TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1A</td>
<td>Introduction to Shipboard Jobs / Safety Training</td>
<td>3</td>
</tr>
<tr>
<td>Lesson 2A</td>
<td>Naval Ship Classes</td>
<td>17</td>
</tr>
<tr>
<td>Lesson 2B</td>
<td>Knot Tying Basics</td>
<td>36</td>
</tr>
<tr>
<td>Lesson 3</td>
<td>Ships Compartmentation</td>
<td>42</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>Ships Nomenclature for all trades</td>
<td>52</td>
</tr>
<tr>
<td>Lesson 5A</td>
<td>Intro to Shop Math - Addition, Subtraction</td>
<td>65</td>
</tr>
<tr>
<td>Lesson 5B</td>
<td>Intro to Shop Math - Fractions (Addition)</td>
<td>65</td>
</tr>
<tr>
<td>Lesson 5C</td>
<td>Intro to Shop Math - Fractions (Subtraction)</td>
<td>66</td>
</tr>
<tr>
<td>Lesson 5D</td>
<td>Intro to Shop Math - Decimals, Percent</td>
<td>66</td>
</tr>
<tr>
<td>Lesson 6</td>
<td>Basic Hand Tools</td>
<td>67</td>
</tr>
<tr>
<td>Lesson 7</td>
<td>Entering Confined Spaces</td>
<td>80</td>
</tr>
</tbody>
</table>
INTRODUCTION TO
SHIPBOARD
JOBS
&
SAFETY
TRAINING

LESSON 1
Introduction

Shipyard related trades:

Shipfitter
Welder
Sheet-metal Mechanic
Machinist
   Inside & Outside
Boilermaker
Electrician
   Marine, High Voltage, Heavy Mobile Equipment
Electronics Mechanic
Pipefitter
Insulator
Shipwright
Fiberglass Boat Builder
Sail Loft
Painter
Rigger
Crane Operator
Temporary Services
   Ventilation, Electrician, Pipefitter
Heavy Mobile Equipment Mechanic
Inspector

Locations:

Norfolk Naval Shipyard
Northrop Grumman - Newport News Shipbuilding
Norshipco Shipyard - B.A.E.
Earl Industries
Jonathon Corporation
Davis Boat Works
Others
Detection and Prevention of Deliberate Malpractice

A fine and/or imprisonment are required by federal law if you are found guilty of fraud or falsification of records against the government.

*Legal Jargon:* “Whoever, in any matter within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals or covers up by any trick, scheme or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.”

*Examples of Deliberate Malpractice are:*

1. Deliberately accepting unsatisfactory work.
2. Intentionally performing unsatisfactory work.
3. Verifying by signature that an action was taken, knowing in fact that the action was not taken, or without performing the required checks to assure the action was taken.
4. Tampering with calibrated instruments in order to avoid rejection of work.
5. Falsifying dates on records to comply with frequency or deadline requirements.
6. Falsifying data in order to have work accepted, thereby avoiding further required work, or to cover up a deviation from a procedure.
7. Intentionally performing unacceptable work.
8. Concealing information on malpractice known to have been committed by others.
9. Verifying action based on hearsay when personal observation was required.
10. Issuing a procedure known to contain an unauthorized deviation from requirements.
11. Knowingly waiving a requirement without authority to do so.
Cases of Deliberate Malpractice are more likely to occur from:

1. When supervision is lacking; Management is not properly providing the required amount of oversight to the employees.
2. There is an insufficient amount or quality of quantitative measurement or testing done for the work.
3. Workers are often assigned to tasks they are not capable of performing.
4. Management shows a lack of interest or refuses to take action on suspected malpractice cases.
5. On-site job checks are not done; only paperwork reviews are completed.
6. Work conditions are poor, which may induce employees to acts of malpractice.
7. Independent oversight is not done.

Examples of Preventive Actions:

Improve Supervision.
Internal Audits and Surveillance.
Develop Awareness of Consequences of Malpractice.
Determine Sensitive Areas.
Use Overcheck Programs.
Records Control.
Carefully Assign Personnel.

A Word to the Wise

Before you determine a case of deliberate malpractice has occurred be sure you have all the facts. The observation of errors and corrections of errors does not automatically mean deliberate malpractice has occurred. The appearance of deliberate malpractice must be proven without a doubt.

All problems noted on a job site should be reported to a supervisor and documented on a deficiency report. This will be submitted to management & engineering departments for the proper resolution. At no time, should a problem ever be ignored or covered up.
Personal Protective Equipment

All workers should wear safety equipment as required by the job site they work at. The common safety equipment includes:

- Hard Hat
- Safety Glasses
- Ear Plugs
- Safety Shoes
- Leather Gloves
- Safety Harness

Do not modify the PPE after it is issued.

Hard hats with the liners out are almost useless.
Normal sunglasses will not protect the eyes when a piece of metal shoots at it.
Safety shoes, for most trades, should be: mid height, leather and have very good traction. Some shops will require special shoes, ex. Electricians. Normal boots will not suffice. If a heavy piece drops on your foot (this happens frequently), the steel toe will protect your foot. Normal shoes will let your toes get crushed.
Cloth or cheap leather gloves will rip easily allowing the worker to get cut. A high quality pair of leather gloves will protect your hands from sharp edges.
Always wear the required PPE for your job!
Blind-Side Work

When working on bulkheads, decks and overheads, it is especially important to check out what is on the other side of the barrier. Accidents happen frequently because workers don’t look on the blind side of the bulkhead. Fires are frequently the problem; but could just as easily cause injury to personnel, damage to equipment, even explosions, if there are flammable vapors or gasses on the other side of the bulkhead.

It is relatively easy to sound out and locate the space. After finding the approximate compartment opposite your work site; you should have a work mate tap the bulkhead with a hammer. You can easily pinpoint the location of the tapping when you come near it. After locating the tapping, you should tap back to confirm the location was spotted. This also serves the purpose of having the mechanic on the other side confirm that you are in the correct position. At this point you should check the area opposite the jobsite for dangerous obstacles or hazards. Once clear, you should post a fire watch or lookout when performing work that could be hazardous to that space.
Respirator Awareness

To deal with the hazards that are a daily concern for workers, the respirator was developed. A respirator allows the worker to be in a hazardous environment and still breath in clean, filtered air. This takes much of the hazard out of hazardous work.

Respirators are attached to the worker by a facepiece. The facepiece is held in place with straps. Typically 1-2 filters are attached to the facepiece or air is fed into the facepiece. The wearer of the respirator must be fitted to the correct size of respirator. Half-face respirators are often worn by painters, welders, etc. Full-face respirators are an alternative for the worker that may be using caustic chemicals or that requires eye protection.

To determine the proper filtration system required, the worker must refer to one of the many charts, books or references available. The filter is determined by the type of mask and the material which needs to be filtered out. Some filters are used multiple times and then discarded and replaced. Others may be used once and discarded.

There are two basic types of respirator:

- Negative-pressure respirators allow the worker to breath in filtered air using mechanical filters and chemical media.
- Positive-pressure units force clean air into the system.

Respirator usage is recommended at any time that fumes/vapors/gasses may be ingested. Full face respirators are especially advantageous as they serve to prevent breathing in toxic substances and also prevent foreign particles from getting into the eyes while working.
Safety Harness

Safety Harnesses are required at all times if worker is at risk of falling from an elevated position. As a general rule, any time the worker is at six feet or more above the working height, a safety harness should be worn. Working height is the distance from the walking surface of the worker to the next lower level that the worker would fall to.

The harness is generally not required if the worker is standing on a deck or solid staging if there are handrails securely attached.

The harness is worn comfortably on the body as shown. It is attached to a secure position by the use of a shock absorbing lanyard or a self retracting lifeline. Special attention should be paid to where you are securing the lanyard. Is the attachment strong enough to hold the person falling, any tools they are holding and the added force of the fall? Do not attach to items that the lanyard could slip off or that may not be able to handle the entire load. The full body harness distributes the force of the fall to the entire body as opposed to safety belts in which the force is concentrated on the waist level position.
Staging

Staging is used to provide a stable work surface at elevated positions. Staging is built using several different designs and is constructed onsite to accommodate the specific situations of each jobsite.

Staging should be built to accommodate the total number of workers, their tools and any force applied to it. A safety factor should be applied that mandates that the staging is built to withstand a greater amount of weight than should ever be allowed to step upon that staging. Falls on the jobsite are a significant hazard; staging should be built to prevent any possibility of this.

Before working on staging, you should perform a list of checks to the staging:

- Is the staging secured and supported safely?
- Is it level?
- Is there a safe ladder or other type of access?
- Is there sufficient decking to perform the job safely?
- Are there handrails at the proper height to prevent falls?
- Are kickboards provided to prevent personnel and tools from falling from the staging?
Work Area Safety Awareness

Make sure to familiarize yourself with required safety precautions when entering into different or unfamiliar surroundings.

Before you turn on a switch, start machinery, or open a valve, check out the location of the other people in the area. Make sure all safety gear is attached to the equipment.

Make sure to pay attention to the surface that you are walking upon. If the surface is uneven or has slippery or loose spots, it is easy to lose your footing and fall.

All electrical cords, hoses, ropes, etc. should be out of the walk path. If they must cross a walk path, they should be elevated or covered over to eliminate the trip hazard.

Make sure the walk path is well lit. This includes all work areas, stairways, and any other personnel passage.

If you are working in sight of other people, you should install barricades to prevent flying sparks & debris from hitting them.

YOU ARE IN CHARGE OF SAFETY ON YOUR JOB!
Asbestos Usage in Shipyards

Asbestos is a fire and heat resistant material that was commonly used in the form of insulation. It is a naturally occurring mineral. Asbestos has been used for insulation, gaskets, sealing pipes and valves, housing shingles, brake liners and many other uses. The use of asbestos was stopped years ago. However, for some of its uses, there has never been an acceptable substitute found. It is still used certain industry with great care.

The danger of asbestos comes when it is an airborne state. It is breathed in by workers. Often, it was on the clothing of those same workers and transported home to wife and children. Several occurrences of family getting asbestos related diseases have been accounted for.

For years, asbestos was widely used as insulation in the shipbuilding industry. Workers were exposed unknowingly to asbestos. The fibers were seen in clouds in the air and those fibers were breathed in since no one wore respirators at the time. The dangers were unknown at the time so few precautions were taken to control the dust. The fibers of asbestos often become airborne while fitting the insulation by cutting, during the removal process also.

The asbestos related diseases include:

**Asbestosis:** a pulmonary condition, only caused by exposure to asbestos, where scar tissue builds up in the lungs causing breathing problems and low blood flow.

**Mesothelioma:** a type of cancer only caused by asbestos exposure that attacks the lining around the lungs and/or heart and/or abdomen.

**Asbestos Related Lung Cancer:** asbestos exposure can lead to the formation of a malignant tumor that blocks the air passages. Cigarette smoking drastically increases the chance of developing an asbestos-related lung cancer in exposed workers. Asbestos workers who do not smoke have a fivefold greater risk of developing lung cancer than non-smokers, and those asbestos workers who smoke have a risk that is 50 to 90 times greater than non-smokers.
Effective Communication on the Job

Many problems on the jobsite are due to poor communication. It is not only between management and the worker; but often the rest of the organization is not communicating effectively.

The three types of communication are:

**Written** – On the job this will include shift reports, turnover sheets to supervisors, deficiency reports, etc. This type of communication should be clear, concise and to the point. There should be no room for interpretation when the report is written clearly. Instead they are often written to be ambiguous or misleading; this is leading the worker into a trouble situation. Deficiency reports (DR’s) are often used to document problems with the jobsite. This is effective only if the problem is written out clearly and the answer is clear as well.

**Verbal** – This is the most common. It is by word of mouth that we do so much communicating. But often times, we assume that the person that is receiving the information is as knowledgeable about the job as we are. They often have very little idea what it is that we are talking about. This is where the problem starts. We then give very little detail and often give incorrect information accidentally. Verbal information is quickly forgotten. If the information is important, it should be recorded by shift reports or similar.

**Graphic** – Drawings, photographs and videos are great means of communication. They can show a problem and what the possible hazards are. People are generally graphic oriented and respond best to seeing photos of accidents, especially if they are often in the same situation. The thought of “That could have been me” is often the response in safety posters and videos. If you are passing along graphic communication in the form of drawings, sketches, etc., you must make sure that they are correct in all aspects. Again, there should be no chance of mis-interpretation on the part of another worker.

With all forms of communication, it is most important to get all the information across in a short, concise message, no matter which type of communication you should use. Make sure to keep it simple and write or draw everything. Do not rely on someone’s memory, especially when you are passing along lots of information.
Shift Reports

The shift report benefit is that all incoming shift workers will begin their shift with a clear understanding of the work that was completed on previous shifts. The benefit of clear and well written shift report is that expensive and major problems that were caused by a lack of communication will be avoided and better decisions are usually made on the job.

Also, due to the fact that the shift report is always available and read by many people, the quality of the work will improve and procedures are carried out fully. Workers tend to take more pride in the work being performed when they put their name on it. The shift report provides this stamp of approval for the worker.

The shift report provides a means of oversight and gives a paper trail that is clearly beneficial in an audit of the jobsite. Each person performing work is aware of their responsibilities and

The shift report is useful to management and to the workers on a jobsite. Incoming managers can quickly catch up on the status of the work. Shift workers can get a verbal turnover and still have a written means of verifying what they were told was actually performed. They can see problems that occurred and possibly avoid those same problems during their shift.

Items that should be listed on a shift report:

- Job Title
- Location of jobsite – be as accurate as possible.
- Location of material for this job.
- Work that was actually performed. Details about the work and how the work was performed will be helpful.
- People that the workers spoke to about the job (engineer, manager, safety, etc.). and useful information from that conversation
- Problems encountered – be specific.
- Resolution to problems – Deficiency report or other paperwork initiated, engineer’s resolution, etc.
• Any additional information that may be helpful to other shifts.

• Signature & date of person writing the shift report.

• This report should be kept with the paperwork at all times for reference. This information is a certified record when signed and dated by the worker. This is the best proof that the work was completed as stated.
NAVAL
SHIP
CLASSES

LESSON 2A
SHIPS CLASSES

The purpose of this training is to enlighten the students of the types of Naval Warships commonly seen at the local shipyards. Private & federal shipyards in this area rely on the Navy for a large part of their work. While working on these ships, it will be beneficial to student and the employer that these future mechanics are aware of the differences in the classes of these ships. Naval Warships are not the only type of vessel seen in local shipyards but it the most common. The list on the next few pages is not an all-inclusive listing of naval ships. However, it is a list of the most common naval vessels seen in this area.

COMMON NAVAL WARSHIP DESIGNATORS

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DESIGNATOR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRCRAFT CARRIERS</td>
<td>CV</td>
<td>MULTI-PURPOSE AIRCRAFT CARRIER</td>
</tr>
<tr>
<td></td>
<td>CVN</td>
<td>MULTI-PURPOSE AIRCRAFT CARRIER (NUCLEAR-PROPULSION)</td>
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<tr>
<td>AMPHIBIOUS</td>
<td>LHA</td>
<td>AMPHIBIOUS ASSAULT SHIP (GENERAL PURPOSE)</td>
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<tr>
<td></td>
<td>LHD</td>
<td>AMPHIBIOUS ASSAULT SHIP (MULTI-PURPOSE)</td>
</tr>
<tr>
<td>GUIDED MISSILE CRUISER</td>
<td>CG</td>
<td>GUIDED MISSILE CRUISER</td>
</tr>
<tr>
<td></td>
<td>DDG</td>
<td>GUIDED MISSILE DESTROYER</td>
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<tr>
<td></td>
<td>FFG</td>
<td>GUIDED MISSILE FRIGATE</td>
</tr>
<tr>
<td>SUBMARINES</td>
<td>SSN 688</td>
<td>SUBMARINE (NUCLEAR-POWERED) – LOS ANGELES CLASS</td>
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<tr>
<td></td>
<td>SSN 774</td>
<td>SUBMARINE (NUCLEAR-POWERED) – VIRGINIA CLASS</td>
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<tr>
<td></td>
<td>SSN 21</td>
<td>SUBMARINE (NUCLEAR-POWERED) – SEAWOLF CLASS</td>
</tr>
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<td></td>
<td>SSBN</td>
<td>BALLISTIC MISSILE SUBMARINE (NUCLEAR-POWERED)</td>
</tr>
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<td></td>
<td>SSGN</td>
<td>GUIDED MISSILE SUBMARINE (NUCLEAR-POWERED)</td>
</tr>
</tbody>
</table>
AIRCRAFT CARRIER – CVN / CV

Since World War II, the U.S. Navy’s carriers have been the national force of choice. In over 80% of the times when the World was faced with international violence, the United States has responded with one or more carrier task forces. Over the past 25 years, requirements for USN carrier forces to be on station to respond to a crisis have increased.

Description
Aircraft carriers provide a wide range of possible response for the National Command Authority.

Features
The aircraft carrier continues to be the centerpiece of the forces necessary for forward presence. Whenever there has been a crisis, the first question has been: "Where are the carriers?" Carriers support and operate aircraft that engage in attacks on airborne, afloat, and ashore targets that threaten free use of the sea; and engage in sustained operations in support of other forces.

Aircraft carriers are deployed worldwide in support of U.S. interests and commitments. They can respond to global crises in ways ranging from peacetime presence to full-scale war. Together with their on-board air wings, the carriers have vital roles across the full spectrum of conflict.

The Nimitz-class carriers, eight operational and two under construction, are the largest warships in the world. USS Nimitz (CVN 68) was the first to undergo its initial refueling during a 33-month Refueling Complex Overhaul at Newport News Shipbuilding in Newport News, Va., in 1998. The next generation of carrier, CVN 21, the hull number will be CVN 78, is programmed to start construction in 2007 and is slated to be placed in commission.
in 2014 to replace *USS Enterprise* (CVN 65) which will be over its 50-year mark. CVN 79 is programmed to begin construction in 2012 and to be placed in commission in 2018.

**Background**

The Carrier Mission is:

- To provide a credible, sustainable, independent forward presence and conventional deterrence in peacetime,

- To operate as the cornerstone of joint/allied maritime expeditionary forces in times of crisis, and

- To operate and support aircraft attacks on enemies, protect friendly forces and engage in sustained independent operations in war.

**General Characteristics, *Nimitz* Class**

**Builder:** Newport News Shipbuilding Co., Newport News, VA.

**Date Deployed:** May 3, 1975 (*USS Nimitz*).

**Unit Cost:** About $4.5 billion each.

**Propulsion:** Two nuclear reactors, four shafts.

**Length:** 1,092 feet (332.85 meters).

**Beam:** 134 feet (40.84 meters); Flight Deck Width: 252 feet (76.8 meters).

**Displacement:** Approximately 97,000 tons (87,996.9 metric tons) full load.

**Speed:** 30+ knots (34.5+ miles per hour).

**Crew:** Ship's Company: 3,200 - Air Wing: 2,480.

**Armament:** Two or three (depending on modification) NATO *Sea Sparrow* launchers, 20mm *Phalanx* CIWS mounts: (3 on *Nimitz* and *Dwight D. Eisenhower* and 4 on *Vinson* and later ships of the class.).

**Aircraft:** 85.

**General Characteristics, *Enterprise* Class**

**Builder:** Newport News Shipbuilding Co., Newport News, VA.

**Date Deployed:** November 25, 1961 (*USS Enterprise*).

**Propulsion:** Eight nuclear reactors, four shafts.

**Length:** 1,101 feet 2 inches (335.64 meters).

**Beam:** 133 feet (39.9 meters); 252 feet (75.6 meters).

**Displacement:** 89,600 tons (81,283.8 metric tons) full load.

**Speed:** 30+ knots (34.5 miles per hour).

**Crew:** Ship's Company: 3,350 - Air Wing 2,480.

**Armament:** Two Sea Sparrow missile launchers, three Phalanx 20 mm CIWS mounts.

**Aircraft:** 85.

**General Characteristics, *John F. Kennedy* Class**

**Builder:** Newport News Shipbuilding, Newport News, VA.

**Date Deployed:** September 7, 1968.

**Propulsion:** Eight boilers, four shafts, 280,000 total shaft horsepower.

**Length:** 1052 feet (315.6 meters).

**Beam:** 130 feet (39.6 meters); Flight Deck Width: 252 feet (76.8 meters).
**Displacement:** 82,000 tons (74,389.1 metric tons) full load.
**Speed:** 30+ knots (34.5 miles per hour).
**Crew:** Ship’s Company: 3,117 - Air Wing 2,480.
**Armament:** Sea Sparrow missiles with box launchers, Three 20mm Phalanx CIWS.
**Aircraft:** Approximately 85.

**General Characteristics, Kitty Hawk Class**
**Builder:** New York Ship Building Corp., Camden, NJ.
**Date Deployed:** April 29, 1961 (USS Kitty Hawk).
**Propulsion:** Eight boilers, four geared steam turbines, four shafts, 280,000 shaft horsepower.
**Length:** 1062.5 feet (323.8 meters).
**Beam:** 130 feet (39 meters); Flight Deck Width: 252 feet (76.8 meters).
**Displacement:** Approx. 80,800 tons (73,300.5 metric tons) full load.
**Speed:** 30+ knots (34.5+ miles per hour).
**Crew:** Ship’s Company: 3,150 - Air Wing: 2,480.
**Armament:** Sea Sparrow launchers, 3 20mm Phalanx CIWS mounts.
**Aircraft:** 85.
AMPHIBIOUS ASSAULT SHIPS - LHA/LHD/LHA(R)

USS IWO JIMA (LHD-7)

Description
The largest of all amphibious warfare ships; resembles a small aircraft carrier; capable of Vertical/Short Take Off and Landing (V/STOL), Short Take Off Vertical Landing (STOVL), Vertical Take Off and Landing (VTOL) tilt-rotor and Rotary Wing (RW) aircraft operations; contains a well-deck to support use of Landing Craft Air Cushion (LCAC) and other watercraft.

Features
Modern U.S. Navy Amphibious Assault Ships project power and maintain presence by serving as the cornerstone of the Amphibious Readiness Group (ARG) / Expeditionary Strike Group (ESG). A key element of the Seapower 21 pillars of Sea Strike and Sea Basing, these ships transport and land elements of the Marine Expeditionary Brigade (MEB) with a combination of aircraft and landing craft.

The Tarawa-class LHA provides the Marine Corps with a superb means of ship-to-shore movement by helicopter in addition to movement by landing craft. Three LHAs—which have extensive storage capacity and can accommodate both LCUs and LCACs—were unusually active during Operations Desert Shield/Storm. Since that time, LHAs (and, later, LHDs) have been participants in major humanitarian-assistance, occupation, and combat operations in which the United States has been involved. Such operations have included providing support to NATO forces engaged in keeping the peace in Bosnia, taking part in rescue operations in the offshore waters of African countries ravaged by civil war, and in Kosovo in 1999, and participating in Operation Enduring Freedom in the Arabian Sea and
the Gulf of Oman in 2001 and 2002. Also, during 2000, *USS Essex* (LHD 2) swapped forward-deployed naval force assignments with *USS Belleau Wood* (LHA 3) as the “big-deck” amphibious ship in Sasebo, Japan. *USS Iwo Jima* (LHD 7) was commissioned in June 2001, and had her first deployment in 2003.

In April 2002 a construction contract was awarded for LHD 8 (Makin Island) with contract delivery to the Navy scheduled no later than 31 July 2007. In 2003, the majority of the amphibious assault ships participated in *Operation Iraqi Freedom*, conducting concurrent Well Deck and Flight Deck operations as an integral part of the multi-national forces operations. In 2003, *USS Peleliu* (LHA 5) deployed as centerpiece of an Expeditionary Strike Group (ESG), introducing a new concept of operations, replacing the Amphibious Ready Groups (ARGs). With delivery of LHD 7, the Navy and Marine Corps has a flexible force of ships—LHAs/LHDs, LPDs, and LSD 41/49s—that can provide 12 fully capable Expeditionary Strike Group forces to fulfill anticipated Marine Corps Lift and forward-presence requirements. The amphibious capability of the fleet will be improved with construction of LHD 8 and the replacement of the *Austin*-class LPDs by *San Antonio*-class LPDs.

**Background**

Amphibious warships are designed to support the Marine Corps tenets of Operational Maneuver From the Sea (OMFTS) and Ship to Objective Maneuver (STOM). They must be able to sail in harm’s way and provide a rapid buildup of combat power ashore in the face of opposition. Because of their inherent capabilities, these ships have been and will continue to be called upon to also support humanitarian and other contingency missions on short notice. The United States maintains the largest and most capable amphibious force in the world. The WASP-class are currently the largest amphibious ships in the world. The lead ship, *USS Wasp* (LHD 1) was commissioned in July 1989 in Norfolk, Va. LHA Replacement or LHA(R) is the next step in the incremental development of the “Big Deck Amphib”. She is being designed to accommodate the Marine Corps’ future Air Combat Element (ACE) including F-35B Joint Strike Fighter (JSF) and MV-22 Osprey, provide additional vehicle and cargo stowage capacities and enable a broader, more flexible Command and Control capability.

**Program Status**

LHDs 1-7 are in-service. LHD 8 is under construction and expected to deliver in July 2007. LHAR program is in the early stages. The lead LHAR is planned for delivery to the Fleet in 2013.

**General Characteristics, LHA(R) Class**

**Builder:** TBD (currently undergoing functional design).

**Date Deployed:** Scheduled for delivery to the fleet in 2013.

**Propulsion:** Two marine gas turbines, two shafts, 70,000 total brake horsepower.

**Length:** 921 feet (280.7 meters).

**Beam:** 116 feet (35.4 meters).

**Displacement:** Approximately 50,100 long tons (50,905 metric tons) full load.

**Speed:** 20+ knots.

**Aircraft:** A mix of: F-35B Joint Strike Fighters (JSF) STOVL aircraft; MV-22 Osprey VTOL tiltrotors; CH-53E Sea Stallion helicopters; UH-1Y Huey helicopters; AH-1Z Super Cobra
General Characteristics, Wasp Class
Builder: Northrop Grumman Ship Systems Ingalls Operations, Pascagoula, MS.
Date Deployed: July 29, 1989 (USS Wasp)
Propulsion: (LHDs 1–7) two boilers, two geared steam turbines, two shafts, 70,000 total shaft horsepower; (LHD 8) two gas turbines, two shafts; 70,000 total shaft horsepower, two 5,000 horsepower auxiliary propulsion motors.
Length: 844 feet (253.2 meters).
Beam: 106 feet (31.8 meters).
Displacement: LHDs 1-4: 40,650 tons full load (41,302.3 metric tons)
LHDs 5-7: 40,358 tons full load (41,005.6 metric tons)
LHD 8: 41,772 tons full load (42,442.3 metric tons).
Speed: 20+ knots (23.5+ miles per hour).
Crew: Ships Company: 104 officers, 1,004 enlisted
Marine Detachment: 1,894.
Armament: Two RAM launchers; two NATO Sea Sparrow launchers; three 20mm Phalanx CIWS mounts (two on LHD 5-7); four .50 cal. machine guns; four 25 mm Mk 38 machine guns (LHD 5-7 have three 25 mm Mk 38 machine guns).
Aircraft: 12 CH-46 Sea Knight helicopters; 4 CH-53E Sea Stallion helicopters; 6 AV-8B Harrier attack aircraft; 3 UH-1N Huey helicopters; 4 AH-1W Super Cobra helicopters.
(planned capability to embark MV-22 Osprey VTOL tilt-rotors).

General Characteristics, Tarawa Class
Builder: Ingalls Shipbuilding, Pascagoula, MS.
Date Deployed: May 29, 1976 (USS Tarawa)
Propulsion: Two boilers, two geared steam turbines, two shafts, 70,000 total shaft horsepower.
Length: 820 feet (249.9 meters).
Beam: 106 feet (31.8 meters).
Displacement: 39,400 tons (40,032 metric tons) full load.
Speed: 24 knots (27.6 miles per hour).
Crew: Ships Company: 82 officers, 882 enlisted
Marine Detachment 1,900 plus.
Armament: Two RAM launchers; two Phalanx 20 mm CIWS mount; three .50 cal. machine guns; four 25 mm Mk 38 machine guns.
Aircraft: 12 CH-46 Sea Knight helicopters; 4 CH-53E Sea Stallion helicopters; 6 AV-8B Harrier attack aircraft; 3 UH-1N Huey helicopters; 4 AH-1W Super Cobra helicopters.
CRUISERS - CG

**Description**
Large combat vessel with multiple target response capability.

**Features**
Modern U.S. Navy guided missile cruisers perform primarily in a Battle Force role. These ships are multi-mission [Air Warfare (AW), Undersea Warfare (USW), and Surface Warfare (SUW)] surface combatants capable of supporting carrier battle groups, amphibious forces, or of operating independently and as flagships of surface action groups. Cruisers are equipped with *Tomahawk* cruise missiles giving them additional long range strike mission capability.

**Background**
Technological advances in the Standard Missile coupled with the AEGIS combat system in the *Ticonderoga* class cruisers have increased the AAW capability of surface combatants to pinpoint accuracy from wave-top to zenith. The addition of *Tomahawk* in the CG-47 has vastly complicated unit target planning for any potential enemy and returned an offensive strike role to the surface forces that seemed to have been lost to air power at Pearl Harbor.

The lead ship of the class, *USS Ticonderoga* (CG 47) was decommissioned on 30 September 2004.
General Characteristics, *Ticonderoga Class*

**Builder:** Ingalls Shipbuilding: CG 47-50, CG 52-57, 59, 62, 65-66, 68-69, 71-73
Bath Iron Works: CG 51, 58, 60-61, 63-64, 67, 70.

**Date Deployed:** 22 January 1983 (*USS Ticonderoga*)

**Unit Cost:** About $1 billion each.

**Propulsion:** 4 General Electric LM 2500 gas turbine engines; 2 shafts, 80,000 shaft horsepower total.

**Length:** 567 feet.

**Beam:** 55 feet.

**Displacement:** 9,600 tons (9,754.06 metric tons) full load.

**Speed:** 30 plus knots.

**Crew:** 24 Officers, 340 Enlisted.

**Armament:** MK26 missile launcher (CG 47 thru CG 51) Standard Missile (MR) or MK41 vertical launching system (CG 52 thru CG 73) Standard Missile (MR); Vertical Launch ASROC (VLA) Missile; Tomahawk Cruise Missile; Six MK-46 torpedoes (from two triple mounts); Two MK 45 5-inch/54 caliber lightweight guns; Two Phalanx close-in-weapons systems.

**Aircraft:** Two SH-2 *Seasprite* (LAMPS) in CG 47-48; Two SH-60 *Sea Hawk* (LAMPS III).
DESTROYERS - DDG

USS Arleigh Burke (DDG 51)

Description
These fast warships provide multi-mission offensive and defensive capabilities, and can operate independently or as part of carrier battle groups, surface action groups, amphibious ready groups, and underway replenishment groups.

Features
Destroyers and guided missile destroyers operate in support of carrier battle groups, surface action groups, amphibious groups and replenishment groups. Destroyers primarily perform anti-submarine warfare duty while guided missile destroyers are multi-mission [Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), and Anti-Surface Warfare (ASUW)] surface combatants. The addition of the Mk-41 Vertical Launch System or Tomahawk Armored Box Launchers (ABLs) to many Spruance-class destroyers has greatly expanded the role of the destroyer in strike warfare.

Background
Technological advances have improved the capability of modern destroyers culminating in the Arleigh Burke (DDG 51) class. Named for the Navy’s most famous destroyer squadron combat commander and three-time Chief of Naval Operations, the Arleigh Burke was commissioned July 4, 1991, and was the most powerful surface combatant ever put to sea. Like the larger Ticonderoga-class cruisers, DDG 51’s combat systems center around the Aegis combat system and the SPY-ID, multi-function phased array radar. The combination of Aegis, the Vertical Launching System, an advanced anti-submarine warfare system, advanced anti-aircraft missiles and Tomahawk, the Burke-class continues the revolution at sea.

The DDG 51 class incorporates all-steel construction. In 1975, the cruiser USS Belknap (CG 26) collided with USS John F. Kennedy (CV 67). Belknap suffered severe damage and casualties because of her aluminum superstructure. On the basis of that event, the decision was made that all future surface combatants would return to a steel superstructure. And, like most modern U.S. surface combatants, DDG 51 utilizes gas
turbine propulsion. These ships replaced the older Charles F. Adams and Farragut-class guided missile destroyers.

**General Characteristics, Arleigh Burke class**

**Builder:** Bath Iron Works, Ingalls Shipbuilding.

**SPY-1 Radar and Combat System Integrator:** Lockheed Martin

**Date Deployed:** July 4, 1991 (USS Arleigh Burke)

**Propulsion:** Four General Electric LM 2500-30 gas turbines; two shafts, 100,000 total shaft horsepower.

**Length:** Flights I and II (DDG 51-78): 505 feet (153.92 meters)
Flight IIA (DDG 79-98): 509½ feet (155.29 meters).

**Beam:** 59 feet (18 meters).

**Displacement:** Hulls 51 through 71: 8,315 tons (8,448.04 metric tons) full load
Hulls 72 through 78: 8,400 tons (8,534.4 metric tons) full load
Hulls 79 and on: 9,200 tons (9,347.2 metric tons) full load.

**Speed:** in excess of 30 knots.

**Crew:** 23 officers, 300 enlisted.

**Armament:** Standard missile; Harpoon; Vertical Launch ASROC (VLA) missiles;
Tomahawk®; six Mk-46 torpedoes (from two triple tube mounts); one 5

**Aircraft:** LAMPS III electronics installed on landing deck for coordinated DDG 51/helo
ASW operations (DDG 51-78). Two SH-60 Seahawk LAMPS III helicopters (DDG 79-105)
FRIGATES - FFG

USS Ingraham along USS Sacramento & USS Carl Vinson

Description
Frigates fulfill a Protection of Shipping (POS) mission as Anti-Submarine Warfare (ASW) combatants for amphibious expeditionary forces, underway replenishment groups and merchant convoys.

Background
The guided missile frigates (FFG) bring an anti-air warfare (AAW) capability to the frigate mission, but they have some limitations. Designed as cost efficient surface combatants, they lack the multi-mission capability necessary for modern surface combatants faced with multiple, high-technology threats. They also offer limited capacity for growth. Despite this, the FFG 7 class is a robust platform, capable of withstanding considerable damage. This "toughness" was aptly demonstrated when USS Samuel B. Roberts struck a mine and USS Stark was hit by two Exocet cruise missiles. In both cases the ships survived, were repaired and returned to the fleet. USS Stark was decommissioned in May 1999.

The Surface Combatant Force Requirement Study does not define any need for a single mission ship such as the frigate and there are no frigates planned in the Navy's five-year shipbuilding plan.

Point Of Contact
Public Affairs Office
Naval Sea Systems Command
Washington, D.C. 20362

General Characteristics, Oliver Hazard Perry Class
Builder: Bath Iron Works: FFG 8, 11, 13, 15, 29, 32, 36, 39, 42, 45, 47, 49, 50, 53, 55, 56, 58, 59
Todd Shipyards, Seattle: FFG 28, 31, 37, 40, 48, 52
Todd Shipyards, San Pedro, Calif.: FFG 9, 12, 14, 19, 23, 30, 33, 38, 41, 43, 46, 51, 54, 57, 60, 61.

**Date Deployed:** 17 December 1977 (*Oliver Hazard Perry*)

**Propulsion:** Two General Electric LM 2500 gas turbine engines; 1 shaft, 41,000 shaft horsepower total.

**Length:** 445 feet (133.5 meters); 453 feet (135.9 meters) with LAMPS III modification.

**Beam:** 45 feet (13.5 meters).

**Displacement:** 4,100 tons (4,165.80 metric tons) full load.

**Speed:** 29 plus knots (33.4+ miles per hour).

**Crew:** 17 Officers, 198 Enlisted.

**Armament:** Standard Missile (MR); *Harpoon* (from Standard Missile Launcher); Six MK-46 torpedoes (from two triple mounts); One 76 mm (3-inch)/62 caliber MK 75 rapid fire gun; One *Phalanx* close-in-weapons system.

**Aircraft:** Two SH-60 (LAMPS III) in FFG 8, 28, 29, 32, 33, 36-61

One SH-2 (Lamps Mk-I) in FFG 9-19, 30, 31.
ATTACK SUBMARINES - SSN

USS Los Angeles

Description
Attack submarine, designed to seek and destroy enemy submarines and surface ships.

Background
The concept of technical superiority over numerical superiority was and still is the driving force in American submarine development. A number of Third World countries are acquiring modern state-of-the-art non-nuclear submarines. Countering this threat is the primary mission of U.S. nuclear attack submarines.

Their other missions range from intelligence collection and special forces delivery to anti-ship and strike warfare. The Navy began construction of Seawolf-class submarines in 1989. Seawolf is designed to be exceptionally quiet, fast well-armed with advanced sensors. It is a multi-mission vessel, capable of deploying to forward ocean areas to search out and destroy enemy submarines and surface ships and to fire missiles in support of other forces.

The first of the class, Seawolf (SSN 21), completed its initial sea trials in July 1996. Attack submarines also carry the Tomahawk cruise missile. Tomahawk launches from attack submarines were successfully conducted during Operation Desert Storm.

In late 1998, the contract was let for building the first of the New Attack Submarine. This class, the Virginia-class fully embraces the new strategic concept in ... From the Sea and Forward... From the Sea. It is the first U.S. submarine to be designed for battlespace dominance across a broad spectrum of regional and littoral missions as well as open-ocean, 'blue water' missions. The Virginia-class achieves the right balance of core military capabilities and affordability.

The Benjamin Franklin-class were converted from Fleet Ballistic Missile submarines and carry drydeck shelters. They are equipped for special operations and support SEALs. The
former missile spaces have been converted to accommodations, storage, and recreation spaces.

**General Characteristics, Virginia class**
**Builder:** General Dynamics Electric Boat Division and Northrop Grumman Newport News  
**Date Deployed:** Commissioned 23 October 2004  
**Propulsion:** One nuclear reactor, one shaft  
**Length:** 377 feet (114.8 meters)  
**Beam:** 34 feet (10.4 meters)  
**Displacement:** Approximately 7,800 tons (7,925 metric tons) submerged  
**Speed:** 25+ knots (28+ miles per hour, 46.3+ kph)  
**Crew:** 134: 14 Officers; 120 Enlisted  
**Armament:** *Tomahawk* missiles, twelve VLS tubes, MK-48 ADCAP torpedoes, four torpedo tubes.

**General Characteristics, Seawolf class**
**Builder:** General Dynamics Electric Boat Division.  
**Date Deployed:** *USS Seawolf* commissioned 19 July 1997;  
*USS Connecticut* commissioned 11 December 1998  
*USS Jimmy Carter* commissioned 19 February 2005  
**Propulsion:** One nuclear reactor, one shaft  
**Length:** SSNs 21 and 22: 353 feet (107.6 meters)  
SSN 23: 453 feet (138.07 meters)  
**Beam:** 40 feet (12.2 meters)  
**Displacement:** SSNs 21 and 22: 9,138 tons (9,284 metric tons) submerged;  
SSN 23 12,158 tons (12,353 metric tons) submerged  
**Speed:** 25+ knots (28+ miles per hour, 46.3+ kph)  
**Crew:** 140: 14 Officers; 126 Enlisted  
**Armament:** *Tomahawk* missiles, MK-48 torpedoes, eight torpedo tubes.

**General Characteristics, Los Angeles class**
**Builder:** Newport News Shipbuilding Co.; General Dynamics Electric Boat Division.  
**Date Deployed:** November 13, 1976 (*USS Los Angeles*)  
**Propulsion:** One nuclear reactor, one shaft  
**Length:** 360 feet (109.73 meters)  
**Beam:** 33 feet (10.06 meters)  
**Displacement:** Approximately 6,900 tons (7011 metric tons) submerged  
**Speed:** 20+ knots (23+ miles per hour, 36.8 +kph)  
**Crew:** 13 Officers; 121 Enlisted  
**Armament:** *Tomahawk* missiles, VLS tubes (SSN 719 and later), MK-48 torpedoes, four torpedo tubes (*Seawolf* has 8).
FLEET BALLISTIC MISSILE SUBMARINES - SSBN

Description
Nuclear-powered submarines armed with long-range strategic missiles.

Features
The first eight Ohio class submarines (Tridents) were originally equipped with 24 Trident I C-4 ballistic missiles. Beginning with the ninth Trident submarine, USS Tennessee (SSBN 734), all new ships are equipped with the Trident II D-5 missile system as they are built, and the earlier ships are being retrofitted to Trident II. Trident II can deliver significantly more payload than Trident I C-4 and more accurately.

The Ohio-class submarines are specifically designed for extended deterrent patrols. To decrease the time in port for crew turnover and replenishment, three large logistics hatches are fitted to provide large diameter resupply and repair openings. These hatches allow sailors to rapidly transfer supply pallets, equipment replacement modules and machinery components, significantly reducing the time required for replenishment and maintenance. The class design and modern main concepts allow the submarines to operate for 15+ years between overhauls.

The first four Ohio-class submarines are scheduled for conversion over the next five years to guided missile submarines (SSGN) with an additional capability to transport and support Navy special operations forces.

Background
Strategic deterrence has been the sole mission of the fleet ballistic missile submarine (SSBN) since its inception in 1960. The SSBN provides the nation's most survivable and enduring nuclear strike capability. The Ohio-class submarine replaced aging fleet ballistic missile submarines built in the 1960s and is far more capable.

Ohio-class/Trident ballistic missile submarines provide the sea-based "leg" of the triad of U.S. strategic deterrent forces. The 18 Trident SSBNs (each carrying 24 missiles), carry 50 percent of the total U.S. strategic warheads. Although the missiles have no pre-set targets when the submarine goes on patrol, the SSBNs are capable of rapidly targeting their missiles should the need arise, using secure and constant at-sea communications links.
General Characteristics, Ohio Class
**Builder:** General Dynamics Electric Boat Division.
**Date Deployed:** November 11, 1981 (USS Ohio)
**Propulsion:** One nuclear reactor, one shaft.
**Length:** 560 feet (170.69 meters).
**Beam:** 42 feet (12.8 meters).
**Displacement:** 16,764 tons (17,033.03 metric tons) surfaced; 18,750 tons (19,000.1 metric tons) submerged.
**Speed:** 20+ knots (23+ miles per hour, 36.8+ kph).
**Crew:** 15 Officers, 140 Enlisted.
**Armament:** 24 tubes for Trident I and II, MK-48 torpedoes, four torpedo tubes.

GUIDED MISSILE SUBMARINES - SSGN

**Description**
Nuclear-powered submarines armed with tactical missiles and the ability to transport and support special operations forces.

**Background**
Four Ohio-class Trident submarines that were previously scheduled for inactivation during Fiscal Years 2003 and 2004 are being converted to guided missile submarines (SSGN) over a five-year period ending in 2007. The primary missions of the SSGN will be land attack and Special Operations Forces (SOF) insertion and support. Secondary missions will
be the traditional attack submarine missions of intelligence, surveillance and reconnaissance (ISR), battle space preparation, and sea control.

These ships will be armed with up to 154 Tomahawk® or Tactical Tomahawk® land attack missiles. They will have the ability to carry and support a team of 66 SOF personnel for up to 90 days as compared to 15 days for a SOF outfitted fast attack submarine (SSN). Clandestine insertion and retrieval of these Special Operations Forces will be enhanced by the ability to host dual dry deck shelters and/or Advanced Seal Delivery System. Each SSGN will be able to conduct a variety of peace-time, conventional deterrent, and combat operations all within the same deployment.

USS Ohio (SSGN 726) entered the conversion yard on 15 November 2002. On 14 January 2003, USS Florida (SSGN 728) became the first Ohio-class submarine to launch a cruise missile. The launch was made from underwater in the Gulf of Mexico.

**General Characteristics, Ohio Class**

**Builder:** General Dynamics Electric Boat Division.  
**Propulsion:** One nuclear reactor, one shaft.  
**Length:** 560 feet (170.69 meters).  
**Beam:** 42 feet (12.8 meters).  
**Displacement:** 16,764 tons (17,033.03 metric tons) surfaced; 18,750 tons (19,000.1 metric tons) submerged.  
**Speed:** 20+ knots (23+ miles per hour, 36.8+ kph).  
**Crew:** 15 Officers, 144 Enlisted.  
**Armament:** Tomahawk missiles, MK 48 torpedoes; 4 torpedo tubes.

This information is given for a broad overview of the types of naval warships. It is not meant to cover all types of ships. The information will change frequently as ships are commissioned and decommissioned.
Basic Knot Tying

Lesson 2B
KNOT TYING GUIDE

Tying on tools and materials can be tricky, and cutting ropes to get them loose is expensive. Learning a few simple, secure and easily untied knots can save you a lot of headaches, time and money.
Little About Rope

Knot tying and rigging has its own special language. To give a better understanding of the instructions for the knots in this guide, spend a few minutes familiarizing yourself with some of the lingo.

1. **Mousing or whipping** is a method of using tape or twine to secure the strands at the end of a rope. Mousing prevents the rope from unraveling.

2. The **running end** of a rope is the moving or workable end of the rope. In rigging, the running end is usually the leading end of a rope.

3. A **bight** is an unclosed loop in a rope that turns back on itself. Bights are often used to take up slack or add strength to ropes.

4. An **underhand loop** is created when a rope is looped back on itself with the running end passing under the standing end.

5. An **overhand loop** is created when a rope is looped back on itself with the running end passing over the standing end.

6. A **turn** is formed when a rope is wrapped 360 degrees (1 time) around a stationary object. Turns add holding power in rigging and maintain the direction of the running end of a rope.

7. A **round turn** is formed when a rope is wrapped 1 1/2 times around a stationary object. Round turns add holding power in rigging and reverse the direction of the running end of a rope.

8. The **standing end** of a rope is any portion of the rope secured to a fixed object or otherwise located behind the running end of the rope. In rigging, the standing end is usually any stationary portion of a rope.

9. **Seizing** is a technique where the running end of a rope is secured to the standing end with a half hitch or double half hitch. Seizing prevents the knot from loosening when rope tension changes.

10. A **tail** is the running end of a rope left over after a knot is tied. The tail of a knot should be long enough to allow you to seize it to the standing end of the rope, usually 6" to 8".
Common Knots

Following are simplified instructions for tying a few commonly used knots.

**Two Half Hitches**
This reliable knot is quickly tied and is the hitch most often used in mooring. To tie:

1. Pass end of rope around post or other object.
2. Wrap short end of rope under and over long part of rope, pushing the end down through the loop. This is a half hitch.
3. Repeat on long rope below first half hitch and draw up tight.

![Diagram of Two Half Hitches]

**Bowline**
This knot doesn't jam or slip when tied properly. To tie:

1. Make the overhand loop with the end held toward you, then pass end through loop.
2. Now pass end up behind the standing part, then down through the loop again.
3. Draw up tight.

![Diagram of Bowline]
**Square Knot**
This knot is used at sea in reefing and furling sails. To tie:

1. Pass left and over and under right end.
   Curve what is now the left end toward the right and cross what is now the right end over and under the left.
2. Draw up tight.
3. This knot is easily confused with the Granny Knot.

---

**Clove Hitch**
This knot is the "general utility" hitch for when you need a quick, simple method of fastening a rope around a post, spar or stake. To tie:

1. Make a turn with the rope around the object and over itself.
2. Take a second turn with the rope around the object.
3. Pull the end up under the second turn so it is between the rope and the object. Tighten by pulling on both ends.
**Figure Eight**
This knot is ideal for keeping the end of a rope from running out of tackle or pulley. To tie:

1. Make underhand loop, bringing end around and over the standing part.
2. Pass end under, then up through the loop.
3. Draw up tight.

![Figure Eight Diagram]

**Anchor Bend**
This knot is used to secure a rope or a line to an anchor. To tie:

1. Pass two loops through ring.
2. Place free end around standing line.
3. Pass free end through loops.
4. Complete by making half hitch.

![Anchor Bend Diagram]
While working onboard naval vessels, you will need to have a basic understanding of the nomenclature and be able to identify your location on the ship. Your location is broken down into several key points, which will be discussed.

This lesson should help you understand what that information represents and how to get around on a naval vessel.

Cutaway of a Nuclear Aircraft Carrier (CVN-71)

A. **Compartment Numbering**

The compartment number is broken down into 4 key parts. Each part is critical to the identification of that space.

1. Deck/level Number
2. Frame Number
3. Relationship to Centerline of Ship
4. Compartment Usage

This information is explained below how each part of the compartment number interacts.

1. **Deck/level Number** – This number tells you how high up you are in relation to the Main Deck of the ship. The floor of a ship is called a deck or level. The main deck and below are called decks. Above the main deck is called a level. This is correct only if the deck is continuous across the length of the ship. If not, the deck is considered a platform.
a. Above Main Deck – 01 level, 02 level, 03 level, etc.
b. Main Deck – 1st deck, (usually just called main deck.)
c. Below Main Deck – 2nd deck, 3rd deck, 4th deck, etc.
2. **Frame Number** – The frames are the transverse structural strength members of the ship. They are installed at set intervals to strengthen the hull of the ship. We number these frames starting at the forward perpendicular and use that to identify our location from forward to aft.
   a. Frame Number is the same as frame number of forward bulkhead of compartment.
   b. When bulkhead is located between two frames, compartment takes number of frame immediately aft of bulkhead.

3. **Relationship to Centerline of Ship**
   a. Compartments with centerline running through them are numbered 0.
   b. Compartments located completely to starboard of centerline are given odd numbers.
   c. Compartments located completely to port of centerline are given even numbers.
   d. Where more than one compartment is located to starboard or port, the first compartment will be numbered 1, the second, 3, or the first, 2, and the second, 4. More compartments call for larger consecutive numbers.
e. Where more than one compartment with centerline passing partially through it shares the same deck and bulkhead number, the compartment with centerline passing through its forward bulkhead is 0. The other compartments are numbered 01, 02, 03, and so on.
4  .  Compartment Usage Designation
The compartment number is finished off by a letter. This letter shows the general usage of that space. Below each letter is identified.

A - Stowage spaces
C - Vital ship and fire control spaces
E - Machinery/Engineering spaces
F - Fuel tanks
G - Gasoline tanks
K - Stowage space for chemicals and semi-safe and dangerous materials
L - Living spaces; Quarters, Medical, and Dental
M - Ammunition spaces
Q - Spaces not fitting in other categories, misc. spaces, not manned
T - Vertical access trunks
V - Void compartments
W - Water storage tanks

Note: Compartments or tanks whose contents are carried as cargo have a double letter designation such as AA, FF, GG, and so on.

B. Compartment Usage
The letter previously used gives a very generic usage such as a living space. However, the middle line of the compartment number tells exactly what the compartment is used for.
C. **Access Closures**

The third line of a compartment number shows the location of the access closure (or the doorway). This information is helpful when multiple accesses are in a compartment or when the access is not readily located. Label plates for access closures shall be combined with compartment designation plates.

1. The first line of the inscription shall give the access closure number.
2. The second line is for the name of the compartment to which access is provided.
3. The third line is the compartment number.

**Example 1**

4-16-2  
C.P.O. Storeroom  
4-14-2-A

**A. First Line (4-16-2) is the access closure number.**

- 4 - Access closure is on the 4th deck.
- 16 - Access is at frame 16.
- 2 - First access on port side off centerline at frame 16.

**B. Second Line (C.P.O. Storeroom) is the name of the compartment.**

Chief Petty Officers' storeroom.

**C. Third Line (4-14-2-A) is the compartment number.**

- 4 - The compartment has its base on the 4th deck.
- 14 - The forward most frame within the compartment is frame 14 or the forward bulkhead is frame 14.
- 2 - The first compartment on port side off centerline with forward most frame/bulkhead being frame 14.
- A - Use of compartment is a storeroom.
Example 2
2-51-2
C.P.O. Storeroom
2-51-2-A

Example 2 is similar to Example 1, except it is located on the 2nd deck and has its access located in the forward boundary of the compartment.

Examples of Compartment Letters with type of Compartment

A - Stowage Spaces;
Ex. - storerooms, issue rooms, refrigeration compartments.

AA - Cargo holds;
Ex. - cargo holds and cargo refrigeration compartments.

C - Control centers for vital ships and fire control operations (normally manned);
Ex. - plotting rooms, communication centers such as radio, radar, and sonar operating spaces such as the pilot house.

E - Engineering/Machinery control centers (normally manned);
Ex. - main propulsion spaces, boiler rooms, pump rooms, generator rooms, switchboard rooms, steering gear rooms.

F - Oil stowage compartments/Fuel tanks (for use by ship);
Ex. - fuel-oil, diesel-oil, lubricating-oil.

FF - Oil stowage compartments (cargo);
Ex. - compartments carrying various types of oil as cargo.

G - Gasoline stowage compartments (used by ship);
Ex. - gasoline tanks, cofferdams, trunks, and pump rooms.
GG - Gasoline stowage compartments (cargo); Ex. - gasoline compartments for carrying gasoline as cargo.

K - Chemicals and dangerous materials (other than oil and gasoline). Ex. - chemicals, semi-safe materials, and dangerous materials carried for ship's use or as cargo.

L - Living spaces; Ex. - berthing spaces, staterooms, washrooms, heads, brigs, sickbays, hospital spaces, and passageways.

M - Ammunition spaces; Ex. - magazines, handling rooms, gun mounts, shell rooms, ready service rooms.

Q - Miscellaneous spaces not covered by other letters; Ex. – shops, offices, laundry, pantries, unmanned engineering, electrical, and electronic spaces.

T - Vertical access trunks; Ex. – escape trunks or tubes.

V - Void compartments; Ex. - cofferdam compartments (other than gasoline), void wing compartments, wiring trunks.

W - Water compartments; Ex. - drainage tanks, fresh water tanks, reserve feed tanks.
**Submarines:**
The main difference in surface craft & submarines is that a submarine will have only 2-3 levels. On a 688 class submarine, the forward levels are called upper, mid & lower levels. Back aft, there are only upper & lower levels. Ohio class submarines have 4 decks instead of 2-3.

**Summary/Review**

![Cutaway of a Los Angeles Class (688) Submarine](image1)

![Cutaway of a Ohio Class Submarine](image2)
BASIC
SHIPS
NOMENCLATURE
FOR GENERAL TRADES

LESSON 4
I. GENERAL TERMS

1. BOW

Forward end of the ship.

2. STERN

Aft end of the ship.

3. STEM

Where the starboard and port sides intersect to form the forward leading edge of the ship.

4. STARBOARD

When looking forward, starboard is the right side of the ship.

5. PORT

When looking forward, port is the left of the ship.

6. FORWARD

Toward the stem.

7. AFT

Toward the stern.
8. **INBOARD**
Towards the centerline of a ship.

9. **OUTBOARD**
Away from the centerline of a ship.

10. **AMIDSHIPS**
In the vicinity of the middle portion of a ship, as distinguished from the ends.

11. **MIDSHIP**
Exact center of the ship; located at the midpoint between the forward and aft perpendiculars.

12. **SHELL PLATING**
Outer plating of ships. The shell is set in rows of plating called strakes.

13. **WEB FRAME**
A larger frame that provides additional strength and is placed usually on placed several frames apart depending on the ship. Often called a King Frame.

14. **STIFFENER**
An angle bar, T-bar, etc. used to stiffen plating of a bulkhead.
15. **DECK BEAM**

Any deck stiffeners running transversely or longitudinally also call stringers (longitudinal), girders, longitudinal frames, etc.

16. **FOUNDATIONS**

Supports for equipment of all types, computers, engines, files, etc. Usually built out of plate and angle iron.

17. **SUPERSTRUCTURE**

A structure built above the uppermost complete deck such as on an aircraft carrier. The island is the superstructure.

18. **STANCHION**

An upright bar, post, or support. To brace or secure.

19. **LONGITUDINAL**

Fore and aft structural member running parallel or nearly parallel to the center vertical keel, along the inner bottom, shell, or deck.

20. **BILGE**

Curved section between the bottom ends of a ship; recess into which all water drains.
21. BULWARK
Strake of shell plating above the weather deck.

22. LIGHTENING HOLE
Hole cut in a structural member to reduce its weight.

23. TRANSOM
After end of a vessel.

24. TRANSOM FRAME
Aftermost transverse frame. Last transverse frame of a ship's structure.

25. SCUPPERS
Scuppers are drains from weather decks.

26. DAVIT
A crane used in handling small boats, stores, lifeboats, gear, etc.

27. ATHWARTSHIP
At right angles to the centerline of ship from side to side. Also referred to as transverse. To go from one side of the ship to the other side.

28. TRANSVERSE
Crosswise. Runs from port to starboard or starboard to port.

29. STERN POST
After part of stern frame to which rudder is attached, also called rudderpost.

30. Rudder
Device located near after perpendicular and used in steering or maneuvering a ship.

31. GO ABOVE
Go up ladder.
32. GO BELOW

Go down ladder.

II. SHIPS LINES

1. CENTER LINE

The exact center between the two sides.

2. BASE LINE

It is a horizontal plane at the bottom of the ship.

3. WATER LINE

Used for measuring heights where it is inconvenient to measure from the base line.

4. FRAME LINE

Frames – Term generally used to designate one of the transverse ribs that make up the skeleton of a ship.

5. BUTTOCK LINE

Buttock lines are vertical planes parallel to the centerline of the ship.

6. MOLDED LINE

The exact location of installed structures.

7. FORWARD PERPENDICULAR

A line perpendicular to the baseline, intersecting the forward edge of the stem at the designed water line.

8. AFT PERPENDICULAR

A line perpendicular to the baseline, intersecting the after edge of the sternpost at the designed water line.

9. MOLDED DRAFT; Also called DRAFT

Depth of the lowest point of ship below surface of water when she is afloat.
10. **MOLDED DEPTH**

   The vertical distance from the molded base line to the top of the uppermost strength deck beam at side, measured at mid length of the vessel.

11. **SHEAR**

   Forward and aft curvature of a deck.

12. **Camber**

   Rise or crown of a deck from side to side. (athwartship)

13. **TUMBLE HOME**

   The decreasing of a vessel's beam above the waterline as it approaches the rail. Slant inboard of a ship's side above the bilge.

14. **DEAD RISE**

   Slant up athwartship of the bottom of a ship from keel to bilge.

15. **KEELS**

   Backbone of the ship, usually built in the form of an I-beam, which runs the full length of the ship.

16. **FREEBOARD**

   The vertical distance from the waterline to the top of the weather deck at the side.

17. **BEAM**

   Extreme width of ship.

18. **DEAD FLAT**

   Straight portion of a ship's side.
III. SHIP CONSTRUCTION

1. HULL

The shell or plating of a ship.

Some structures within the hull are:
2. **GUNWALE**

The upper edge of the sides of the ship; the point at which the sides of the ship meet the main deck.

3. **LIFELINES**

Light wire ropes erected around the edges of weather decks to prevent personnel and equipment from being swept overboard.

4. **FRAMES**

The members of a ship's hull:

   A. **Athwartship Frames** - extend from the keel to the sides of the ship.
   B. **Longitudinal Frames** - run parallel to the keel.

5. **BULKHEAD** - interior walls of a ship which subdivide the interior of a ship into compartments or rooms.

   A. **Structural Bulkheads** - divide the ship into watertight compartments.
   B. **Metal Joiner Bulkheads** - serve as partitions; they are not watertight.

6. **BRIDGE**

Area from which the ship is controlled by the captain or the officer of the deck.

7. **MASTS**

Used to support radio and radar antennas, signal lights and booms. A ship may have more than one mast. The masts on a two masted ship are identified as follows:

   A. **Foremast** - the first mast aft from the bow.
   B. **Mainmast** - the second mast aft from the bow.

8. **YARDARMS**

Spars mounted athwartship near the top of the masts.

9. **GAFF**

A light spar suspended from the upper part of the main mast, used to fly the national ensign when the ship is underway.

10. **STACK**

Serves to carry off smoke and hot gases from boilers and exhaust from the diesel engines in non-nuclear powered ships.
11. **BULKHEADS**

A term applied to any one of the partition walls, which subdivide the interior of a ship into compartments or rooms.

**IV. DECKS**

1. **DECKS**

Decks are the "floors" of the ship. A deck in a ship corresponds to a floor in a building. It is the plating or covering of any tier of beams above the inner bottom, forming a floor, either in the hull or superstructure of a ship. Decks are designated by their location as upper deck, main deck, etc.

2. **WEATHER DECK**

The uppermost complete decks exposed to the weather.

3. **MAIN DECK**

Uppermost complete deck on most ships.

4. **SECOND DECK**

The first complete deck below the main deck.

5. **THIRD DECK**

The second complete deck below the main deck.
6. **LEVELS**

Term used to designate deck heights above the main deck: ex. - 01 level, 02 level, etc. Also used on submarines. Decks are called Upper Level, Mid Level & Lower Level on a 688 class submarine.

![Diagram of deck levels](image)

7. **FANTAIL**

After end section of the upper weather deck; opposite the forecastle, also referred to as the "poop deck".

8. **FORECASTLE**  (fōk'sul)

Forward most section of the upper weather deck.

V. **Access Ways**

1. **DOOR**

Provides access through a bulkhead.

A. Watertight (WT) - to weather decks/structural bulkheads.

B. Non-watertight (NWT) - to spaces within a watertight area.
2. **HATCH**

Provides access through a deck.

3. **SCUTTLE**

A small opening through a hatch or deck to provide access to other areas of the ship. For passing ammo or personnel passage.

4. **LADDERS**

Lead from one deck level to another. Similar to a stairway in a building. May be vertical or angled.
Math For Welders by Nino Marion

Class 1

Unit 1  Introduction to Whole Numbers
- Introduction
- Math work habits
- Our number system
- Rounding numbers
- Denominate numbers
- Practicing using whole numbers

Unit 2  Addition of Whole Numbers
- Introduction
- Method used to add whole numbers
- Checking accuracy by adding up and down
- Look for tens
- Mark your answer
- Denominate numbers
- Practicing addition of whole numbers

Unit 3  Subtraction of Whole Numbers
- Introduction
- Method used to subtract whole numbers
- Checking subtraction by adding
- Practicing subtraction of whole numbers

Class 2

Unit 6  Introduction to Common Fractions
- Introduction
- Parts of a fraction
- Proper fractions
- Improper fractions
- Mixed numbers
- Equivalent fractions in higher terms
- Equivalent fractions in higher terms
- Equivalent fractions in lower terms
- Reducing improper fractions
- Changing Mixed numbers to improper fractions
- Practicing with common fractions

Unit 7  Addition of Fractions
- Introduction
- Method used to add fractions
- Adding fractions with common denominators
- Adding fractions without common denominators
- Adding mixed numbers without common denominators
- Practicing addition of fractions
Class 3

Unit 7  Review of Addition of Fractions
  Review classwork
  Review homework

Unit 8  Subtraction of Fractions
  Introduction
  Method used to subtract fractions
  Subtracting fractions with common denominators
  Subtracting fractions without common denominators
  Subtracting mixed numbers without common denominators
  Practicing subtraction of fractions

Class 4

Unit 11  Introduction to Decimals
  Introduction
  Converting decimal fractions to common fractions
  Converting common fractions to decimal fractions
  Accuracy of decimal fractions
  Elimination of digits to round
  Practicing with decimal fractions

Unit 12  Addition & Subtraction of Decimals
  Introduction
  Method used to add decimal fractions
  Method used to subtract decimal fractions
  Practicing adding and subtracting decimal fractions

Unit 23  Percentages
  Change a percent to a fraction
  Change a percent to a decimal
  Change a fraction to a percent
  Change a decimal to a percent
  Calculate a percent of a number
  Calculate the percentage one number is of another number
  Practicing percentages

Class 5

Shop Math Test
BASIC HANDTOOLS FOR ALL TRADES

LESSON 6
TOOL SAFETY RULES

1. Always inspect your tool prior to use and after finishing work. Look for damage that may have occurred. Keep tools in good condition.
2. Advise your supervisor of any unsafe conditions or practices, which may exist.
3. Always obey safety rules
4. Always read and follow the safety guidelines for the tools that you are using. Always be familiar with the tool prior to using it on the job site.
5. Do not allow horseplay in the work area.
6. Always use the proper tool for the job. Do not attempt to make due with the incorrect tool. Many people are injured doing this.
7. Return broken tools to the tool room. They are a hazard. Workers are more efficient with a tool in good condition and safety is greatly improved.
8. Report injuries to your supervisor immediately.
9. Always keep tools in their proper storage box or rack. Punches & chisels that have a mushroomed shaft must be ground down or turned in.
10. Always wear PPE – Personal Protective Equipment. Safety glasses, hard hat, ear plugs, leather gloves, safety shoes are all part of the standard safety gear required shipboard. Additional PPE may be required, depending on the job.
11. All PPE must be in good repair. A hard hat without the liner is not acceptable. Leather gloves with holes in them will not protect your hands. Safety glasses that are seriously scratched can make it harder to see the job site. Safety shoes that are worn could be a hazard to you.
12. Safety belts are no longer acceptable per OSHA guidelines. Safety harnesses must be worn if working in an area requiring this.
13. Special care must be taken if you are working around open electrical circuits. Special clothing and tools must be used along with special precautions. Treat electricity with RESPECT!
14. Keep your mind on the job at hand. Do not allow distractions to increase your chances of injury.
15. Be aware of your surroundings. Before cutting near electrical cables or cords, have them tied back to prevent damage.
16. When using a tool, be sure to look where you are stepping; such as when measuring, it is easy to forget about your surroundings and make a step in the wrong direction.
17. Always protect ships equipment. It is the workers responsibility to prevent damage.
I. DIVIDERS

Dividers are instruments used for checking distances between two points, scribing arcs or circles, transferring measurements to other parts.

**Types:**
- Spring Divider
- Wing Divider

**Usage:**
1. Set the radius on the dividers using a ruler.
2. Place one point of the divider in the center of the arc to be drawn.
3. Lean the dividers in the direction of movement and scribe the circle by revolving the dividers.

**Care/Safety:**
Keep dividers clean & dry. Protect the points against damage. Store where they will not become bent or broken.

II. RULERS

**Types:**
- Folding Ruler – 6’
- Steel Tape - 6’, 12’, 25’, 30’, 50’, 100’ & others
- Steel Rule – 6”, 12”, 2’ & others

**Usage:**
1. Measuring lengths of stock.
2. Measuring outside diameter of pipe.
3. Measuring inside diameter of pipe.
4. Measuring the circumference of pipe.
5. Measuring inside dimensions.
6. Measuring the thickness of stock through a hole.
7. Measuring outside dimension with a tape.

**Care/Safety:**
Keep ruler and tape clean & dry. Store where they will not become bent or damaged.
III. LEVELS

Levels are used to check whether an object is in a true vertical or horizontal position. All levels consist of a liquid filled vial supported in a metal or wooden frame.

**Basic Types:**
- Carpenters Level
- Machinist Level
- Torpedo Level
- Line Level

**Usage:**
A level may be checked for accuracy by placing it on a known level surface and noting the position of the bubble. Reverse the level end for end. Observe the position of the bubble. If the relative position of the bubble was the same for both readings, the level is accurate.

The level may have more than one leveling vial. Some levels include vials for checking horizontal, angled and vertical surfaces. Make sure you are using the correct level vial for the surface you are checking. The bubble should be between the two etched lines on the vial. If it is not, the surface is not level.

**Care/Safety:**
Extreme care should be taken when storing the level. It can be very sensitive to rough handling. Store in a clean, dry environment away from other tools that could damage the level.

IV. SQUARES

**Types:**
- Carpenters Square
- Combination Square
- Try Square
- Sliding T-Bevel
Usage:
A square is used to transfer perpendicular lines. Squares may have graduations that are used for measuring. Combination squares can be used for laying out 45-degree angles and may include a protractor head for measuring different angles and a centering head for laying off the center of pipe & round stock. The sliding T-bevel square is used to transfer a known angle to other material and checking known angles or bevels.

Care/Safety:
Squares should be kept in a clean dry environment. As with all measuring tools, the square should be kept away from other tools that could damage the square.

V. Pliers

Types:
- Slip Joint Pliers
- Lineman’s Pliers
- Diagonal Cutting Pliers
- End Cutting Pliers
- Needle Nose Pliers
- Wire Strippers

Usage:
Pliers come in many different shapes with pivoting jaws. The jaws may have a serrated edge for holding or a cutting edge. Slip joint pliers have a pivot joint that allows the jaws to handle large or small objects. Use the correct type of pliers for the job.

Care/Safety:
Clean with a rag. Apply a light coat of oil after use.
Store pliers in a toolbox or hang on a rack.
Do not remove insulation on handles that have insulation.
Do not use for prying.

VI. Clamps

Types:
- C-Clamps
- Sliding Bar Clamps
- Hand Screw Clamps
Usage:
Clamps are used to hold work, which is not held in a vise. They come in a variety of sizes and types.
C-clamps are excellent for holding work to a flat surface near the edge of a plate. It is measured by the opening between the swivel pads.
Sliding bar clamps are faster alternatives to C-clamps. There is one fixed jaw and one-jaw slides into position to clamp down on the work piece.
Hand screw clamps are used extensively in woodworking. They are excellent at holding pieces at odd angles.

Care/Safety:
Clean threads & swivel with a rag and lubricate with a light coat of oil.
Store on a rack to prevent damage.

VII: HAMMERS
Types:
Carpenters Hammer
Machinist’s Ball Peen Hammer
Blacksmith’s Hammer (SledgeHammer)
Soft-Faced Hammer

Usage:
Hammer handles may be either wood, fiberglass or steel. The face (striking surface) may be flat or bell shaped. Hammer faces are usually smooth; some have a milled surface to prevent slipping. Care should be taken to prevent damage to the work surface when using a milled face hammer, as it will mar the work surface should it come in contact with it.
Hammers come in different weights. Depending on the type of work and the hammer being used, the weight could be from 7 ounces up to 10 pounds or more.
All hammers come with one primary striking face and opposite that may include a claw, peening head, or other surface.
Hold the hammer firmly near the end of the handle. This provides the best control and striking power with the least effort. Be sure to strike the surface squarely to prevent damaging the surface.

Care/Safety:
Make sure the head is attached firmly to the handle and the handle is in good condition. If it should become loose, replace it.
Make sure the face is clean and free of oil to prevent slipping.
Replace the hammer if it has a worn or chipped face or claw.
VIII. SCREWDRIVERS

Blade Types:
Standard (Flat)
Phillips
Square Drive

Usage:
Screwdrivers come in many shapes & sizes. Types of screwdrivers include common screwdrivers, stubby screwdrivers, cabinet screwdrivers, offset screwdrivers & ratcheting screwdrivers. Each is intended for a specific use.
The tip of the blade should be straight & square with sides being parallel to each other.
Make sure the tip is sized properly for the slot size of the screw. Too narrow or too wide of a tip will cause slippage and possibly damage the work surface.
Standard screwdrivers and identified by the length of the blade, such as 3", 6" and 10". Phillips screwdrivers are identified by tip size, ranging from 0 to 4. Square drive screwdrivers are identified by tip size also, which include #1, #2 and #3.
Hold the screwdriver properly. Slipping can mar the work surface and injure the worker.

TIP - When driving screws into hard woods, rub the screw into wax or soap prior to driving into a pre-drilled hole. This extra lubrication makes driving easier.

Care/Safety:
Do not use the screwdriver as a pry bar or chisel.
Use the proper tool for the job.
Always use the proper size screwdriver for the job.
Make sure the screwdriver tip is in good condition. If not, the screwdriver will slip and damage the work piece.

<table>
<thead>
<tr>
<th>Screwdriver Tip Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slotted: Standard or flat for driving single slotted screws. Tip width range from 1/8&quot; to 1/2&quot;.</td>
</tr>
<tr>
<td>Phillips®: Designed specifically for use with Phillips® head screw, which has two recessed slots at right angles to each other. Sizes range from 0 point (small) to 4 point (large).</td>
</tr>
<tr>
<td>Pozidriv®: Similar to the Phillips® style, the screw can be identified by additional lines on the face. Sizes range from 1 point (small) to 4 point (large).</td>
</tr>
<tr>
<td>Square head: Square tip, used in mobile homes, recreational vehicles and industrial applications. Sizes range from 1 point (small) to 3 point (large).</td>
</tr>
<tr>
<td>Torx®: Star shaped, used in the automotive industry. Sizes range from T-10 (small) to T-30 (large).</td>
</tr>
</tbody>
</table>
IX. **WRENCHES**

Wrenches are designed for tightening & loosening nuts, bolts, studs & pipes. They are forged from steel alloys to prevent breakage. Each type of wrench is intended for a specific use and should be used correctly for ultimate efficiency.

**Types:**
- Open End Wrench
- Box Wrench
- Combination Wrench
- Adjustable Wrench (Crescent)
- Socket Wrench
- Hex Key Wrench
- Clamp Pliers (Vise Grip)
- Pipe Wrench
- Torque Wrench

**Usage:**
Ensure you have the correct type and size of wrench to perform the task. Longer wrenches provide additional torque but can also damage a nut or bolt. Short wrenches will not provide the required torque and may slip from the work piece easier.

Adjustable wrenches should be tightly adjusted and pulled so that the force is on the side of the fixed jaw.

Clamping Pliers should be used with caution. They are excellent for removing rounded nuts, but will cause damage if not used correctly.

Torque wrenches are precision instruments and should only be used for final torquing of nuts or bolts. Prior to torquing, all nuts & bolts should be installed with another wrench.

**Care/Safety:**
Check for worn, cracked or sprung jaws on the wrench.

Avoid using extensions on wrenches for additional leverage.

Never use a wrench as a hammer. Use the right tool for the job!

Always pull the wrench to protect your knuckles in case the wrench slips.

Wrenches should fit the nuts and bolts snugly to prevent slippage. Use penetrating oil on rusted nuts and bolts. Allow time for the oil to penetrate prior to turning the wrench.

Keep the wrench in good condition in a clean, dry environment.
X. CHISELS

Types:
Woodworker’s Chisel
Machinist’s Chisel

Usage:
For Woodworker’s Chisel, secure the work piece in a vise or clamp. Always cut with the grain of the wood. Rough-cuts are made with the bevel down. Smooth cuts are made with the bevel up. Use short, rapid mallet blows to control depth and length of cut.
For machinist’s chisel, place work piece on firm surface. Place chisel and lightly strike with a hammer. Check chisel mark to make sure cut is in desired location. Continue striking until the chisel has cut through the work piece.

Care/Safety:
Eye protection should always be worn when using chisels.
Never cut towards yourself with a chisel
Store chisels in racks to protect the sharp edges.
Lubricate with a light coat of oil after usage.
Regrind broken or chipped edges prior to using.

XI. PUNCHES & PINS

Two common types of punches include the solid and the hollow. Hollow punches are for cutting holes in leather, paper and other material. Solid punches are used for marking metal, aligning parts, driving pins and similar tasks.

Types:
Center Punch
Hole Cutting Punch
Drift Pin
Alignment Pin

Usage:
For marking centers of holes, hold the center punch on a predetermined spot. Strike the punch firmly with one blow to create a divot, which will be used as a starting point for dividers or a drill bit.
For cutting holes, place the material on a piece of wood. Position the punch over the desired spot. Punch firmly with a hammer. The material should have a hole punched cleanly in the correct spot.
Drift and alignment pins are used to bring drilled holes into alignment for bolt insertion.
**Care/Safety:**
Always wear safety glasses when using a punch.
Store punches in a rack so that the edges are not damaged.
Mushroomed edges should be ground down smooth.
Clean punches and apply a light coat of oil before storing.

**XII. Files**

Files are used for cutting, smoothing or removing small amounts of metal, wood, plastic or other material. Files come in different shapes, lengths and surface cuts. The file has five parts: 1. Point 2. Edge 3. Face or Cutting Teeth 4. Heel or Shoulder 5. Tang

**Types:**
- Mill File
- Pillar File
- Round File
- Square File
- Taper File
- Three Square File
- Warding File
- Swiss Pattern File

**Usage:**
Files come in grades of coarseness. They are the:
1. Bastard cut for heavy work
2. Second cut for finish work
3. Smooth cut for finish work
4. Dead smooth cut for an extra fine finish

Clamp the work in a vise.
When filing hard metals, apply pressure in the forward stroke only.
When filing soft metals, apply pressure on the return stokes also to keep the file clean.

**Care/Safety:**
A new file should be broken in by using it on brass, bronze or smooth iron.
Use a file brush cleaner to keep the file clean.
Store clean files in its holder or a rack away from other files.
Use a handle on file to prevent injuring your hands.
Do not use a file as a pry bar.
Do not hammer on the file.
XIII. TAP AND DIES

Taps & dies are used to cut threads in metal, plastic or hard rubber. Taps are used to cut internal threads. Die nuts are used to cut external threads.

Tap Types:
- Taper (Starting) Tap
- Plug Tap
- Bottom Tap

Usage:
Apply cutting oil to the taps and the hole. The threaded hole should be started with the taper tap. Ensure the tap is perpendicular to the surface being tapped. Do not apply pressure, the threads will pull the tap into the work piece. While tapping, it may become necessary to bring the tap out to clean the hole. Remove the tap and check the new threads. For a bottom tapped hole, the bottom tap will need to be run through the hole.

To use a die nut, the die nut should be positioned in a diestock (handle). Apply cutting oil to the die and the work. Position the die over the work piece. Turn the die forward one turn and then turn backward one-quarter turn. Repeat this method until the desired cut length has been accomplished. Ensure the die is square to the work piece. Back off the die nut and remove.

Care/Safety:
Do not sharpen taps or dies.
Keep cutting edges lightly oiled.
Store taps & dies in a protective case to prevent damage.

XIV. SAWS

Saws are tools with thin, flat steel blades with a row of spaced teeth along the edge. The blade is attached to a handle. They are available in various sizes depending on the material to be cut. Typically, there are two categories of handsaws: ripsaw and crosscut. Ripsaw is designed to cut with the grain of the wood. Crosscut is designed to cut across the grain of the wood.
Common Types:
Handsaw
Hacksaw
Backsaw
Keyhole Saw

Usage:
Place the workplace on a level surface with material braced near the line of the cut. Make sure the saw is perpendicular to the work surface and angled about 45 degrees along the cut line. Sawing is done on the downward stroke only while applying even pressure. Make sure to support the work piece when nearing the end of the cut to prevent it breaking unevenly.
Hacksaws are designed to cut metal objects. The appropriate blade can be attached depending on the hardness of the metal. Hard metals will require more teeth; softer metals require fewer teeth in the saw blade.

Care/Safety
Always inspect the saw for damage prior to use.
Store in a toolbox or hanging to prevent damage.
Wear eye protection when using a saw.
Clamp or hold firmly material prior to cutting.
Be careful of hand placement while sawing.

XV. Chalk Line

The chalk line is a common tool used to strike perfectly straight lines onto material. The case holds a length of string with a hook on the end. Chalk is poured into the case which will transfer to the deck. The chalk is commonly found in white and blue. The chalk line can also be used as a plumb bob if one is not available. Although it is usually not the best choice.

Usage:
One person should hold the case with the turning knob turned out 90° to the case. Another worker should pull the string out to the desired length. The worker with the case should put his string down on the desired mark while the 2nd worker pulls the string taut and places his string down on the appropriate mark. One of the workers or an 3rd worker lifts the middle of the string a few inches off the deck and drops it. The string snaps back to the straight line leaving a perfectly straight chalk line.
Care/Safety
Be sure to reel the string back in after use. Oil the knob lightly as required. Keep the chalk well furnished with chalk for sharp lines. Using a center punch, punch the lines on the deck after use, if allowed.

XVI. Plumb Bob

The plumb bob is the correct tool to use to transfer a point or to find a perfectly plumb line from the overhead. The plumb bob is attached to a length of string.

Usage:
Layout a crosshair of a measurement in the overhead. Have one worker hold the string on that crosshair while lowering the plumb bob down to the deck. The second worker should bring the plumb bob to within about 1/16” of the deck. Steady the plumb bob. Mark where the point is. Rotate your line of sight 90º and make another mark. This will transfer a crosshair down below. Punch the mark, if allowed.

Care/Safety:
Protect the point of the plumb bob from damage. Also protect the point so that it does not stab a worker. It is sharp. Roll the string up to prevent cutting it.
ENTERING
CONFINED
SPACES

LESSON 7
1. Definitions

**Confined Space:**

A space which has limited or restricted openings for entry and exit. It lacks natural ventilation. It may contain hazardous contaminants or have oxygen enriched or deficient atmosphere. This space is not intended for normal occupancy on a continuous basis.

Ex., Tanks

**Poorly Ventilated Enclosed Space:**

A space which has restricted air movement and could easily become hazardous to personnel due to the presence of toxic, flammable, or combustible materials.

**Well Ventilated Enclosed Space:**

A space, which has restricted natural air movement.

Ex. Engine Room

**Gas-Free Engineer:**

The person in charge of administration of the Confined Space Program for a shipyard.

**Gas Monitor (Competent Person):**

The person trained to test and inspect confined and poorly ventilated spaces for sufficient oxygen levels for personnel access. They also ensure the site is acceptable for hot work.

**Immediately Dangerous to Life or Health (IDLH):**

Compartment has a less than 19.5% or greater than 22% of oxygen or the flammable or explosive vapors are at 10% or more of the lower explosive limit. Then the compartment is considered IDLH. No personnel are allowed to enter IDLH areas without a Self-Contained Breathing Apparatus (SCBA).
Inerting:

Introducing a non-flammable gas into an atmosphere so that the content of oxygen to flammable vapors is reduced to acceptable levels and will no longer burn or explode.

Permissible Exposure Limit (PEL):

PEL is the OSHA standard a worker may be exposed to of toxic materials. If the concentration levels of the toxins should go above PEL, then the workers will not be allowed in the area. Ex. Lead work

2. Gas Monitor

Gas Monitors are highly trained personnel specially trained to perform testing of oxygen levels for confined and poorly ventilated spaces prior to personnel entry. They make the determination on whether hot work can be safely performed in the space. The Gas monitor will issue a Gas Free Certificate stating the levels in the compartment and the work involved. Gas monitors also inspect opposite sides of bulkheads or decks prior to work being performed. Having a Gas Monitor checking the work space is not sufficient as the only person checking the space. The mechanic working the job must check the space also. Conditions change frequently and should be inspected.

Reasons why it is important to have a confined or poorly ventilated enclosed space checked by a Gas Monitor prior to entering:

(a) Lack of sufficient oxygen to support life.
(b) Excessive oxygen levels, which increase the danger of fire or explosion.
(c) Presence of flammable or explosive atmospheres and materials.
(d) Presence of toxic atmospheres and materials.
3. Gas Free Certificate

A gas-free certificate must be posted and up to date outside each space prior to going into that space. The mechanic should be aware that the gas monitor issued the certificate after a satisfactory inspection was completed. This inspection could be hours prior to the mechanics entry in a compartment. Another inspection should be performed by the mechanic prior to work.

Confined and poorly ventilated spaces must be tested periodically, even continuously, depending on conditions and work being performed in, on, or against them.

Make sure you understand the safety rules and regulations when working in a confined or poorly ventilated enclosed space. It is the responsibility of the person entering the space to do so. Remember, your life may depend upon it! Report any unsafe conditions to your supervisor immediately. Warn others in the area of any unsafe conditions. Report injuries to your supervisor immediately or as soon as possible.

A gas-free certificate shall be posted as follows:

(a) One copy will be posted at the main entrance or most commonly used access to the space.

(b) One copy will be posted at all other access areas, which are open and readily accessible to personnel.

When a space is rejected for a gas free certificate, a ticket noting one of the following shall be posted:

If the space is suitable for personnel, but not for hot work – a ticket stating: “Safe for Entry. Not Safe for Hot Work” shall be posted at the entrance.

If the space is not suitable for personnel or hot work – a ticket stating: “Not Safe for Entry, Not Safe for Hot Work” shall be posted at the entrance.

24 hour is the maximum allowable time for a gas free certificate to be issued. Some operations such as painting should only be issued for 10 hours. The gas free engineer is the only person authorized to extend the allowable time on the certificate.
4. CATEGORY OF CERTIFICATE:

Gas free certificates to be issued by the gas monitor shall have categories similar to the following:

No Entry - No Hot Work.
This category shall be used when:

(a) There is danger due to toxic materials, vapors or gases present or likely to evolve under prevailing conditions or danger of suffocation due to oxygen to an oxygen deficiency.

(b) There is danger of fire or explosion due to the presence of flammables or explosive materials, vapors or gases, or oxygen enrichment present, or likely to evolve under prevailing conditions.

(c) There is danger of fire, explosion or toxic hazards in the presence of hot work due to the existence of flammable, explosive, toxic or reactive residues, vapors or gases, or oxygen enrichment; or,

(d) There is a danger of fire, explosion or toxic hazards in the presence of hot work, due to boundary spaces, which have not been protected.

Safe for Entry - Not Safe for Hot Work
This category shall be used when:

(a) Toxic materials, vapors, or gases, if present, are below Permissible Exposure Limits (PELs), or are not likely to evolve in excess of the PEL and oxygen content is sufficient (19.5% TO 22%) and suitable for personnel, or such conditions are adequately and consistently controlled by ventilation.

(b) There is danger of fire, explosion, or excessive toxics in the presence of hot work due to flammable or explosive materials, vapors, or gases.

(c) There is danger of fire, explosion, or excessive toxics in the presence of hot work due to boundary spaces that have not been protected as required.
Safe for Entry - Safe for Hot Work
This category shall be used when:

(a) Toxic materials, vapors, or gases are not present or likely to be evolved and oxygen levels are sufficient and suitable for personnel or such conditions are controlled by proper ventilation within established permissible exposure levels (PEL's).

(b) Flammable materials, vapors, or gases have been removed, are not likely to evolve, and/or are controllable by ventilation.

(c) Surrounding boundary spaces have been inspected and protected as required.

Inspected by Gas Free Engineer - Ready for Certification

This ticket is used specifically by the Gas free engineer for situations, which if not treated correctly could cause injury to personnel or damage to equipment. These spaces include fuel tanks and void spaces that cannot be accessed. The gas monitor should not issue a ticket for this type of work.

The gas free engineer shall be responsible for making determination if the work is acceptable in this area. This GFE ticket and a normal “Safe for Entry; Safe for Hot Work” ticket shall be issued and posted as required.

5. Emergency and Rescue Procedures

Rescue operations in a confined or poorly ventilated space shall be reviewed by the gas free engineer periodically. This is to determine weaknesses or potential problem areas that may affect the a possible rescue.

RESCUE
In the event of an emergency aboard ship/submarine, personnel shall:

Notify the quarterdeck by the fastest means possible. This may include CASCON systems. The quarterdeck will notify the fire department.
Stand-by and await further instructions before leaving the quarterdeck personnel whether on phone or in person.

Direct the rescue party to the victim or the scene of the emergency.

**In the event of an emergency ashore, personnel shall:**

Notify the fire department by phone or pull the nearest fire alarm.

Stand-by and await further instructions before leaving the quarterdeck personnel whether on phone or in person.

Direct the rescue party to the victim or the scene of the emergency.

It is important to note that rescue personnel are specifically trained in confined space rescue tactics.

Firefighters will wear appropriate gear they have been specially trained for:

<table>
<thead>
<tr>
<th>SCBA</th>
<th>Self Contained Breathing Apparatus</th>
</tr>
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<tbody>
<tr>
<td>Harness with a lifeline.</td>
<td></td>
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</table>

The rescue party will perform CPR or other emergency medical treatment as required on the jobsite after they are removed from the confined space. Then the victim will be transported to the nearest appropriate medical facility as required by the situation.

### 6. Personal Protective Equipment

Personal protective equipment (PPE) shall be provided and used by all personnel entering into confined or poorly ventilated enclosed space as appropriate for each condition or space.

Personnel shall be trained, medically qualified and fitted with appropriate respiratory protection in accordance with NIOSH requirements when respirators are required.
Respirator usage for each job will be specified by:

a) Management.
b) Approved technical procedures/instructions
c) Local Instructions
d) or the Safety Division

If you are unsure of the type of respirator required for new or unusual work, you should contact the safety office for guidance.

You are not to enter the following types of spaces under any circumstances:

a) confined spaces not certified Safe for Entry or the Safe for Entry certification has expired.
b) oxygen deficient atmospheres (below 19.5% oxygen) or oxygen enriched (above 22% oxygen).
a) immediately dangerous to life and health (IDLH) atmospheres (10% or greater lower explosive limit).
b) Toxic atmosphere at IDLH level.

Personnel that are to enter into IDLH spaces as above are required to wear a self-contained breathing apparatus (SCBA). The requirements for this type of respirator are:

a) Prior to entry into a hazardous area, personnel shall be inspected for proper clothing, which is commensurate with hazards involved, proper equipment, which is in good operating condition and intoxication resulting from drinking of alcoholic beverages or use of drugs. No one shall be allowed on the job if intoxicated.

b) Physical Examination - Personnel assigned to work in confined spaces shall receive physical examinations in accordance with current requirements.

7. Ventilation

Special care shall be taken when working in confined and poorly ventilated enclosed spaces due to the levels of oxygen. They can be depleted or enriched. Either is deadly to unprepared workers. In this situation, mechanical ventilation shall be established to provide fresh breathable air.
OSHE manuals are specific on the type of ventilation required for specific processes. The use of mechanical exhaust ventilation in confined or poorly ventilated enclosed spaces is used for:

(a) Removal of contaminated air (flammable or toxic) from the space and maintain safe levels of concentration in terms of Permissible Exposure Limits (PELs) or Lower Explosive Limits (LELs) as appropriate.

(b) Provide fresh, respirable air in the space for breathing.

(c) Capture and remove contaminants generated within the spaces or dilute such contaminants to safe levels of concentration in terms of applicable PELs or LELs.

8. Hot Work in a Confined or Poorly Ventilated Enclosed Space

(a) Hot Work Operations

Hot work is any work which produces heat at or greater than 400 °F by any means. This includes welding, torch cutting, plasma cutting, brazing and back gouging. It is also considered hot work while working with spark producing ignition sources and flammables or flammable atmospheres.

(b) Space Cleaning and Ventilating

Confined and poorly ventilated spaces shall be tested, cleaned and ventilated prior to performing hot work. Flammables & combustibles shall be removed from the space if possible. Combustibles include: wood, paper, rope, rags, trash, etc. (Any material which leaves an ash when burned). If they cannot be removed, they shall be protected and inspected by the gas monitor.
(c) Boundary Spaces

Hot work does not only affect the space in which you are working. The adjacent spaces are also affected. Spaces adjacent to the hot work will also be inspected, cleaned & ventilated as required prior to hot work being performed.

(d) Fire Prevention

Firewatch: The fire watch is a specially trained person whose sole duty is to observe the hot work process, be aware of the potential for sparks and fires. He shall have a knowledge of the proper use of fire extinguishing equipment. He shall have that equipment immediately available on the job site.

More than one fire watch may be required for certain jobs. A firewatch may be positioned on the opposite side of a bulkhead or deck when performing hot work there. Communication shall be established for the hot work operator and the firewatch in order to stop hot work.

(e) Fire Extinguishing Equipment

Appropriate fire fighting equipment shall be furnished by the employer. The correct selection shall be based upon the flammable and combustible material in the compartment and the type of compartment in which it is to be used. Vaporizing liquid extinguishers shall not be used in confined or Poorly Ventilated Enclosed Spaces.

CO2 is an excellent fire fighting agent, but has special hazards associated with it. The discharge of CO2 into a confined space will deplete the oxygen level and be hazardous to personnel. For this reason, special consideration shall be taken prior to using this type of fire fighting equipment.

For Class A (combustible or flammable residues), a water type fire extinguisher or water hose equipped with a fog nozzle is the best choice for fire fighting.

Fire extinguishing equipment shall be selected based on:

(a) The extinguishing agents ability to suppress the fire.
(b) Any hazards which may be created by the discharge of the agent into the space.
(c) The capacity of the equipment in relationship to the size.
(d) Intensity of the anticipated fire.
Note: Exceptions may be made in the selection of fire protection where restrictions exist due to the nature of the space or ship.
Ex: Submarines

If a CO₂ fire extinguisher is discharged into a confined or poorly ventilated space, the space shall be evacuated and shall be re-inspected by a gas monitor prior to the commencement of work.

9. General Safety Precautions

The gas monitor shall inspect all confined and poorly ventilated spaces prior to personnel entering the space.

Confined or poorly ventilated enclosed spaces shall have a gas free certificate posted at the main point of entry and also at all other points of entry. The ticket will show the condition of the space; all personnel entering the space shall read and comply with the certificate.

Reminder: Conditions change! The gas free certificate was issued at the time the gas monitor performed his inspection. The area may have changed since that time or another shop may have introduced flammable/toxic materials into the area. Use caution anytime you are working in a confined or poorly ventilated space. It is the responsibility of the person performing the work to comply with the gas free certificate.

It is estimated that about 15 people die per year in confined space accidents. It is up to you to work safely!

Buddy System
Always use the “Buddy System”. Keep at least two people on a job in a confined space at all times. One person shall be inside the space and one person outside keeping constant communication with the other person.
Alternative: Two persons enter the approved confined space together.
If a confined or poorly ventilated enclosed space has an expired gas free certificate, personnel shall not enter that space.
Immediately leave the space if you are becoming dizzy, sleepy or develop a headache while working in a confined or poorly ventilated enclosed space. Immediately report your condition to your Supervisor at once!

Oxygen is depleted quicker and carbon Dioxide levels are raised quicker in a confined or poorly ventilated space with a large number of people working in that space. Natural ventilation may be sufficient for those spaces but will be determined by the gas monitor.

When personnel work in a confined space, there shall be someone designated to perform frequent checks on them at all times. There shall be some type of communication established prior to the work starting such as voice, signal line or electronic means. Also the frequency of the contact is such to ensure the safety of the employee in the space maintained.

If you find someone unconscious in a confined or poorly ventilated space, **DO NOT ATTEMPT RESCUE!** Immediately call the fire department or pull the nearest alarm box.

Do not use lighting that is not Non-explosion proof in a confined or poorly ventilated space that contains residual combustible or flammable liquids.

Smoking is considered hot work. Do not smoke in a confined or poorly ventilated enclosed space.

All workers should carry a flashlight with them at all time while working on a confined or poorly ventilated enclosed space for emergency situations.

Oxygen, Acetylene and other compressed gas cylinders shall not be taken into a confined or poorly ventilated space. They should be placed outside these spaces in well-ventilated areas (e.g. Hanger bay) not subjected to any fire, explosion, or emergency, which may occur within the space. This does not apply to CO\textsuperscript{2} fire extinguishers, as they are not a gas. However, CO\textsuperscript{2} shall not be used in a confined space since CO\textsuperscript{2} displaces oxygen and could be hazardous to personnel.
Do not work on tagged out systems unless you are directly assigned to. This includes DANGER tags & CAUTION tags. You should be trained in the use of these tags. If you are working around this type of tag, you should be aware of the installation & removal procedures. Ensure the tag is removed properly and tested after the job is complete.