises, and deployment protocols.</p> <p>LSRB's early involvement in the acquisition process helped acquisition program managers to minimize their programs' risks, including unacceptable system performance, delays in testing, and cost and schedule slippage. The success of the Navy's Laser Radiation Safety Program is illustrated by the absence of a single mishap or injury attributed to laser systems or misguide laser munitions during the Gulf War conflict, when tens of thousands of sophisticated laser systems were used.</p> <p>The Department of the Navy's (DON) policy (OPNAVINST 5100.19 Series and OPNAVINST 5100.23 Series) is to identify and control Laser Radiation Hazards early during the system design and development process. This section of the Acquisition Safety website will concentrate on the safety and health challenges of laser radiation in the shipboard environment and the Navy's success in designing systems that eliminate risk. [See the Resources Section for more information on DON policy and instruction on Laser Radiation].</p>
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Aboard USS Kitty Hawk (CV 63), an Aviation Electronics Technician 3rd Class disassembles the Forward Looking Infrared (FLIR) pod, which uses lasers to guide laser-guided bombs from F/A-18 "Hornets" to their targets. US Navy photo by Photographer's Mate 3rd Class Lindsay Minturn.

❑ Laser Radiation

- Types:
 - Ultraviolet
 - Visible
 - =====
 - Laser-guided weapons
 - Laser Target identification devices
- Navy uses ANSI Z136.1-2000
- Most Laser mishaps are caused:
 - During alignment of laser beams
 - By misaligned optics
 - By lack of laser eye protection
- Mishap Root Causes:
 - Inadequate training
 - Incorrect Laser Safety Officer conduct
 - Inadequate oversight
 - Failure to wear protective equipment



Sailors assigned to the Weapons Department attach a laser guidance unit to a BLU-111 500-pound general-purpose bomb in an ammunition magazine aboard USS *Kitty Hawk* (CV 63).

□ Laser Radiation Recommendations

- Laser Safety Design and Review:
 - Mandatory “*Laser Safety Design Requirement Checklist*” in OPNAVINST 5100.27.
 - Navy’s Laser Safety Review Board reviews and approves/disapproves design of each future laser system.

❑ Laser Radiation Recommendations (cont.)

- Laser Engineering Controls include:
 - Protective Housing and Interlocks.
 - Remote Firing and Monitoring.
 - Barriers, Beam Stops/Beam Attenuators, and Enclosures.
 - Viewing Windows.
 - Service Access Panel, or requiring removal tool with appropriate warning label.
 - Master Switches (master switch may allow key or coded access (such as a computer code) to operate the laser).
 - Laser Warning Systems such as alarm/buzzer or warning light.
- Laser Administrative Controls
 - Access Restriction
 - Controlled Area



Room size protective laser housing enclosure

❑ Laser Radiation Recommendations (cont.)

Other Acquisition Laser Requirements:

- Define Laser System Safety Officer (LSSO) Roles, Responsibilities, and Training Requirements.
- Provide Appropriate Laser Safety Training and Equipment for Laser Operators/Maintainers.
- Perform Annual Laser Safety Evaluations, Inspections, and Surveys.
- Enforce Laser Safety Personal Protective Equipment
 - Eyewear
 - Skin Protection
 - Laser Event Recorder (LER)



Laser event recorder (LER) warns aviators of potential for eye injury from radiation.

❑ Laser Radiation Summary

- Laser safety design is strict: All Navy Laser Acquisitions must get approval from the Laser Safety Review Board (LSRB).
- Goal is 0 Mishaps
- Technology exists to eliminate all mishaps
- Laser Safety Training and personal protective equipment compliment laser safety design.



Aviation Electrician's mate 2nd Class maneuvers an AQS-24 mine locator, which is designed to use sonar and laser technology to photograph underwater mines.

Laser

Example References:

- Laser Safety for Medical Facilities
- Medical Management of Non-Ionizing Radiation Casualties
- Protection of DoD Personnel from Exposure to Radiofrequency Radiation and Military Exempt Lasers
- Navy Laser Hazards Control Program
- NAVOSH Program Manual for Forces Afloat
- ANSI Z136.1-2000, Safe Use of Lasers
- ACGIH Documentation of the TLVs for Physical Agents
- US Department of Energy, Special Operation Report: Laser Safety
- OSHA Safety & Health Topics Web Page on Non Ionizing Radiation

System Safety Overview

System Safety is the accepted methodology for:

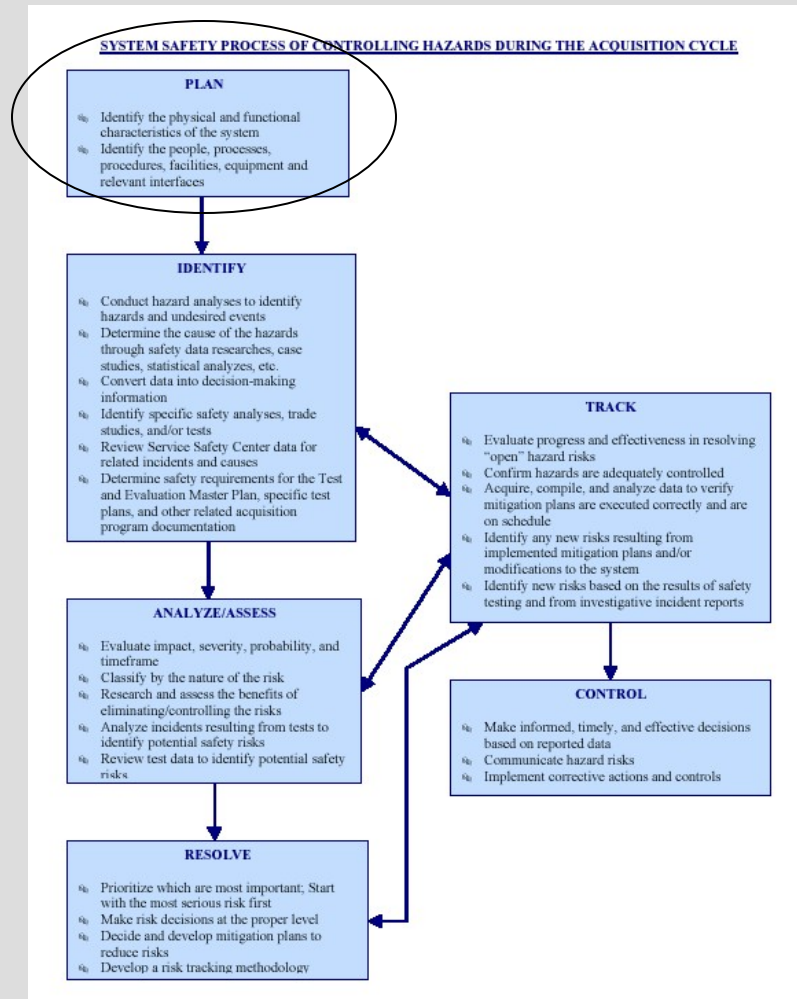
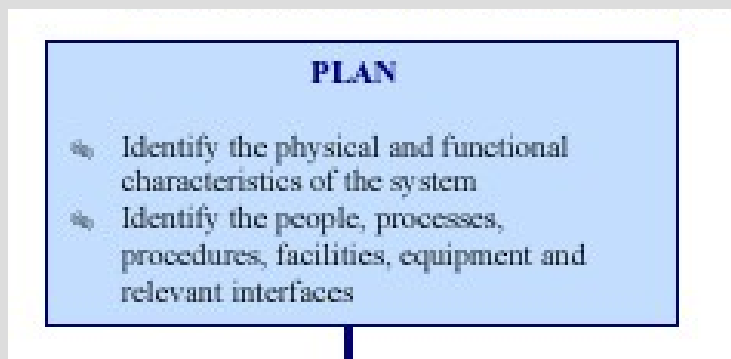
- Identifying and addressing potential hazards during the design process
- Managing safety threats to program viability and cost
- Tracking and resolving potential hazards
- Reducing hazards overlooked during design process (Systems or Sub-systems already acquired)



The screenshot shows the Naval Safety Center website. The header includes the slogan "Work, Play, Live ... Safely!" and the "Naval Safety Center" logo. Navigation links include "Site Map", "Search", "Afloat", "Ashore", "Aviation", "Media", "OSH", "Services", "Training", and "Popular". The main content area features a "System Safety Approach to Acquisition Risk and Cost Management" article. The article text states: "Ensuring that all systems, subsystems, and their interfaces operate effectively, without sustaining failures or jeopardizing the safety and health of operators, maintainers, and system mission is a significant acquisition challenge. Acquisition programs can sustain costly setbacks, and even create unnecessary loss of life, if risk factors are not identified and either eliminated or managed effectively in the developmental process and throughout the life of the system. The discipline of *System Safety* was developed to manage the risks and avert the failures of the American space and rocket program of the late 1950s and early 1960s. It has evolved into a mainstay of acquisition risk management." The article concludes: "*System Safety* is the accepted methodology for identifying potential hazards during the design process and preventing hazards by addressing their root causes. This methodology proactively identifies risks inherent in a process, reviews operations of systems for possible failure modes and provides a systems engineering practices and principles approach to tracking and resolution (by elimination or management) of potential hazards. System Safety is also an approach for managing safety threats to program viability and cost containment. This is

System Safety Approach

- Safety should NOT be considered an “Add On”
 - Incorporate health and safety requirements at the beginning of the acquisition process
 - Early investment ensures reduction of Total Ownership Cost (TOC) throughout the life of the ship, aircraft, weapon system, etc.



System Safety Process

□ System Safety Approach

Continued

Department of Defense

- Views system safety as a means of reducing risk through early identification, analysis, elimination, and control of hazards
- [Mil Std 882 \(Series\)](#) specifically identifies the system safety approach
- [Department of Defense Instruction \(DODI 5000.2\)](#)
 - Requires that Project Managers “have a comprehensive plan for Human Systems Integration early in the acquisition process...”

□ System Safety Approach

Continued

- [Secretary of the Navy Instruction \(SECNAVINST\) 5000.2C](#)
 - States that “the program manager (PM) is accountable for accomplishing program objectives for total life-cycle systems management, including sustainment...”
- [OPNAVINST 5100.24B, Navy System Safety Program Policy](#)
 - Provides policy for implementation of system safety in Department of the Navy. Policy objectives are to eliminate or reduce associated mishap risks, improve operational readiness, reduce life cycle cost, and increase environmental, safety and occupational health for all acquisition programs, over entire program life cycle.

□ Program Manager's Role



- Must make safety a priority in system design
- Responsible for ensuring system safety is integral to the systems engineering process
 - Identify a government lead system safety engineer
- Prepare Programmatic Environmental, Safety, and Health Evaluation (PESHE)
 - PESHE identifies system safety, environmental and occupational health risks, how they are mitigated, and how compliance with regulatory requirements are achieved throughout the life cycle of the system

□ Occupational Safety & Health Professionals' Role

- Safety and Occupational Health professionals can assist the Program Manager ensure safety during design, development, and testing by means of
 - Hazard Analysis
 - Health Hazard Assessments
 - Safety Assessments
 - Risk Management



□ System Safety Engineer's Role

- Optimizes the acquisition process from development to disposal
 - Primary point of contact for all aspects of the system
 - Develops a system safety management approach for the acquisition program and documents the approach in the Government's System Safety Management Plan (SSMP)
 - Ensures the contractor has a System Safety Program Plan (SSPP) for development of the system
 - Establishes a System Safety Working Group (SSWG) made up of Government and contractor representatives



□ Summary : Acquisition Safety Improves Readiness

- Safer Ships will:
 - Help military recruiting
 - Improve military retention
 - Increase productivity
 - Improve war fighter capability
 - Provide a military competitive advantage

□ Summary : Acquisition Safety Saves Money

During concept design	-----	If it costs \$1
At the final drawing stage	-----	It will cost \$10
As a construction modification	-----	It will cost \$100
During start-up and testing	-----	It will cost 1,000
During maintenance phase	-----	It will cost \$10,000



□ Summary : Design is the Future for Safety



Design for Safety is the cutting edge of readiness